European Commission

Study on the impact assessment for a new Directive mainstreaming deployment of renewable energy and ensuring that the EU meets its 2030 renewable energy target

Final task 1 & 2 report:

"Mainstreaming RES"

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1.1 Renewable energy financing

Given the hypothesis that the plans and actual deployment of RES may come short with regard to the 2030 goal, the question is how investments in RES can be increased in order to enlarge the installed capacity. This chapter provides the first arguments towards answering this question by introducing the RES investment landscape with its instruments, measures and players (paragraph 2.1) and analysing the trends within this landscape (paragraph 1.1.2). Case studies will be used to further complete and illustrate the market perspective.

1.1.1 Financial landscape

The financial landscape of RES investments is defined by the financial instruments and measures available as well as the players that provide them. We will therefore firstly provide a definition of the most important terms with regard to the financial landscape. Then, we will give an overview of the current investors and their roles. Next, existing financial measures are presented and categorized that can potentially stimulate and increase in RES investments. Lastly, the market perspective on RES related investment risk is introduced.

First, it is important to make a distinction between different types of mechanisms in the RE-investment market. In this report we use the following definitions:

- Direct financial measures: financial interventions by which authorities aim to increase or facilitate RE-investments (e.g. subsidies, debt guarantees, low cost loans, etc.).
- Indirect financial measures: non-financial means by which authorities aim to increase or facilitate RE-investments (e.g. legal standards, tax exemptions, quota obligations, tendering, green procurement).

This study emphasize on direct financial measures undertaken by the public sector. However these interventions should be placed in the context of total financing instruments (including private investments) and indirect financial Measures.

In the end the measures can be linked. Subsidies (e.g. FIP) can be made available through competitive tendering/bidding procedures. The availability of subsidies allows private financing to step in, because e.g. safety of cash flows is provided.

Therefore effectiveness and efficiency of newly constructed/revised financial instruments introduced at the EU level, can only be assessed against the background of the total investment landscape.

1.1.1.1 Elements of financing

In order to understand possible financial measures, it is important to understand the elements of financing. First of all, two types of financing structure exist: balance sheet financing and project finance.

Financing structure: balance vs. project finance

- Balance sheet finance: RE-investments are financed from the balance sheet of a company, typically utilities or large energy companies. The company can use its own equity to finance the investment, and/or borrow money from another financial institution (e.g. bank or through emission of bonds)). The risk and return related to the provided finance is based on amongst others the corporate strategy, leverage, dividend and policy.
  Typically this type of financing has proven to be troublesome in the past years. The large utilities (e.g. RWE, E-ON, Vattenfall) do not have a strong balance sheet due to amongst others low electricity prices and sunk investments in conventional energy, while other companies also show reluctance (e.g. since it is not a core activity or the investments are too high).

- Project finance: Project finance is solely based on the project's own cash flow and is not secured by other assets or projects (the balance sheet). For the project finance business case to work, the financing cash flows must mirror the operational cash flows: the drawdowns must mirror the required capital investments and the subsequent interest payment and principal (repayment(s)) must mirror the projected revenues of the project. One distinct aspect of project finance is that it involves the set-up of a Special Purpose Vehicle (SPV). An investor creates a SPV to which he provides equity and requests additional debt from other financiers. SPVs are separated from the company's balance sheet in order to abolish the company's eligibility to the projects' risks. SPVs in general have a complex deal structure to allocate and manage those risks and make them acceptable for debt providers. This complexity requires an extensive due diligence process, which makes project finance often only deemed worthwhile for large-scale projects.

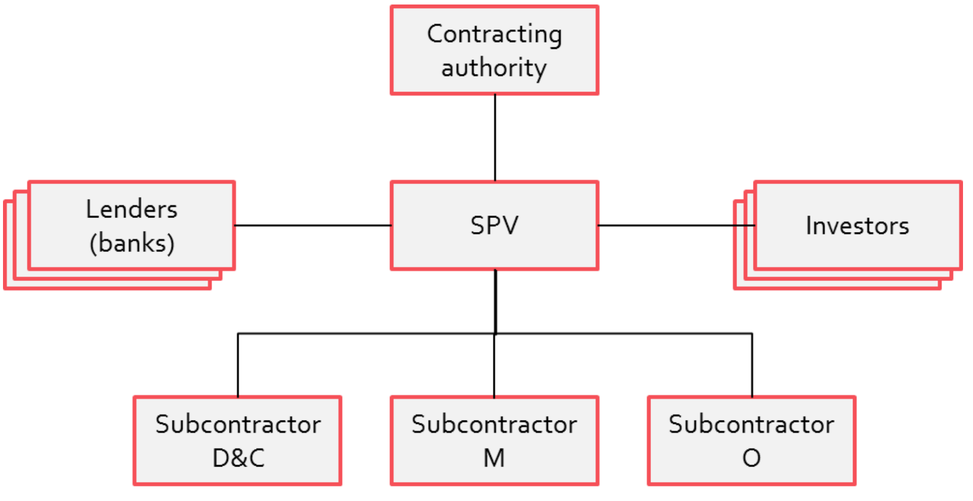
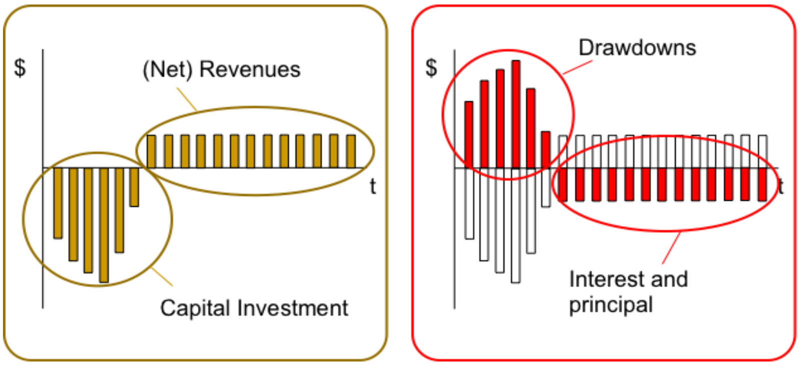


Figure 1 SPV structure

Typical RES investments with project finance include private wind energy or solar energy parks. Typically this type of financing is heavily dependent on the existence of subsidy schemes like the FIT/FIP, since this allows project developers to show cash flows in the business case and (hence) reach financial close.



Operational cash flows **Financing cash flows**

Figure 2 Cash Flows and Structure of Project Finance

<u>Type of financing: debt vs. equity</u>

An investment (both through balance sheet and project finance) can be financed with two types of financing: debt and equity. Both have advantages and disadvantages, which are discussed separately next

- <u>Debt:</u> For debt financing, a loan is taken to meet the investment need (usually from a bank or comparable financial institution). Lenders have to be paid back both the loan as well as an interest. Depending on the riskiness of the investment (and the general market conditions), the required interest, or 'return' can be higher or lower. In general, the cost of capital for debt are lower than for equity. The advantage of debt is that the lenders do not have control over the project or company – once the loan is paid back, the relationship with the financier ends. The main disadvantage of debt is that repaying debt and the required interest is a regular expense that might be difficult for innovative or volatile investment to pay. With regard to RES projects, wind and solar power projects face a revenue risk due to uncertainties with regard to the weather. Other projects face technology risk (geothermal, tidal, hydrogen fuel) or lengthy payback time (energy saving, heating). Thus, debt financing with an inflexible payback scheme can pose a possible risk when these risks are not accounted for in the repayment scheme.

- <u>Equity</u>: Equity financing involves investors that invest their money in the firm (for balance sheet financing) or project (for project financing). In return, they require a stake or share in the company, which entitles them to a share in the profits. Investors take all the risk – if the project or company fails, no money has to be paid back. Furthermore, there is no regular expense involved as compared to debt. Equity investors do however get a say in the company or project and the profit of the company has to be shared. Given the risk these shareholders face, especially with regard to more innovative RES projects, the required return by equity providers is usually higher than the required return by debt providers. Therefore equity has in general a higher cost of capital than debt.

When addressing the cost of capital, the so called gearing of a project/company, which indicates the level of debt related to equity is crucial. As aforementioned, since debt has in general a lower cost of capital than equity, the total cost of capital decreases with the amount of debt raised in the project/company.

Financial instruments

Debt or equity has to be raised in different ways, or in other words, through different financial instruments. The following list is an introduction to the wide variety of financial instruments that exist, but does not provide a comprehensive overview.

- Bonds: a bond is a debt investment in which an investor loans money to an entity (e.g. a wind park) which borrows the fund for a defined period of time at a variable or fixed interest rate. It has been proven successful to issue (project) bonds to the public for large RES projects in order to raise debt. These bonds do not only have the advantage of raising the needed capital but also connect the investors (which are usually local (civilians) with a personal interest in the project) to the project objectives and thus reduces the risk of public opposition.

- Guarantee: a confirmation of an entity (e.g. company/bank/institution) that the liabilities of a debtor will be met. In RES projects it is common that large (and risky) private investments are backed up by public entities due to common interests. For example, a large wind park can receive a revenue guarantee from the regional government as this government has to achieve RES targets and does not have the capacity to engage in RES development activities on its own. A guarantee can also be linked to a specific risk. An example of these kind of guarantees is a specific government guarantee for risks related to drilling for geothermal projects.

- Crowdfunding: 'the crowd' can be seen as an alternative financial market which operates through direct financing (loans/equity) by consumers. Although crowdfunding has relatively small transaction volumes in Europe with regard to RES, there has been a substantial yearly growth recently with an even stronger growth expected for the next few years (see paragraph 1.1.2.2 about trends in crowdfunding investments).

- Funds / pooled investments: investments from various sources can be pooled in funds. Pooled investments enable risk reduction due to diversification. Funds are actually intermediary financial instruments as funds in turn provide finance for companies or projects. There are both funds which are financed by private parties and funds financed by public institutions /government. To provide an insight in the diversity of such funds three examples are given:
    - The independent fund management company DIF has launched a fund in 2007 that focusses on RES projects[1]. 26 investments have been made out of this fund with a total committed capital of 134 million euros,

[1] http://www.dif.eu/funds/fund-detail/117-dif-renewable-energy

projects including onshore wind and solar energy projects in Germany, France, the Netherlands and Spain.

- An example of a public fund (or in this specific case, a fund-of-funds) is GEEREF[2]. GEREEF is advised by the EIB and financed by Germany and Norway as well as partially by the EU with a total of 222 million euros. GEREEF invests in private equity funds with a RES focus which in turn invest in developing small and medium sized RES deployment or efficiency projects in emerging markets. It should be noted that while GEEREF is a European RES fund, it does not invest in projects inside the EU.

- An example of an instrument focussing at SME, particularly clean tech/RES, within Europe is the "Dutch Venture Initiative II" (DVI-II), a joined structure of EIF and Dutch Regional development companies.[3]

The four instruments above are all typically private sector financial instruments and far more specification is possible in financial instruments (e.g. mezzanine; convertible loans etc.). As a starting point all these financial instruments can be applied by public sector as well.

The typical government intervention that is not listed above would be subsidies. A subsidy is actually 'funding' to a project. The difference to debt or equity financing is that the subsidy does not have to be repaid and that no return is required by the public sponsor.

1.1.1.2 Parties involved in financing RE

RE-investments can come from a variety of sources, e.g. governments, a utility, or external financing via a bank or the capital market. On a global level, private investments account for about 58% and public sources for about 42% of total investment in renewable energy[4]. This ratio differs strongly across MS.

Private financiers include:

- Utilities are the incumbents of the energy market. Many of the European utilities are state-owned, some are privatized. Utilities still play a large role in RE-investments, although many are struggling with the changing business models. Utilities provide equity financing by issuing new shares. The assets of RES projects for which they provide equity can form an asset on their balance sheets. Another option is if the RES projects are separate legal entities in which the utility is only participating by providing equity and assuring.

- Corporate actors like manufacturers and corporate end-users are more and more investing in their own renewable energy supply and/or affiliated energy efficiency of e.g. their processes and buildings, which means a lower energy

2 http://www.geeref.com
3 http://www.eif.org/what_we_do/equity/news/dvi_netherlands_second_venture.htm
4 Climate Policy Initiative (2014). The Global Landscape of Climate Finance http://climatepolicyinitiative.org/wp-content/uploads/2014/11/The-Global-Landscape-of-Climate-Finance-2014.pdf

demand. With regard to transportation, examples of corporate actors include both public transportation operators or large logistic companies who invest in zero emission fleets. Corporate actors also use both equity and debt financing. Depending on the maturity stage of the RES investment, corporate actors might also be interested in guarantees or subsidies in order to back up riskier investments. Currently, mainly the "low-hanging fruits" are picked by corporate actors with low risks and high returns.

- Energy Service Companies (ESCo's) are playing an increasingly important role in these processes, with e.g. contracts that assure the corporate actor certain savings on its energy bill, of which the ESCo pays off the debt on the extra investments (including a fee for the ESCo). An often applied example of this construction is that the ESCo makes the investment and places solar panels at the corporate actor. The corporate actor keeps paying its normal energy bill, but now to the ESCo instead of the utilities. The ESCo uses this money to pay off the debt on the solar panels and next to this earns a fee. After the solar panels are paid off the contract releases and the corporate actor is the owner of the solar panels.

- Consumers in general finance two types of investments:
  - Small scale installations for their homes, like solar-PV or solar heating devices.
  - Investments through crowdfunding:
    - Relatively small scale private investments in larger RES projects (e.g. Dutch start-up 'We Share Solar'[5] for participating in solar projects).
    - Supporting small innovative businesses or community organizations which would otherwise have limited access to financial sources.

- Commercial financial institutions, which are mainly commercial banks. In many cases they provide (structured) debt for RES projects. Commercial banks are looking for ways to lend money from the savings accounts they manage and get a small return on it. This requires a low risk profile, which is assessed per country and per project and is mainly driven by the costs and revenue risks of a proposed project. A commercial bank is usually one of the biggest investors in RES projects and the main provider of debt. Each investment decision of commercial financial institutions is based on the risks versus the rewards of the project.

- Institutional investors like insurance companies, pension funds and other long-term investors with a large amount of money under their management are interested in low risk, long term investments. For management purposes in both the investment process (tendering and due diligence) and in the operational process (daily management) the total project value should be large enough for these parties to participate and provide equity. This is why these parties hardly invest in single RES projects but mostly in "renewable funds" compiled of different (large scale) RES projects. The rating of these funds plays a crucial role in whether or not institutional investors decide to invest in it or not.

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5 https://www.zonnepanelendelen.nl/

Furthermore, due to the required low risk levels and long term investments these institutions mostly invest in already running projects with a proven yearly return. Additionally, in these cases the assets are already in place (e.g. wind turbines) which provides them a safety net in case of a default.

- Private Equity (PE) is a comprehensive name for multiple types of equity investors. The most common practice for PE investments is to take a major stake in a company, or even acquire a whole company at once (buyout). But PE also acts as a fund manager for institutional investors, and in some cases there is even a resemblance with institutional investors notable. Mainly this latter category of investments are of interest to RES projects, since PE can acquire multiple smaller companies or projects and place these in one fund that is large enough for institutional investors to participate in (a "fund of funds").

- Venture Capital (VC) is a more risky form of private equity. Venture capitalists mainly invest in innovative companies involved in RE, for instance start-ups. VC investments are almost always in equity and require a share or stake in the company they invest in. The focus of VC is on fast growing companies with innovative technologies or innovative business models for existing technologies.

Public involvement in the energy sector remains to be critical for RE-investments. Public investments in RES in the EU however originate from several sources:

- Governments have a large instrument panel to increase or decrease RE-investments. They can offer subsidies or grants as direct investment in a project or as compensation on a later moment. Furthermore they can introduce tax exemptions or tax deductions on RES investments. Additionally, also pricing (ETS) or a quota system can indirectly influence the incentives for RES investments.

- Public financial institutions (e.g. EIB/EBRD/national and regional public banks) can invest in RES projects with debt or equity. These institutions are funded by governments and therefore can offer debt under more favourable terms than the commercial banking sector. Furthermore, for the equity investments the same applies: Since these institutions are funded by governments, they can provide equity against a lower required internal rate of return (IRR) than other equity providers such as utilities or institutional investors.

1.1.1.3 Measures to increase RE-investments

A large and growing variety of measures to support RES deployment in the EU are available. In order to identify measures that mainstream EU efforts, it is crucial to get a basic overview of the measures that exist and how they work.

As pointed out in the introduction, this study differentiates between direct financial measures and indirect financial measures. The main differentiation between these two measures is that the first provides capital directly to RES projects, while the latter does not. Indirect financial measures support the availability of (low cost) capital, for example, through instruments that decrease the risk. In the upcoming paragraphs the categories of financial measures that currently exist in the RE-market are discussed.[6]

1.1.1.3.1 Direct financial measures

Public financing instruments: By providing capital directly to RE-projects governments directly increase the level of RE-investments. Governments can invest through both debt and equity and directly as well as through funds. The conditions of these public financial instruments are in general more generous than the conditions of the market financial instruments, generally through lower interest/dividend requirements, or longer grace periods. A common form of a public financial instrument is a concessional loan (or low interest loan), which takes higher risks than private financiers would do for similar interest requirements. Through this position in a project, the public party reduces risks for other debt providers. The public financier can also choose to provide lower interest or dividend rates, thereby reducing financing costs for RE-projects and increasing the project viability. In both cases the public financier increases the potential of the project to get private finance and creates leverage on a project. Public financial instruments are in general aimed at projects with commercial prospects.

Measures	Examples of measures
Public (subordinate) loans	EIB loans, EBRD project finance, national loan programs (often via banks as concessional loans, or public funds)
Concessional loans (low interest loans)	Regional and national public banks provide loans for RES-E and H&C (e.g. KfW Germany, Nordic Investment Bank, Croatian Bank for Reconstruction and Development etc.). Greece offers interest free loans for RES-H installations.
Public equity	EIB/EIF capital, EBRD project finance
Public(-Private) funds	Regional funds and national funds provide loans via funds for RES-E and H&C (for example, Croatia, Lithuania, Poland, Slovenia)

Subsidies and grants: Subsidies and grants are direct investments by governments, without (financial) return requirements. With subsidies/grants governments can fill the gap of non-viable RE-projects and thereby increase appetite for market investments. Subsidies can be granted at the start of a project (e.g. investment grants, innovation subsidies), or during operation (e.g. feed-in tariffs or premiums). Grants and subsidies are particularly effective with regard to the required high upfront investment costs related to RES projects. Lowering these costs can make the project more attractive to investors. Subsidies can also be

[6] All examples of measures are based on the comparison tool of Legal Sources on Renewable Energy, retrieved March 2016 from: http://www.res-legal.eu/comparison-tool/

effective in promoting innovation by covering for costs and risks associated with immature technologies.

Feed-in tariffs and premiums can minimize revenue risk substantially and thus create an attractive environment for investors. Feed-in tariff schemes usually come in the form of long term purchase agreement at a certain price. In contrast to that, feed-in premium schemes only provide a certain mark-up on the market price. A more complex form is a sliding feed-in premium (or Contract for Difference), which pays the difference between the market price and a certain 'strike price'. The financial impact on government budgets are thus lower for premiums than for tariff schemes. However, while these schemes have a positive effect on the feasibility of RES projects, at the same time these schemes may distort the market pricing of electricity and do not encourage price competition between project developers.

Measures	Examples of measures
Feed-in tariff/premium	Feed-in tariffs exist in almost all MS for different RES-E technologies. Some of them have been changed to premiums. See paragraph 1.1.2.2 on the trends with regard to feed-in schemes.
Contract for Difference/ sliding feed-in premium	The UK provides CfD schemes for RES-E projects.
Biofuel subsidy	Croatia supports biofuel producers with a subsidy per produced liter of biofuel. Lithuania supports raw material producers (rapeseed, cereal grain) with a subsidy on their sales price.
Investment grants	On European level: EFRD; many MS have policies that provide cost recovery grants for percentages of the investment costs, usually between 20% and 50% of the project cost (some up to 80%).
Innovation subsidy	On European level: Horizon2020, NER300/400; many MS have policies that provide direct and indirect subsidies to R&D projects through both grants (for example, in Denmark, Finland, Germany, Sweden or the UK) or tax exemptions (for example, in Belgium).
Coverage technical support	On European level: EIB, Elena, EEEF.

Example Feed-in Tariff

In the region of Sachsen-Anhalt in Germany an onshore wind park of 70 MW installed capacity was built in 2004. The total investment for this park was about 90 million euro, which was financed through private project financing. The loans for the project, which comprised 70-80% of the total investment sum were financed from the public bank KfW through programs providing RES projects with particularly lower interest rates. The most decisive factors for a business case were according to the developers "a reliable framework and predictability of support schemes that allowed for a bankable project". Mainly the German feed-in tariff compensation scheme made this possible. It allowed for a secure and stable investment framework with long-term investments, which resulted in a bankable project and thereby reduced the cost of capital. Moreover, the feed-in tariff scheme enabled small regional investors to get engaged in the project. This was a significant driver for public acceptance, which in turn again reduced the risks for the project and as a consequence further reduced the cost of capital.

State guarantees: Guarantees cover risks for privately financed projects and thereby facilitate debt or equity financing of project. A guarantee can be linked to a public loan when the public party takes the first loss in a project and thereby lowers the risks for other debt providers.

Measures	Examples of measures
First loss guarantee / loan guarantee	EFSI, Denmark has a loan guarantee scheme for local wind energy plants, Bulgaria provides a partial credit guarantee for H&C projects
Public insurance	Guarantee Mechanism for geothermal projects (NL, France) In Germany, a share of risk insurance can be covered for the discovery risk of geothermal projects.

1.1.1.3.2 Indirect financial measures

Although indirect financial measures do not provide capital to RES projects themselves, they do influence the availability of capital through improving the relative attractiveness of investing in RES.

Fiscal schemes: Fiscal schemes include a wide variety of measures that can either stimulate or place drawbacks for RES investments. Reducing the financial burden and thus stimulating investment in RES are targeted by, for example, tax allowances, exemptions and investment tax deductions. However, fiscal schemes can also have a negative effect on RES investment, for example the absence of the widely debated CO_2 tax or the existence of a reduced taxing system for energy intensive industry. A policy measure that abolishes adverse fiscal schemes could benefit RES investments indirectly. In this light, the fact that the revision of the ETS is on its way is promising for RES investments.[7] A substantially higher price for CO_2 emissions would make an immense difference for projects in the area of, amongst others, energy saving and carbon capture and storage (CCS). The current emission allowances around 5 euro are one of the main drivers that RES projects require subsidies before new projects are initiated.

[7] http://ec.europa.eu/clima/policies/ets/revision/index_en.htm

Measures	Examples of measures
Tax reduction for RES investments	Tax regulations exist in most MS. Some have specifications for companies/ developers (Greece, Ireland, UK) or individuals/private (France, Lithuania, Luxemburg, Netherlands, Poland, Slovakia). The form differs, some MS apply deductions from profit tax for environmentally friendly investments
Tax protection schemes energy intensive industry	Practically all MS apply degressive tax systems to protect their energy intensive industry from external competition. Consumers in NL pay up to 200* (%) more taxes compared to energy intensive industry.
CO_2 tax	The well-known ETS system should in principle ensure a price for CO_2 emissions. The past years the prices has been too low to provide for such an incentive.

Example Biofuel

Beta Renewables, a joint venture between Biochemtex, Mossi Ghisolfi Group, the US fund TPG and Novozymes, have invested 150 million euro in second generation (2G) technology for bioethanol production. At full capacity, the first plant operating with this technology can produce up to 40.000 tons ethanol per year.

This project has been financed by a mix of EU public (FP7 program), national public (Government of Piedmont) and private capital (company and other private capital). During operation, financial support is provided by the NER300 fund which provides a subsidy of 200 euros per ton ethanol produced for a period of five years.

The investors mention three main concerns:

- Innovative and first/second of a kind investments need more funding and financing than currently available (for example, through the H2020 program) as access to finance is limited and now remains to be self-financed by the developers.
- Quota/ blending obligations need to be ensured for a long term also for 2G biofuels in order to create certainty for investors. Currently, it is unclear how long the obligation will continue and how the new EU directive changes the situation. This is needed to minimize off-take risk.
- Current oil prices are low which makes it hard to compete in this sector. Furthermore, conventional oil and gas still enjoy subsidies and other incentive schemes that distort real market prices and thus aggravate the competitive position of biofuels.

Quota oligations: in a quota obligation system, governments set a minimum amount or proportion of RES to be either supplied or delivered to the end user, thereby 'forcing' the market to invest in RE-production. Quota obligation systems are backed by certification trading systems to provide flexibility in compliance. Quota obligations are indirect financial measures as there is no debt or equity provided but a quota generates the revenue certainty that is needed to attract investors. It should be noted that while quota systems provide revenue certainty with regard to *volume*, they do no guarantee a certain *price*, such as feed-in tariffs or premiums.

Measures	Examples of measures
Production quota obligation for RES-E	Italian, British quota obligation for energy production Norway has a quota scheme for all RES power production (including hydro power) that increases each year until 2023 and decreases after until 2035, Sweden has a similar scheme
Supply quota obligation for RES-E	For example, Belgium, Sweden and Poland have quota obligation for suppliers.
Biofuel quota	Static targets for biofuel as part of total fuel (for example in Austria, Czech Republic, Belgium, Denmark, Germany, Ireland, Lithuania) or growing targets (Croatia, Finland, Poland, Portugal, Romania, Slovakia). See case study below.
Quota based on *Combined Heat and Power (CHP) Directive*	Flanders in Belgium uses a quota system that requires CHP certificates per MW of electricity produced in order to promote cogeneration and re-use of heat and power.

Competitive bidding (tender/auctions): competitive biddings might not be as straightforward in their impact on the availability of capital as other measures but they provide an incentive for private investment. A government lets parties bid on a certain capacity or location. Sometimes, the expected revenue from this location or capacity is backed by feed in tariffs or other subsidies. In order to win the competition, the bidders have to optimize their price. The parties involved in a competitive bidding are stimulated to provide some capital for the project and thus lower the cost of capital. Thus, more capital from private parties can be mobilized in an auction than in a non-competitive tender

Measures	Examples of measures
Capacity tender	Biogas/ biomass tender in Italy including an incentive scheme per MWh, tenders for all RES-E in France including wind, solar and biomass, Dutch offshore wind tender (see example below)

Example Competitive Bidding

The Netherlands introduced a tender procedure for new offshore wind parks in the North Sea. In these tenders developers place a bid for a price (based on the Levelized Cost Of Electricity) they are able to produce the electricity at the offered site. The developer with the lowest bid in this process is awarded the license, which includes the permit as well as a guaranteed subsidy for the operator. The novity of this tender is the combination of granting the subsidy together with the permit at once. Although it is market practice for other large infrastructure projects (like road and rail) in the Netherlands that the market is not burdened with permit risks after winning a bid, it is only recently introduced for offshore wind parks as well. The combination of a subsidy with a permit lowers the uncertainty and risk for developers, and therefore results in better (i.e. lower) offers. An additional upside of this combined permit with subsidy is the shorter lead time for developers, since from the moment the tender is won the license to construct and operate is ready. A shorter time period between winning the auction and start of construction further decreases the risk of the project in relation to raw materials or interest rates. To assure the government that the developer with the winning bid is actually putting the plan forward to build and operate the wind park for the offered price, bank guarantees in case of aborting are included in the tendering process.

The first results of this competitive bidding for offshore wind parks showed that in one month time there were a striking number of 38 bids registered for the upcoming 700 MW offshore wind park in the Netherlands. Most of these bids consisted of a consortium of parties (e.g. utilities, developers, financiers), including international parties. The tender resulted in an unexpected outcome where all the bidding parties offered a price lower than EUR 0.09 per kWh (excluding grid connection), while the maximum price was set by the government to be EUR 0.124 per kWh (excl. grid connection). The winning bid by DONG Energy was even EUR 0.0727 per kWh (excl. grid connection), which means that the offshore wind farm will be built at considerably lower costs than budgeted by the Dutch government. This can account up to a total saving of EUR 2.7 billion during the 15 year subsidy scheme. This outcome shows that the competition, as well as reduction of the risk in the development phase of the project (concerning e.g. location and permits) allowed the consortia to reduce their prices. At the same time, the actual impact of this significantly lower price is still to be seen.

Norms and standards: Norms and standards can help to generate stability and continuity in business and thus more certainty (and less risk) for RES. For example, requiring certain certifications of RES installations increases business certainty for installation companies that they need to invest in their business. Often, these certifications are required for being eligible for RES subsidies or other support programs. It should be noted that an excessive use of norms and standards might have an opposing effect as it creates a financial burden and limits the market.

A different measure could be exemplary roles of governments in setting and following certain standards, for example, ministries that set themselves minimum standards for RES in their procurement. This has a positive effect on investors' confidence.

Measures	Examples of measures
Exemplary roles	Exemplary roles of public bodies, for example, Irish public bodies shall only procure equipment, such solar thermal installations that are certified under the European Solar Keymark database. In Slovenia, government gives priority for electricity produced by RES compared to conventional production, in general, so either 40% or 100% have to be RES-E.
Standardization and certification of installations	Certifications and guidelines for RES installations, for example, PV quality certification in France and Spain, heat pump label requirement in Germany, heat pumps and solar boilers in the Netherlands.
Certification and training	Training and certification for installers of RES installations, for example, in Estonia and the Czech Republic.

1.1.1.4 Current EU level measures and instruments

The previous paragraph sketched the landscape of possible measures to increase RES investments. The discussed incentive schemes such as FiT and FiP are MS level schemes, however also European institutions provide many of these instruments. The list below is based on a quick scan of instruments, selected specifically on their applicability for RES projects.

Funding instruments (grants)

Measures/instruments	Description
Horizon2020	A European Commission facility to enhance Research and Innovation. The programme accounts for EUR 80 bln, of grants. Part of this funding is directed to clean energy projects
Sustainable energy (ELENA)	A programme covering technical support costs for large energy efficiency and renewable energy projects (e.g. feasibility and market studies, programme structures).
NER300	The programme uses money from carbon allowances to support carbon capture and storage and innovative renewable energy projects.
Cohesion Fund	Aimed to support MS with low gross national income. Amongst others supports the increase of renewable energy use. Total fund size equals EUR 63,4 bln, only partially aimed for renewable energy projects.
European Regional Development Fund	Aims to reduce economic and social disparity between regions. One of the four priorities of the ERDF is low carbon economy.

Financing and blended instruments[8]

Measures/instruments	Description
EIB financing	The EIB supports RES projects through financing by means of: • Project loans: debt provided for projects > 25 mln. • Intermediated loans: loans through local banks and other intermediaries • Venture capital: through EIF the EIB offers conditional and subordinated loans to SMEs and individuals[9]. • Microfinance: loans for micro, small and medium enterprises and low income self-employed. • Equity and fund investments: EIB invests in infrastructure funds, carbon funds and energy efficiency and renewables in developing countries. • Guarantees for large and small projects, thereby

8 http://www.eib.org/products/
9 Mostly debt financing, only in Croatia and France (through JEREMY) equity intermediary

	enabling private financing.
Structured finance facility (SFF)	Finances projects with a higher risk profile, specifically for priority projects.
Project bonds	A joint initiative by the EC and EIB, aimed to stimulate private financing for large-scale infrastructure projects. The bonds are supported by the EC and can take the form of subordinated debt from the bank, or as a credit line.
COSME	The fund for competitiveness of Enterprises and Small and Medium-sized Enterprises (COSME) aims to improve access to finance for SMEs through Loan Guarantee Facilities and Equity Facility.
InnovFin	An initiative under Horizon2020, launched by the EIB and EC. Includes investments in research and innovation, by means of financing tools and advisory services.
European Structural and Investment Funds (ESIF) Financial Instruments	At MS level ESIF funding can be allocated to regional revolving funds (e.g. JESSICA). A minimum of EUR 38 bln is made available for low carbon economy investments in the ESIF for the period of 2014-202.
Private Finance for Energy Efficiency (PF4EE)	Managed by EIB and funded from the LIFE programme, the PF4EE provides a risk sharing facility, long-term financing and export support services.
European Fund for Strategic Investments (EFSI)	Also 'Juncker fund'; an investment fund for structural economic growth in the EU, containing 16 bln guarantee by EC, 5 bln capital contribution and 60.8 bln additional investment by EIB. Using a 15:1 multiplier effect , the Commission has estimated the total amount of investment would reach € 315 billion (only partially focussed on RE).[10]
Sustainable Energy Initiative (SEI)	Initiative by the EBRD, only for development countries, using the full range of banking financial instruments to finance sustainable energy projects.
European Energy Programme for Recovery (EEPR)	Finances energy infrastructure, offshore wind projects and carbon capture and storage projects. Budget totals EUR 3,98 bln, of which EUR 565 mln to energy infrastructure, offshore wind, carbon capture and storage and energy efficiency (EEEF).
KIC Innoenergy	Supports and invests in innovation. Renewable energy is one of the main thematic fields. The fund provides riskier capital as well as a knowledge network to innovative projects.

The list of grants and the list of financing and blended instruments show a wide variety of measures by which means the European Commission, the EIB and EBRD can influence RES investments. Some of the funds and programmes (such as

[10] European Parliament (2015). Cornerstone of the Commission's Investment Plan – European Fund for Strategic Investments (EFSI).

ELENA), focus specifically on energy projects, others (like the ESIF financial instruments) have a broad scope often focussing on improving infrastructure.

1.1.1.5 Market perspective: Risks in RE-investments

For private financial institutes, whether banks or equity providers, whether or not to finance a project is all about risk versus return. The perceived risk of a project is therefore reflected in the cost of capital (WACC) of a project. Where the WACC reflects the total risk of a project, the risk adjusted return calculates the risk of a single investor. The paragraphs below will shortly explain both metrics as they are important to understand the market perspective on RE.

1.1.1.5.1 Weighted average cost of capital

RES projects are very diverse and every project is subject to different technological, regulatory and market risks. Also the scale of the project, the available infrastructure, the environmental impact and stakeholders impact the risk profile of a project. The financing structure strongly depends on the risk profile of the project. One of the indicators of the risk profile of a project is the Weighted Average Cost of Capital (WACC).

The WACC is based on a calculation of the cost of capital in which each category of capital is proportionately weighted. It gives a subdivision between equity value and debt value of the proposed capital needed. This way, the WACC represents the minimum return that is required by investors (equity) and lenders (debt) for providing capital to a project. In other words, it is the required earning on an existing asset base to satisfy the creditors, owners, and other providers of capital for a project. The formula used to calculate the WACC is given in equation 1.

$$WACC = \left(\frac{E_{MV}}{E_{MV}+D_{MV}}\right) R_E + \left(\frac{D_{MV}}{E_{MV}+D_{MV}}\right) R_D (1 - T_C) \qquad [1]$$

Here E_{MV} is the total market value of the shareholders equity, D_{MV} is the total market value of the debt, R_E is the cost of equity, R_D is the cost of debt, and T_C is the corporate tax rate.

In general it can be said that the riskier the project is, the higher the WACC and thus the more costly the capital is. It should be noted however that this is not restricted to absolute project risks, but also risk-derived parameters, such as the amount of capital that is available, are of influence on this rate.

RES projects are relatively capital intensive: they require a relatively large amount of money upfront, which can only be paid back on a longer term. The WACC can therefore be very decisive to the viability of a RES project. A higher risk decreases the amount of money available, which results in a higher required return, making a project unviable. Especially innovative projects with non-proven technologies, or projects with substantial uncertainties regarding the revenues face this problem as there is a financing gap for these, or comparable, high risk projects.

1.1.1.5.2 Risk adjusted return on capital

The WACC is a metric for an entire project, combining the cost of capital for all equity and debt providers. A closely linked indicator to the WACC, which is leading from the investors point of view in most RES projects to proceed or forgo with an investment, is the risk adjusted return on capital.

$$RARC = \frac{R - E - PD * LGD + Ic}{C} \quad [2]$$

Here RARC is Risk Adjusted Return on Capital, R is total project revenue, E are the total project expenses, PD is the Probability on Default, LGD stands form Loss Given Defaults, Ic reflects income from capital and C is the total capital by the investor.

This risk is different for banks compared to institutional investors and depends on multiple factors, such as the duration of the investment (short term or long term), other investors involved and their risk profile (compared to your own), and innovativeness of technologies.

1.1.2 Trends in investments in RES in EU

The aim of this paragraph is to provide an overview of RE-investments in the EU, based on historic developments and trends. As many studies and reports on trends preceded this analysis, the overview of current investments and trends is based on existing data from recent reports. Case studies will be added to complement and illustrate the conclusions of these existing reports. Most trends that are described are observed in the renewable electricity and heating and cooling sectors and might not apply to transport. Investments in transportation are less capital intensive than electricity and heating & cooling projects and are thus less relevant for this part of the study.

1.1.2.1 Trends in investment level

This paragraph provides a quantified substantiation in the capital trends and development of RES costs in order to present an overview of the historic, current and expected investing environment regarding the deployment of RES. Here, the situation in Europe and the MS is given as well as some of the global trends. The trends include This should provide an insight and forms the basic assumptions for further analyses on capital trends. The analyses in this paragraph are merely based on existing research and studies.

Capital trends in the renewable energy sector

In the year 2015 a record investment of $309 billion in RES projects was witnessed worldwide (including hydro-power projects). This is an increase of roughly 400% compared to the year 2004. Additionally, in 2015, for the first time the yearly investments in RES resources are higher than the yearly investments in fossil fuels. This could indicate a tipping point for RES[11].

In Europe, however it seems like the peak investment in RES has already passed. Although an increase in RES investments of 150% over the period of 2004 to 2014 is witnessed (which indicates a Compound Annual Growth Rate of 9%), the annual

[11] Source: Bloomberg Energy Transition presentation by Michael Liebreich (Berlin, 18-03-2016)

investments declined in the last years. Figure 1 depicts both the worldwide yearly investments as well as the European yearly investments in RES[12].

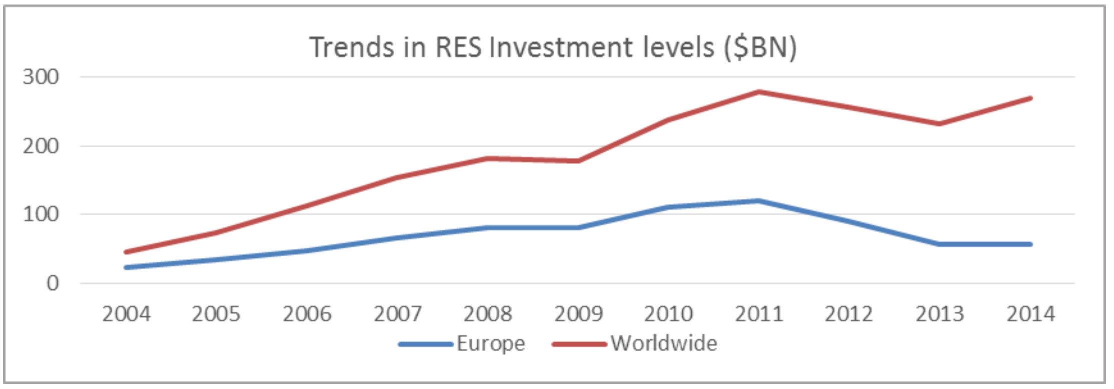

Figure 2 Comparison of the yearly European RES investments with the Worldwide RES investments.

Both the worldwide, as well as the European investment levels show a clear drop in 2011. The four main causes for the decreasing investment levels between 2011 and 2013 are likely to be:

- Major **changes in regulatory framework** have altered the investment landscape and might have caused investments in RES to drop. Both abolishment of support schemes or drastic changes to them do not stimulate private capital providers to invest in RES or only against a high risk premium. For instance Germany cut the feed-in tariff in 2012 and 2013 for solar PV and the UK have changed from a feed-in tariff to a premium scheme for RES production, while Bulgaria has abolished the support scheme altogether.

- **The financial crisis** had a double impact on the RE-sector. Firstly due to the crisis, investors were more reluctant to invest in RE-projects, causing the investment level to drop. A second impact of the financial crisis originates from prior to the economic crisis, when the total installed power capacity (also fossil fuel-based) in Europe expended based on optimistic economic forecasts. During the crisis, the power demand in Europe dropped, causing an overcapacity of power production and lower electricity prices. These electricity prices have had an impact on the viability of renewable energy business cases and thus caused lower investments in RE-projects[13].

- The **decreasing prices of RE-technology** especially in case of solar energy. This has caused investments to go down in monetary terms, but the drop of investments is not necessarily followed by the same drop in volumes.

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[12] Source: UNEP and Bloomberg New Energy Finance, available at: http://fs-unep-centre.org/sites/default/files/attachments/key_findings.pdf.

[13] IEA (2014). World Energy Investment Outlook. http://www.iea.org/publications/freepublications/publication/weio2014.pdf

- **Low ETS-prices and limited pricing of externalities**. The anticipated impact of ETS as an instrument that would trigger investments has not worked out as planned. Contrary, profits from over-allocation of free emission allowances have been generated.

These reasons will be further discussed later on in this and the next paragraph.

Besides the drop in investments between 2011 and 2013, it can be concluded from figure 1 that Europe is losing its position in worldwide RES investments. While in 2010 and 2011 nearly 50% of the worldwide RES investments were made in Europe, in 2014 this amount has declined to only 20%. In order for the MS to reach their upcoming 2020 and 2030 targets, a shift in this declining trend could prove to be essential.

Additionally, the worldwide investment levels in fossil energy are declining and the investment levels in RES are increasing: 2014-2015 was the first year that globally the investment volume in RES was higher than in fossil fuels[14]. When looking at the distribution of worldwide investment flows to RES technologies in the recent years, solar PV and both onshore as offshore wind energy are the major beneficiaries.

In Europe the same trend towards investments in these two RES sectors is visible. Figure 2 shows the RES investment levels in Europe in 2015, subdivided per investor type. The investments totalled to an amount of 48.8 billion dollar, which is a decrease of 21% compared to the previous year. Moreover, this result is mainly due to an extremely successful year for the United Kingdom (UK), in which multiple "final investment decisions" for offshore wind projects were settled. In fact, the UK contributed nearly half of the total investments in Europe in 2015 ($22.2 billion in total, of which approximately $10.5 billion can be attributed to the offshore wind sector).[15] The general decline in new investments throughout Europe can form a threat to the 2030 targets and makes long-term estimates on new investments unpredictable. This also influences investors and investment decisions in new RE-projects.

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14 Source: Bloomberg Energy Transition presentation by Michael Liebreich (Berlin, 18-03-2016)

15 Bloomberg New Energy Finance (2016): http://fs-unep-centre.org/sites/default/files/publications/globaltrendsinrenewableenergyinvestment2016lowres_0.pdf

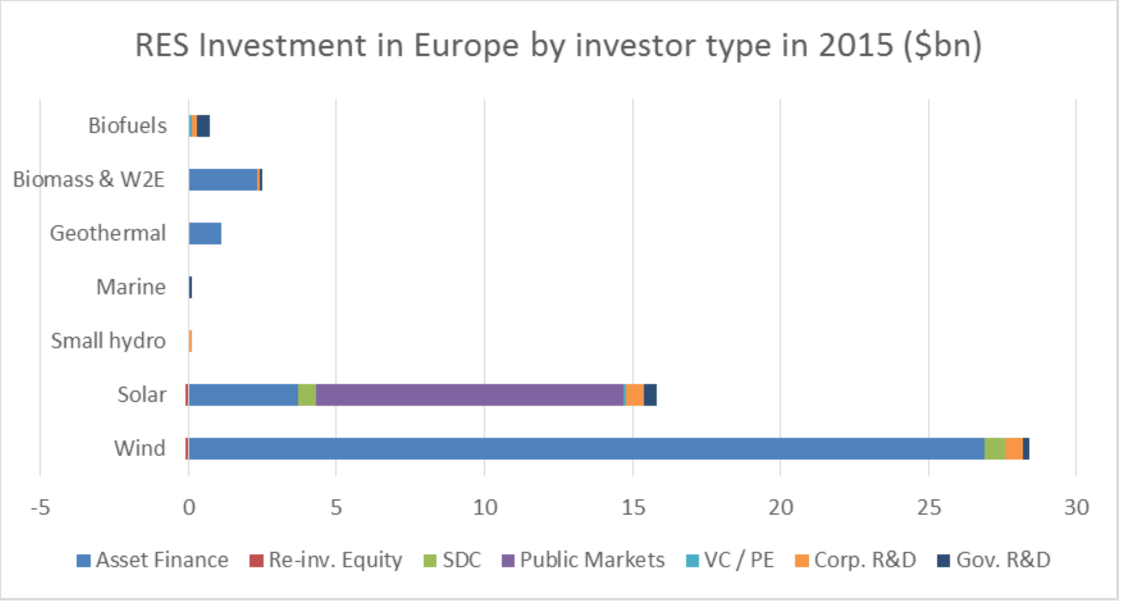

Figure 3 RES Investment in Europe 2015 in $bn. Derived from data available by Bloomberg New Energy Finance (2016).

The majority of the European investments in RES were based on asset finance in 2015. An example of asset finance investors are the utility companies. In 2014, nine of the largest European utilities invested a total of $11.9 billion in RES. Although this is an increase of 6% compared to 2013, it is almost 20% less than the total RES investment of these utilities in 2010.

Cost-development of renewable energy resources

The last decades the cost of renewable energy resources in general has declined sharply. Especially in the capital expenditures (CAPEX) this downward trend is visible. On the other hand the operational revenues in similar RES projects have been increasing mainly due to efficiency improvements. Therefore, a decline in the levelized cost of electricity (LCOE), i.e. the cost per generated unit of energy, for nearly all renewable energy resources and technologies can be observed. Figure 3 provides an overview of the LCOE development of wind and solar energy between the last quarter of 2009 and the first half of 2015, showing this trend.

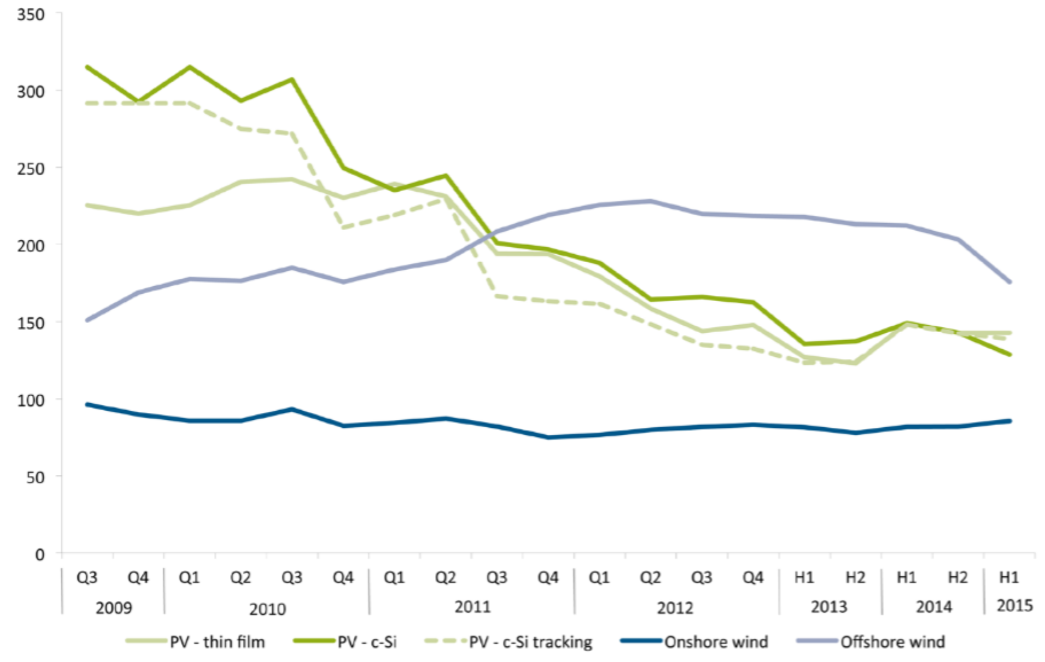

Figure 4 Global average LCOE for onshore and offshore wind projects and 3 different types of solar PV projects between Q3 2009 and the first half of 2015 (in $ / MWh). Source: Bloomberg New Energy Finance.

Here a sharp decline in the LCOE for solar PV projects is apparent, while the onshore wind LCOE shows a relatively stable profile and the offshore wind shows even an increase in the LCOE. The reasons for the latter point are mainly due to the limits of suitable space that can be used for low-cost offshore wind projects, may develop over time once more offshore wind parks are being developed (shared use of infrastructure, vessels, etc).

Learning curves

The decline in the LCOE of RES projects due to improved technological operations corresponds in most cases with the increased total installed capacity of a RES technology. Such a correlation can be graphically shown in so-called 'learning curves' which reflect the relationship between the LCOE and total installed capacity. Learning curves can also show the relation between the cost of a unit and the cumulative production of it. One of the most famous examples of the latter comparison is Swanson's Law. Swanson's Law states that the price of solar PV modules tends to drop with 20% for every doubling of the cumulative shipped volume. Swanson's law is graphically depicted in figure 4.

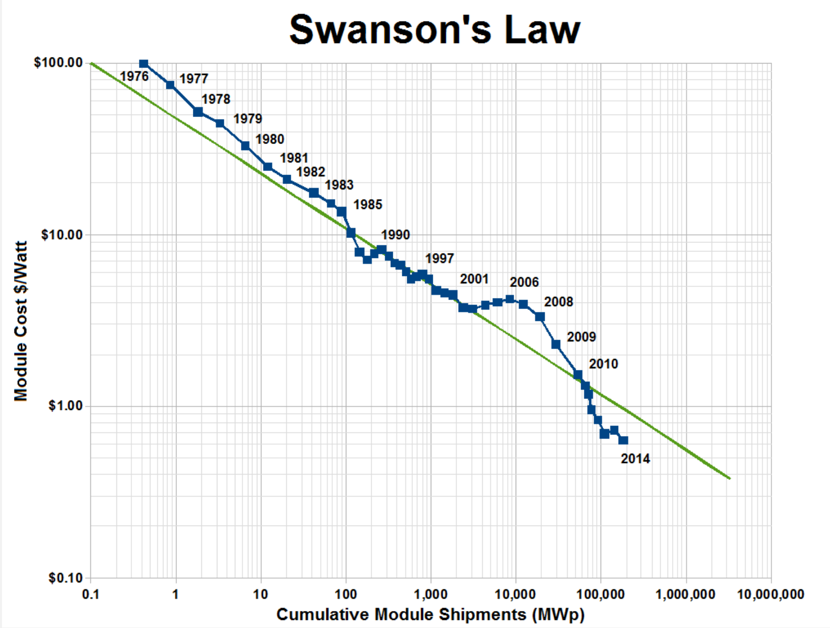

Figure 5 Swanson's Law representing the decline in module cost of solar PV modules over the cumulative module shipments throughout the last 40 years (presented on logarithmic scale).

Swanson's Law is only applicable to solar PV modules since these are based on a semi-conductor technology. For other renewable energy resources different learning curves are observed. In the following paragraph the learning curves and cost developments of the five main renewable energy technologies in the European Union are briefly discussed.

The renewable energy resources and technologies that are present in the Member States are all in different phases of technological maturity. Therefore, the (expected) trend in cost-development for each is unique, depending amongst others on the current status of deployment. All renewable energy technologies can roughly be placed in a maturity curve showing the current status and future path of the technology. Such a curve, as used by the Berkman Center for Internet & Society at Harvard University research, is shown in figure 5.[16] Although this figure is drafted in 2008 the overall picture is still considered to be accurate and only a slight shift on the line to the right has been made in the meantime for some technologies.

16 Available at: http://cyber.law.harvard.edu/commonsbasedresearch/Alternative_Energy/Paper

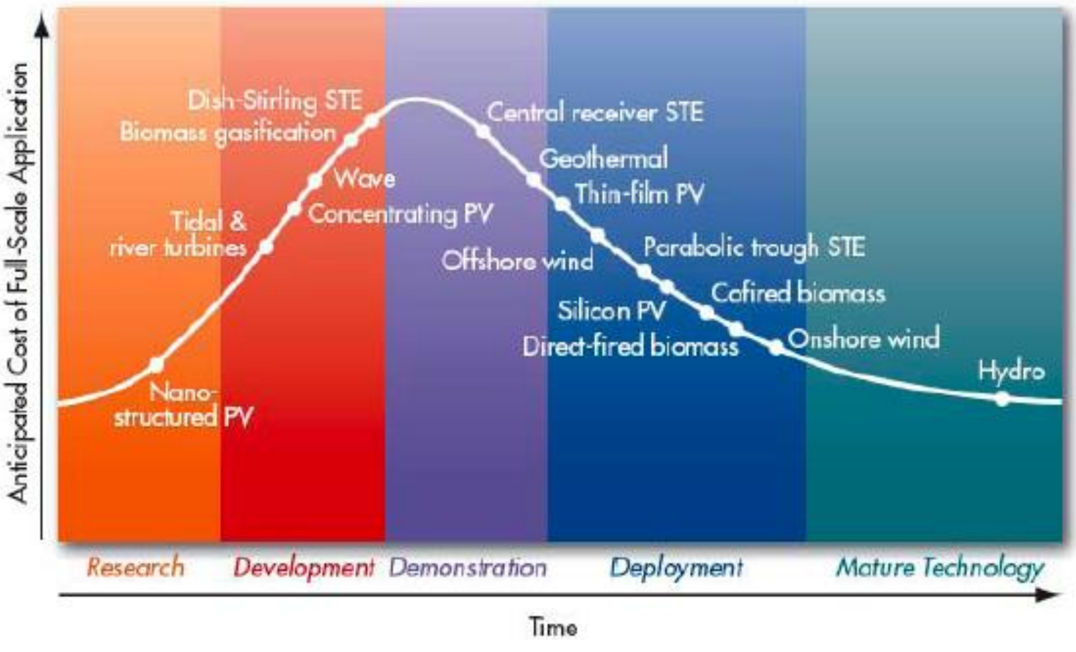

Figure 6 The maturity phase and corresponding anticipated cost of full-scale application for different renewable energy resources and technologies. Source: The Berkman Center for Internet & Society at Harvard University (2008).

Since the maturity influences the learning curve and the cost-development of the different renewable energy resources and technologies, they should be assessed separately. Therefore, the trends and the learning curves for the five most important renewable energy technologies in the EU , i.e solar PV, onshore wind, offshore wind, geothermal energy and hydro energy, are discussed separately in the next sub-chapters.

<u>Solar PV</u>

The sharpest decrease in the LCOE of proven renewable energy technologies in the past decades is witnessed in the solar PV sector. As shown by Swanson's Law, the correlation between produced units (and thus installed capacity) and the decline in the module costs is very high. Figure 6 illustrates this trend on a non-logarithmic scale.

In the European Union solar PV has taken an enormous flight between 2000 and 2013. From the first global trends in 2000 to the maturity of the solar PV sector in 2013, Europe has lead the way. In 2013 more than half of all the solar PV installed capacity in the world was deployed in Europe. However, since 2013 the leading region for solar PV deployment has shifted from Europe to Asia, mainly due to the rapidly growing installation rates in China, Japan and India.

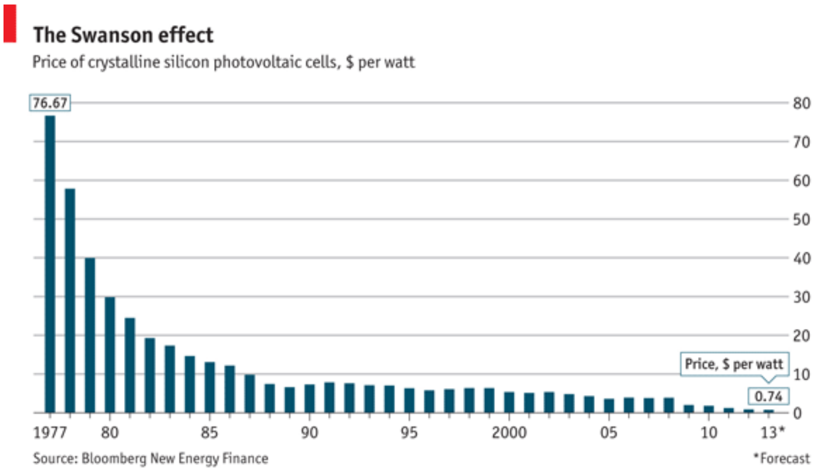

Figure 7 The decline in module cost of solar PV modules over the last 40 years.

This rapid deployment, in combination with the high learning rate (20% following Swanson's Law) have resulted in PV module prices declining by around 75% between the 2009 and 2014. Since there is still a growing international market for solar PV panels it is expected that this decline in prices will continue, although not as fast as recently witnessed. The main drivers for future cost reductions in solar PV modules are increased efficiency, economies of scale and product optimization.

<u>Onshore Wind</u>
Onshore wind is currently one of the lowest-cost RES sources available, and in some cases already competing with fossil fuel resources regarding their LCOE. This is mainly due to the technological improvements and decline in installed cost of wind turbines in the recent years. Since 2009 the LCOE has fallen with 50% for onshore wind energy projects.

However, the LCOE of onshore wind energy projects differs significantly per project, depending on multiple regional factors. A general learning curve for onshore wind is visualized in figure 7. The cost decline of wind energy in the European Union is at an average level compared to other regions. Countries as China and India show significant lower costs, which can be explained by the current massive deployment of wind energy projects in the Asian region.

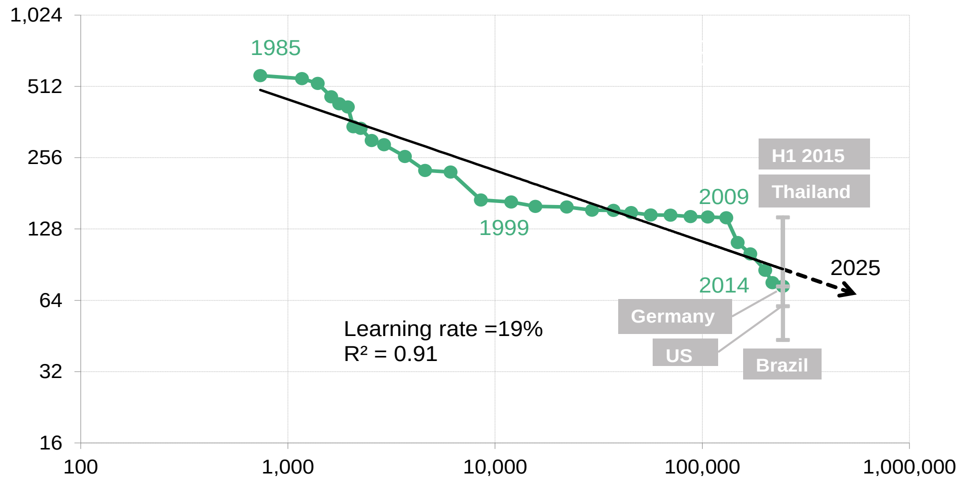

Figure 8 Global onshore wind learning curve where the LCOE in EUR/MWh is visualized against the total installed capacity in MW. Source: Bloomberg Energy Transition (2016).

Onshore wind energy is currently a mature technology which provides a solid basis for the deployment of renewable energy resources on a large scale. Further large cost reductions are not expected to occur in the near future, but this depends strongly on the local conditions and financial environment.

<u>Offshore Wind</u>

In comparison to declining capex for most other renewable energy resources, offshore wind energy projects experience an increase in capex. This can mainly be explained by the linked increase in the distance to shore and depth of more recent wind farms. Since the low hanging fruits for offshore wind energy, i.e. shallow waters and areas close to shore , has been picked, the projects that were recently deployed were more expensive to develop. This directly relates the LCOE of offshore wind energy in Europe, which shows an increase of nearly 60% between 2000 and 2014. Figure 8 indicates this increase in the LCOE over the last decade.

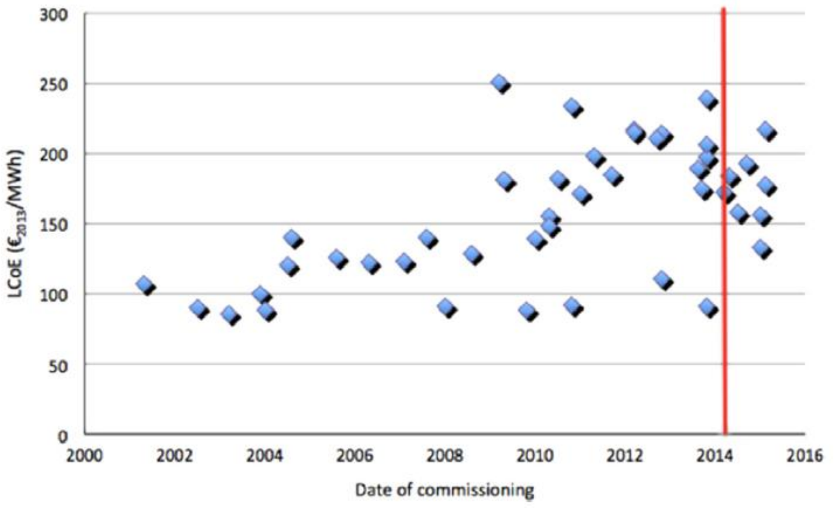

Figure 9 LCOE calculation of operating European offshore wind farms between 2000 and 2015. Note: For OWFs right of the straight red line at 2014, a capacity factor of 40% has been assumed. Source: Voormolen et al. (2016).

Ultimately, in offshore wind projects the LCOE depends, just as onshore wind projects, on local circumstances. When zooming in on country level, large differences in the LCOE development can be noticed. Denmark is a best case practice in this: Despite the rising capex the LCOE decreased between 2008 and 2014. This decrease in LCOE is mainly attributed to a rising capacity factor of the offshore wind farms and a stable policy framework. The rising capacity factor increased the revenues and the stable policy framework decreased the WACC and therefore the financing costs. This combination of positive influences offset the higher capex in these cases. On the opposite, in the United Kingdom an unstable policy framework increased the WACC for projects, which in combination with the high capex is one of the main reasons that the LCOE of offshore wind in the UK is rising faster than in any other European country.

Geothermal Energy

There are different types of geothermal energy, they can provide heat or power and the technology differs depending on the accessibility and temperature of the source. For the high temperature, easy accessible sources, geothermal has passed its demonstration stage and is now considered as a mature commercially available solution for energy. For non-optimal conditions, geothermal is not widely developed yet and by investors seen as a risky technology.

Since geothermal was not widely deployed yet in the past decade, there is not much data on the development of the costs. In general geothermal power plants are capital intensive, but they have very low and predictable running costs. This high upfront capital costs are the main issue regarding large-scale deployment of geothermal since it implies a high risk profile.

Development costs have increased over time as engineering, procurement and construction costs have risen, but in general the total installation costs have been stabilized over the last period. In figure 9 the LCOE for geothermal power projects is given for different regions, including the expected trend for future deployment.

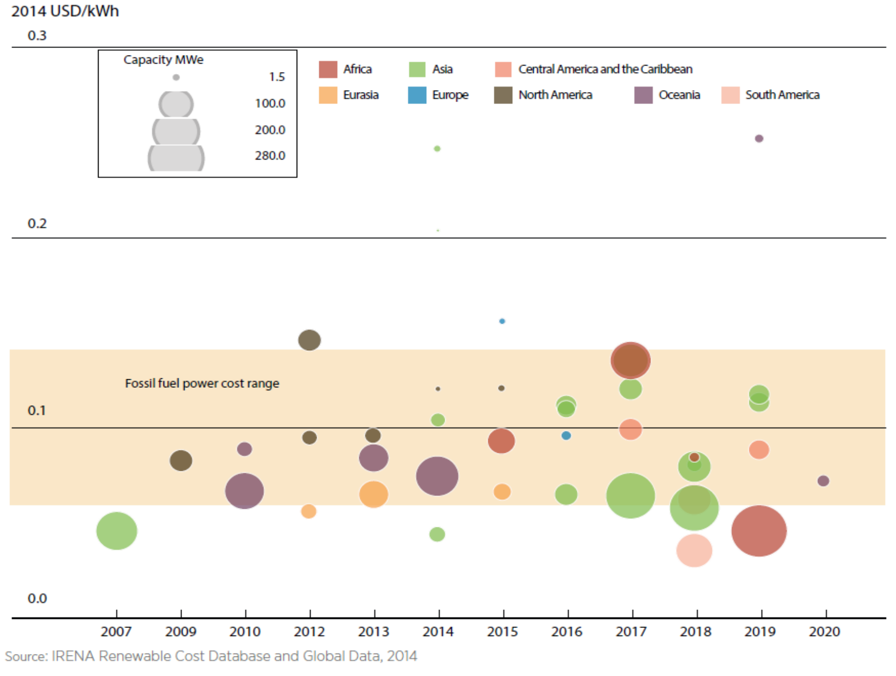

Figure 10 The LCOE development of geothermal power plants by region and size.

At the end of 2013, the worldwide installed capacity in geothermal energy was around 12 GW. These projects were almost all in active geothermal areas with good resources. However, the expected deployment in Europe tends to be in less optimal resource regions (i.e. lower reservoir temperatures), which indicates that a large decline in the LCOE in the EU is not expected in the near future.

Hydro Energy

Hydro energy is a relatively old form of renewable electricity generation and hydropower can be considered as a fully matured technology. Hydropower is currently the largest renewable power generation resource worldwide, with a global installed capacity of over 1000 GW at the end of 2013. Hydropower is also the main renewable resource for electricity generation in Europe.

The maturity of hydropower has an influence on the costs of projects which are generally low. However, this also means that the cost reduction opportunities of future projects are unlikely since the high-productive sites are already in use. Especially in Europe the unexploited low-cost hydropower potential is very limited and an increase in deployment is not expected. To give a numerical example: compared to the unexploited potential of large-scale hydropower in developing countries with a LCOE of 0.02 $/kWh, new European large-scale hydropower plants are estimated at best to have a LCOE of 0.10 $/kWh.

Effect of trend in electricity prices

The general trend of electricity prices is relevant to all RES technologies. In the EU the average wholesale electricity price has declined over the past years. Such a decline deteriorates the competitive position of RES with respect to fossil fuels, since fewer new RES projects will prove to be feasible to deploy. On the other hand the large-scale installed capacity of fossil fuel fired power plants will be able to keep producing (cheap) electricity, meaning these will maintain, or even expand, their share in the electricity mix. Moreover, the low electricity price also has an impact on the existing RES projects, which in some cases currently experience higher operating costs than revenues. The paradox in this is that it can be argued that the large-scale deployment of RES is one of the attributors to this decline in electricity price, since most RES technologies have zero marginal costs, which causes the electricity spot price to decline. Therefore, with an increasing share of RES in the electricity mix a new balance needs to be established in order to stabilize the electricity price.

On the other hand, as described above the LCOE of some of the RES technologies is declining as well. This development could counteract the effects of a declining electricity price, creating a net neutral effect. The adverse effects of the declining electricity price for the currently deployed RES projects are however not counteracted, and when these projects shut down their operations the 2020 and 2030 targets of the EU could be endangered.

Effect of trend in interest rates

For the past decades, the capital market in Europe experienced a turbulent period, including multiple bubbles and a financial crisis. This unprecedented volatility is reflected in the interest rates and the cost of capital in the European financial markets. After a cautious recovery in the post-financial crisis years between 2010 and 2012, the current trend is again downwards. This downward trend is amplified by the ECB's monetary policy of "quantitative easing". In Table 1 the 12-month Euribor interest rate shows this volatility in the market and recent low level of interest rates.

Table 1 The 12 month Euribor interest rates first day of year. Source: euribor-rates.eu (2016)

Date	12-month Euribor interest rate
2016	0,058%
2015	0,323%
2014	0,555%
2013	0,543%
2012	1,937%

Date	*12-month Euribor interest rate*
2011	1,504%
2010	1,251%
2009	3,025%
2008	4,733%
2007	4,030%

Due to the policy of quantitative easing, financial institutions, like banks, can borrow capital at extremely low interest rates. Therefore, more capital is available for financing (amongst others) large-scale RES projects. Due to quantitative easing, as well the cost of debt has lowered, creating a lower total cost of capital (WACC). A lower WACC has, in turn, not only a positive effect on the development and investment decision of RES projects, but also on the LCOE and therefore the competitiveness of RES. The lower LCOE for RES related to the low interest rates in Europe can act as a stimulus for the development of new renewable energy projects and renewable energy technologies. Therefore, a positive impact in the market is expected as more renewable energy projects become financially viable.

Future expectation on investment level

As discussed above, it is expected that the price of solar PV, and to some extend wind energy keeps declining in the future with the increasing share of solar in the energy system. Other renewable energy technologies are expected to have a limited to no further decrease in price at present.

In order to achieve the goals defined in the 2030 energy and climate framework, including a 27% share of RES, large and continuous investments are needed. The most cost-efficient manner to increase the share of renewables in Europe on the short term is through investing in mature RES technologies in countries with low risks and corresponding low cost of capital. The question however rises whether such a focus on low risk countries and technology would be respectively politically desirable and stimulate innovation on the long term.

For the interim 2020 goals, including a 20% share of RES, it currently seems that the MS are on the right track. Figure 10 shows the status of the RES share in the gross final energy consumption until 2013, including both the RED indicative trajectory as well as the expected trajectory based on the National Renewable Energy Action Plan (NREAP) of each MS until 2020. The fact that the NREAP trajectory is higher than the RED trajectory is explained by a number of factors, of which the most influential are the lower than expected final energy consumption in the MS, due to amongst others a lower than expected economic growth.[17]

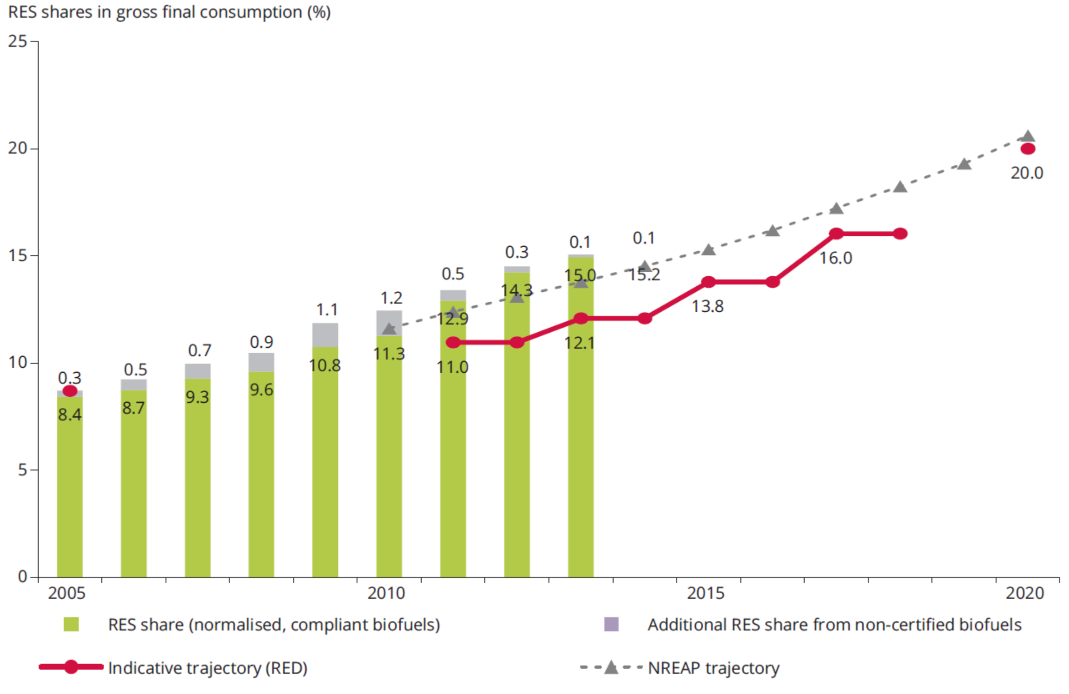

Figure 11 EU-28 actual and approximated progress to 2020 targets. Source: EEA (2016).

Looking more in-depth into the RES technologies that are expected to be deployed until 2020 a trend towards wind and solar (PV) energy is visible. However, in absolute numbers, the main RES technology is expected to remain to be hydro power. Although no new large investments in hydro power in are expected in the

17 Ecofys (2014). Renewable energy progress and biofuels sustainability. https://ec.europa.eu/energy/sites/ener/files/documents/Final%20report%20-November%202014.pdf

EU-28, it is still forecasted that hydropower will play a major role in the renewable electricity supply in the (near) future[18]. Figure 11 depicts the historic development and future expected deployment of RES technologies for electricity generation in the EU-28 MS.

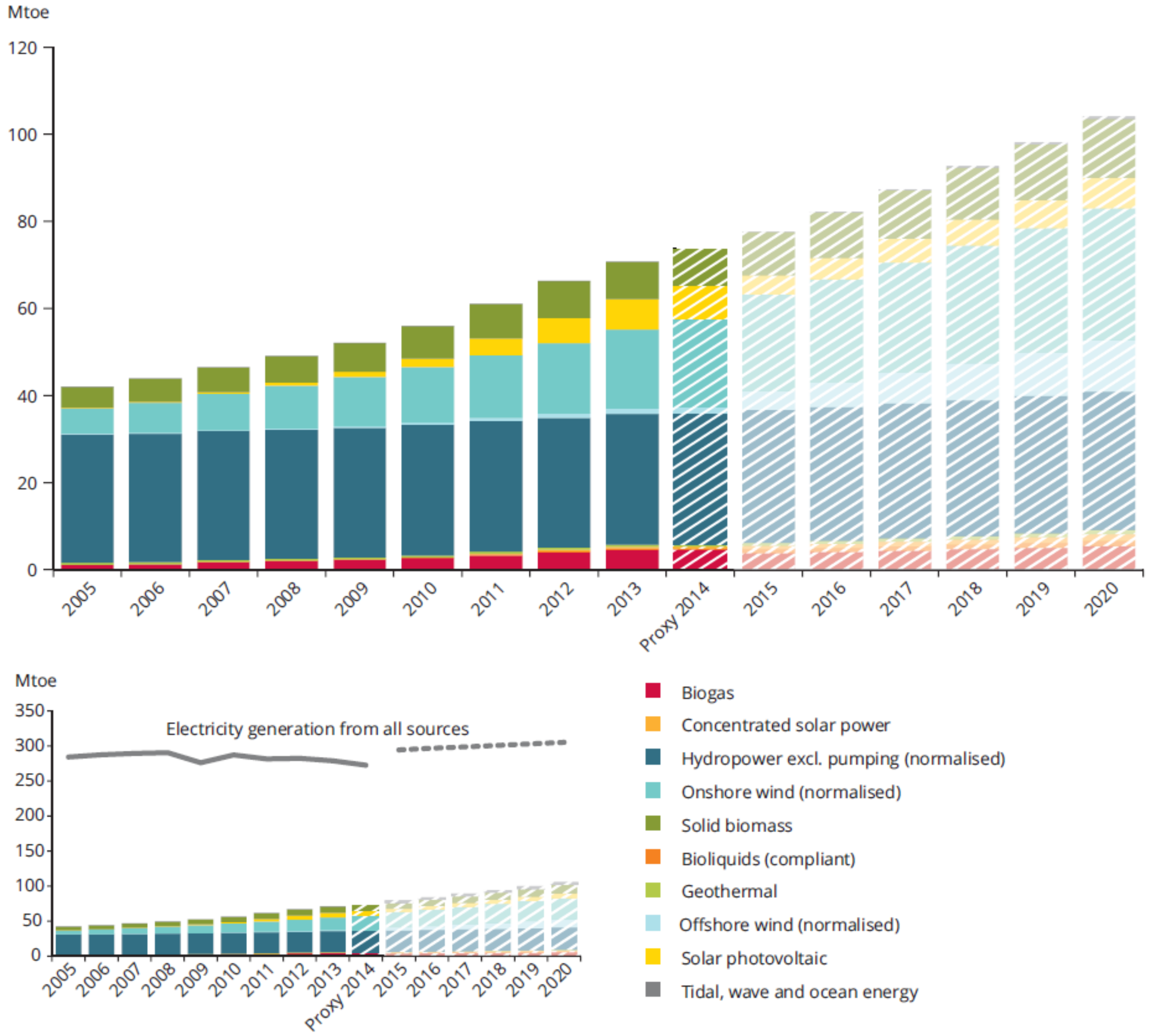

Figure 12 Renewable electricity in the EU-28 per sector. Source: EEA (2016).

The most remarkable trends visible in figure 11 are the expected increase in both onshore as offshore wind energy for the coming years, as well as the large increase in solar (PV) in recent years. This underwrites the conclusion on capital trends that wind energy and solar (PV) energy are the renewable energy resources that are expected to experience a further growth in investment capital in the coming years.

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18 Source: European Environment Agency Report, April 2016.

Estimation of investment needed

Estimations on the investment needed for a clean power sector strongly differ depending on the source and the scope of research. The main sources provide insight in the total costs of decarbonising the energy sector, including both investments in RES, and investments in the necessary expansion and reinvestments in grid infrastructure and potential back-up facilities. The EIB (2016) estimates the investment need in generation capacity in order to achieve the 2030 GHG targets for EU MS to be EUR 53 billion per year.[19] This figure applies to the total generation capacity, including for instance (back-up) gas-fired power plants. The World Energy Investment Outlook, drafted by the IEA, concludes that roughly $ 1,6 trillion (which is currently approximately EUR 1,4 trillion) is needed between 2014-2035 for new generation capacity in the EU, of which three quarters (approximately EUR 1,05 trillion, or EUR 50 billion per year) will be invested in renewable energy technologies.[20] The Power Perspectives 2030 report of the ECF (within the Roadmap 2050 project) estimates that between 2010 and 2020 around EUR 567 billion is needed for new generation capacity, and between 2020 and 2030 around EUR 1 trillion is needed (both numbers are exclusive of required back-up capacity and transmission expansion investments). These numbers translate to a yearly investment of EUR 57 and 103 billion for respectively 2010-2020 and 2020-2030, or on average over het whole period EUR 80 billion.[21] These latter estimates are based on the *"on track case"* to a decarbonised power sector.

The different sources and outcomes on the investment need towards a decarbonised power/energy sector mentioned above show the difficulty in estimating the total annual investment required. This is because the differences in the estimations are not only linked to the scope of the source or sector (e.g. including also back-up power generation), but are also strongly dependent on the forecast scenarios that are used. This latter includes amongst others which generation technologies will be deployed (e.g. merely inexpensive mature technologies, or also innovative RES), and the rate at which the development in the cost-decline of RES technologies is expected.

Figure 13 displays the different figures mentioned above. Due to the differences in scope and scenarios a relatively wide spread (between EUR 50 billion and EUR 80 billion) is displayed.

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19 EIB (2016). Restoring EU competitiveness 2016 Updated version. P. 31 http://www.eib.org/attachments/efs/restoring_eu_competitiveness_en.pdf

20 International Energy Agency (2014). World Energy Investment Outlook. http://www.iea.org/publications/freepublications/publication/weio2014.pdf

21 ECF Power Perspectives 2030, On the road to a decarbonised power sector. Executive summary: http://roadmap2050.eu/attachments/files/PowerPerspectives2030_ExecutiveSummary.pdf

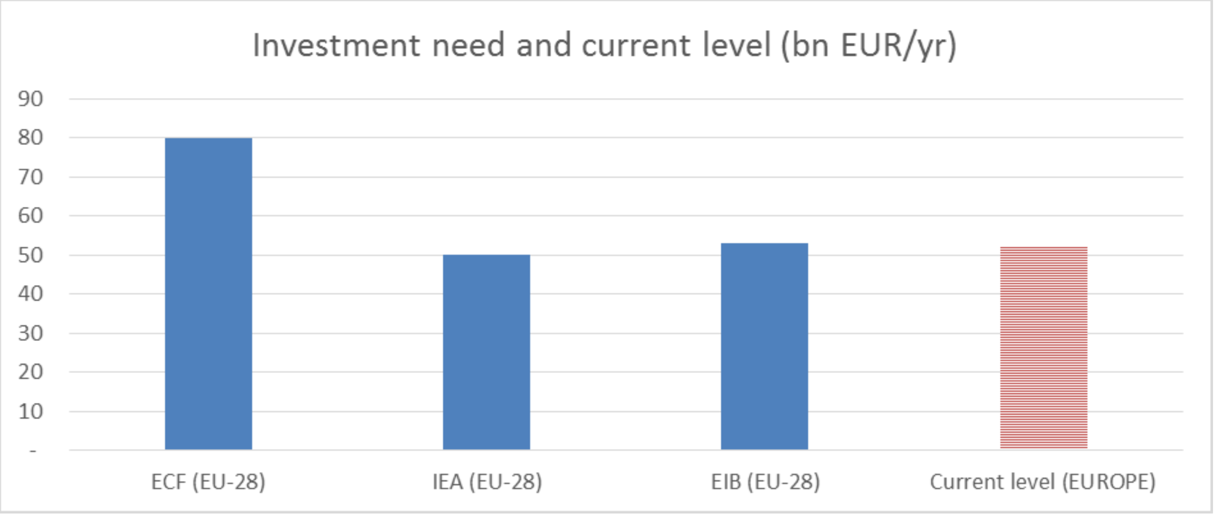

Figure 13 Estimated investments that are annually needed in the EU-28 to decarbonise its power sector, and the current RES investment level in Europe

The figure not only displays the investment needs, but as well the 2014 investment level in renewable energy systems in Europe, as presented in paragraph 1.1.2.1 of the report (N.B. converted $ to EUR). Note that the numbers are not completely comparable, as this latter figure includes Europe as a whole, while the scope of the estimations of investments needed is solely for the EU MS.

Comparing the rough estimates of future investments to the current investment level shows that in case the 2014 levels are sustained only in the ECF scenario an investment gap appears of EUR 28 billion per year (or slightly higher due to the geographic scope difference). Note however that even in case there is a limited or no investment gap (as two estimates show), this does not say anything on the necessity of public contribution in RES, as the current investment level depends to a large extent on public resources.

Table 1 Investment needed, current investment and investment gap for the four sources.

Investment needed (bln EUR/yr)	Recent investment levels (bln EUR/yr)	Investment gap (bln EUR/yr)
50-80	52	0 - 28

These insights are based on rough estimates and assumptions on existing resources with different scopes. A more detailed analysis is required on similar scope analyses to determine the actual investment gap.

1.1.2.2 Trends in public measures

The potential of RES projects under present market circumstances (energy prices, CO_2 price) is currently not sufficiently profitable. Even large scale projects including off shelf technologies like solar PV and onshore wind depend upon the presence of guaranteed subsidies as a trigger for private investment appetite. This is due to both the insufficient revenues compared to the costs, as to the uncertainty related to the expected revenues.

The existing incentive schemes for RES in European member states all have a different impact on the attractiveness of RE-projects for financiers. In many projects, a mix of measures subsidies, guarantees or loans is used to attract private finance.

Paragraph 1.1.1 described the type of impact that measures have on RES investments. However, not only do these measures have an impact on their own, it is also the long term certainty that it can provide which strongly influences the potential. Regulatory uncertainty can cause investments to drop significantly. As stated by Michael Liebreich, Chairman of the Advisory Board for Bloomberg New Energy Finance: *"Southern Europe is still almost a no-go area for investors because of retroactive policy changes, most recently those affecting solar farms in Italy."*[22]

Example Feed-in tariffs in Bulgaria and the lack of PV investments

Bulgaria provides valuable lessons with regard to the design of a feed-in tariff and the need for continuity which resulted in a serious lack of PV projects. A PV project that was planned in 2010 but eventually never executed serves as a concrete example of the situation in Bulgaria. This project enclosed an investment in 5 MW of capacity with a total investment size of 13,4 million euro. The project was set-up to be privately financed through project financing with a gearing of 70% debt to 30% equity. Debt was to be provided by bank loans.

Viability of the project was mainly ensured by a feed-in tariff scheme. However, turned out to be less of an economic foundation than needed to make the project succeed. One reason is the design of the tariff itself: the law that was defining the tariff scheme included a clause which indicated that, in theory, the feed-in tariff could be reduced every year by 5%. The crucial detail was, that this reduction of the feed-in tariff also applied to existing projects, which was a major source of uncertainty for project revenues. This risk, in combination with general inexperience with regard to PV projects, made lenders such as banks cautious with regard to PV projects and thus, increased the cost of debt available to the project.

Furthermore, banks were not willing to finance the value added tax of the project. As a consequence, project developers had to pre-finance these cost at their own expense which in fact changed the gearing to 60% debt to 40% equity, which increased the capital cost of the project even more.

Not only was the feed-in tariff not well designed, it also did not last long. The eventual abolishment of the feed-in scheme led to a total halt on PV investments in Bulgaria which explains the lack of solar projects in a country with good climate conditions. It can be concluded that uncertainties with regard to the amount provided by feed-in tariffs and its continuity are key drivers of access to private financing and cost of capital.

Hence the question is not only whether a subsidy scheme exists, but also to what extent the related cash flows can be guaranteed by the project developer via contracts with the authorities involved.

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22 Source: http://www.un.org/climatechange/blog/2015/04/renewables-re-energized-unep-green-energy-investments-worldwide-surge-17-270-billion-2014/

Many member states are currently reconsidering or evaluating their support measures. In this reconsideration MS not only look into traditional subsidy schemes but also consider financial instruments such as debt and equity provision. Another trend in the evaluation of the support schemes is the development of operational subsidies, namely feed-in schemes. While early support schemes have mainly focused on fixed feed-in tariffs, new schemes are only providing a premium on the market price to RES producers. This premium can be fixed (e.g. through RES obligations or certificates) or variable (e.g. through Contracts of Difference). The trend away from fixed tariff towards premium schemes can be explained by two main reasons: First of all, the economic concerns have caused MS to downsize support schemes as the financial burden was becoming too large, especially in the light of the economic recession. Second, feed-in tariffs do not stimulate RES to become more competitive as the tariff is fixed and thus might even lead to a higher electricity price. Figure 13 illustrates this trend.

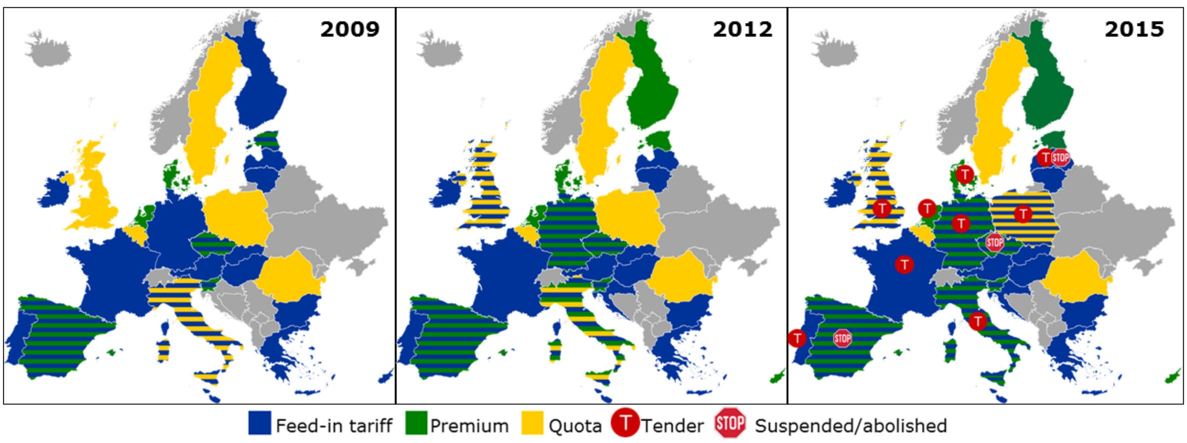

Figure 14 Trends in feed-in tariffs, quota and premiums in MS 2009-2015[23]

Traditionally EU and MS involvement consists of subsidies and grants. However in recent years some MS and regions have developed 'revolving funds'. These MS funds refrain from subsidies but apply a different, less stringent, risk profile compared to private funds. This involvement of governments in private financial instruments will be further discussed in paragraph 1.1.2.3.

As mentioned earlier, in the current energy market RES projects are still dependent on public support, despite movements in RES policies. Especially typical innovative projects in an early phase of development require government funds before private funds can be attracted. For example, innovative tidal energy projects typically depend on subsidies and grants for up to two thirds of the investment.

[23] Based on: Brückmann, R./ Eclareon (2016). Renewable energies – Overview on political frameworks in Germany and Europe.

Example Demonstration Project

In 2008 a demonstration concept was started to show that communities can benefit from geothermal projects. These were all innovative and small-scale projects, which only produced heat from a geothermal source. The project was executed in 3 countries (Italy, Hungary and Slovakia) each with a different installed capacity and preconditions. Funding for this execution came from the *7th Framework Programme for Research and Technological Development* (FP7). This funding provided in the technology investment and part of the district heating network installation or extension. The other part of the expenditures were accounted for by the public municipalities where the project was executed. In the total project cost, approximately 50% could be borne by the available funding of FP7, which allowed the project to reduce the amount of years before it became profitable. This had a positive effect on the perception of the project. In Slovakia, the demonstration project investments triggered additional investments without EU funding: 3 of 11 large buildings were originally connected to the geothermal project, and in the following year, another 3 buildings were connected to the installation without support from European Commission (only private means and regional funding).

Feed-in schemes still account for 50-60% of onshore wind revenues. If these are surrounded with regulatory risks, this will limit appetite of banks and reflect in a higher WACC and limited competition among funders. In the long term, the dependency on public funding should gradually be lowered, since a 27% penetration rate of renewables will not be possible in a constellation where total investment volumes depend on 50% or more of public investments. On the other hand, the lack of functioning pricing systems (ETS) and tax protection schemes (like regressive energy taxes) prevent the internal market from functioning properly. Investment trends in MS where FIT/FIP was abolished, restricted or made subject of politically motivated adjustments, investments dropped dramatically. Simply under present market circumstances with low electricity prices and non-application of the "the polluter pays principle", the RES business case does not lead to a feasible project without government intervention. If under new state aid guidelines subsidy schemes would be restricted this is likely to have an impact on even the 2020 targets, because of the uncertainties in the market. In order to move away from subsidy dependency and shift to market conditions more gradually, it is worthwhile to take a closer look at risks and conditions applied by the private sector.

1.1.2.3 Trends in sources of finance and financing instruments

Utilities used to dominate the energy market. Installed capacity (mostly fossil fuel-based) were in the past mostly financed through utility balance sheets. Many utilities are however struggling with traditional business models and asset portfolios, due to a weak electricity demand, a high-cost regulatory framework and low generation margins[24]. At the same time new players are entering the market, both from bottom up (small projects by consumers) and top down (large projects financed by the financial sector).

[24] Source EY (2015) http://www.ey.com/Publication/vwLUAssets/EY-power-transactions-and-trends-2014-review-and-2015-outlook/$FILE/EY-power-transactions-and-trends-2014-review-and-2015-outlook.pdf

Increasing involvement of small investors

Households and communities are increasingly involved in the energy market by investing in small-scale (mainly solar) installations. This accounts for significant investments. According to EurObserver (2014) in 2013 about EUR 13 billion was invested in commercial and residential PV. Household financing for small solar plants is thereby around four times larger than financial sources for large scale solar plants (in 2013)[25].

Example Public-Private Debt Fund

The "Nederlands Energiebespaarfonds" (NEF) is an innovative Dutch debt fund that offers low-interest loans to households for small scale private RE investments, such as solar panels. This fund is available for every home owner that aims to make its house more sustainable, and ranges from loans between 2.500 and 25.000 euro. The Dutch Government cooperates with two private banks (Rabobank and ASN Bank) in this revolving debt fund, in which 300 million euro is available. The banks together put in 225 million euro, while the Government tops this off with 75 million euro, based on a first loss principle. The fund is part of an energy agreement set between governmental organizations, non-governmental organizations and private companies in order to trigger sustainable energy policies.

Crowdfunding: The amount of financing through crowdfunding is limited, but growing for several years[26]. Worldwide, 165 million euros have been raised for over 300 clean energy projects, according to the Renewable Energy Crowdfunding conference 2015.[27] Numbers related to European RES projects are not readily available. Next to crowdfunding innovative business ideas for RES, more and more proven RES projects like solar farms and wind farms are being (partly) crowdfunded. This can both take place as a participation construction (and therefore the provision of equity), or as private bond loans (and therefore the provision of debt). EU wide projects such as CrowdFundRES and Citizenergy[28] aim to lower crowdfunding barriers and harmonize crowdfunding in Europe.

New sources of finance

Large scale RE-projects are increasingly financed through project finance. Project financed RE-projects often involve consortia consisting of utilities, construction companies, developers and financial institutions, and thereby allow new financiers to get involved in RE. For instance in the offshore wind market, commercial banks are becoming more and more comfortable with providing debt for projects. Also institutional investors like insurance companies and pension funds are involved in several large RE-projects.[29] This shift to project finance with consortia of investors is likely to shift the risk profile and WACC of RES projects as well, since banks and

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[25] EurObserv'ER 14th annual overview barometer. http://www.eurobserv-er.org/14th-annual-overview-barometer/ (from p.143 on).

[26] Vasileiadou, E. Huijben, J.C.C.M., Raven, R.P.J.M. (2015). Three is a crowd? Exploring the potential of crowdfunding for renewable energy in the Netherlands. Journal of Cleaner Production (2015) 1-14

[27] Renewable Energy Crowdfunding Conference (2015). Post-show Report. http://static1.squarespace.com/static/538c3ba5e4b0a205ac394361/t/564b2291e4b08f4e89f6ed24/1447764625960/RE+Crowdfunding+2015+-+Post+Show+Report+1.1.pdf

[28] European Crowdfunding Network (2016). http://eurocrowd.org/energy-related-projects/

[29] http://cleanenergypipeline.msgfocus.com/files/amf_vb_research/workspace_1/Guides/CleanEnergyEuropeFinanceGuide2015.pdf (p.38)

institutional investors base their investment decision largely on the risks of a project versus the rewards.

Example Pension Fund

The Irish sovereign wealth fund Ireland Strategic Investment Fund and the British Strathclyde Pension Fund have committed to investing in a wind-energy fund managed by Legal & General and NTR. While the Irish fund has committed 35 million euros, the British fund has committed 50 million euro to the 250 million dollar vehicle which will build an onshore wind portfolio in the UK and Ireland. The green energy company NTR launched the fund to invest in onshore wind projects in Ireland and the UK with a total capacity of around 270 MW.

Institutional investors have shown sheer interest in RES projects, partially driven by the public - organised in movements like GoFossilFree – pushing (public) institutions towards fossil free investments. Institutional investors can potentially play a large role in financing RE, in particular since institutional investors worldwide have an estimated amount EUR 63 trillion worth of assets[30]. On the other hand, considering the relatively steady income stream of most renewable energy technologies (large upfront investment, but long term revenues), RES investments could potentially play a considerable role in the total institutional assets.

When short term and relatively high risk construction loans are refinanced after the development and construction period by low risk (low interest) long term operational loans an attractive opportunity for institutional investors is formed. Not only the long term investment and low risk complies to the investment demands of an institutional investor, but moreover, the assets that are in place in this state form a safety net contributing to an even lower risk. An increasing number of projects recently refinanced debt following this construction and more interest from the sector is lurking[31].

RES projects are however rather complex, due to their technological characteristics, as well as due to the different incentive schemes in member states.[32] Investors, such as funds or institutional investors, require big expert investment teams to be able to invest in RE, which is costly and only attractive with certain economies of scale. These costs can only be justified for large portfolios by large funds. Climate Policy Initiative estimates the threshold for investments to be roughly 50-100 billion euros[33]. It is not uncommon though that smaller funds or institutions 'tag along' with larger players and thus rely on the expertise and judgement of the larger investor. However, this usually goes along with less favourable deals for the smaller party. An example of such a clustering is a fund consisting of multiple funds.

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30 Converted from USD 71 trillion. Source: Climate Policy Initiative (2013). The Challenge of Institutional Investment in Renewable Eenrgy. March 2013

31 Source: Moody's (2015). Refinancing in the European renewable energy sector may reduce some credit risks.

32 This is also a reason why there is subtantial value to be gained with standardisation of FIT/FIP within Europe. Even without full harmonization, a certain application of similar standards allows investors to develop know how on RE financing in a more effective way.

33 Climate Policy Initiative (2013). The Challenge of Institutional Investment in Renewable Energy. March 2013

Example "Fund Of Fund"

Like many institutional investors APG (a Dutch pension fund) aims to invest part of their funds in renewable energy. Operational hydropower plants in Scandinavia form an attractive low risk and long term investment, which suits the profile of institutional investors perfectly. However, the downsides of hydropower investments are high transaction costs for relatively small investments. That's why APG, like many other institutional investors, created a 'fund of funds' at Aquila Capital. Aquila is a private equity firm that has set up this tailor made fund for APG. Aquila has a management team and expertise in the hydropower sector, and invests in hydropower by buying operational (small-scale) hydropower plants throughout Scandinavia. These hydropower plants are offered in batches of 10 to 40 at the same time at the market when Aquila acquires these. By setting up this tailor-made fund for APG, Aquila offers a way for APG to invest 500 million euro in the hydropower sector, without having multiple transactions (with associated exploration and due diligence cost) and daily management issues of all the plants. The assets themselves remain on the books of fund manager Aquila, which charges a fund management fee to acquire and manage these assets for APG. Besides the fact that this construction is tailor made for one large investor, these 'fund of fund' constructions are an increasingly common way for institutional investors to efficiently inject funds in the renewable energy sector.

Not only does the size of the institutional investments matter – also the size of the project matters. Single RES projects are in many cases too small to be of interest for institutional investors like pension funds. These funds manage large amounts of money and only invest in large projects where enough money can be stored at once in order to limit the transaction and management costs. This argument goes along with the above mentioned complexity barrier.

Pooled investment vehicles: Yieldcos

In order for commercial (institutional) investors to play a larger role in RES investments, instruments that pool investments and thus lead to more large scale investment opportunities are essential. Those pooling instrument exist and grow on the financial market already, for example, Yieldcos or different fund structures[34]. Yieldcos are entities that hold RES assets (e.g. wind parks, solar farms) and attract investors with a long term perspective of steady cash flows and dividends. Different RES projects (also of different companies) can be bundled in the portfolio of a Yieldco in order to spread risk and realize growth.

In the EU, the number of Yieldcos is relatively limited (compared to the US). For a favorable investment climate, two aspects are crucial. In addition, investors can hope for future growth of the Yieldcos when other projects become operational and are added to the Yieldcos portfolio. However, as growth is only a secondary objective and is dependent on future projects, the focus lies on the long term stable dividends.

With regard to the role that governments and in particular the EU can play in incentivizing Yieldcos, two aspects are crucial. First of all, the long term stable dividends that are at the heart of the Yieldcos are mostly guaranteed by the purchase agreements and existing feed in support schemes that are offered by national governments. Without these support

[34] Based on Bloomberg New Energy Finance (2013). How to attract new sources of capital to EU renewables, Climate Policy Initiative (2013). The challenge of institutional investment in renewable energy and consultant experience in fund design and evaluation.

schemes it is unlikely that Yieldcos continue to flourish. Second of all, Yieldcos become more attractive with size and diversity of their portfolios. However, as only mature projects that have reached operation are added to the portfolio, the growth of a Yieldco is dependent on the risks during preparation and construction. The easier, quicker and cheaper capital is available for new (and large) projects, the more growth potential and thus attractiveness Yieldcos have to investors. And thus, more capital will be supplied by investors. In addition, the less risky the preparation, R&D, and construction, the quicker projects reach maturity and can be part of the portfolio. Thus, all EU wide measures can potentially be 'accelerators' for pooled investments: support schemes for guaranteeing stable dividends, guarantees and subsidies for lowering risks in R&D and construction of new projects, and other debt or equity vehicles for especially financing large projects.

Public Involvement through financial instruments

Export credit agencies and multilateral finance organizations play an essential role in project financing RES projects. According to Clean Energy Pipeline (2015) the large offshore wind finance deals in Europe were all supported by one of these institutions. These institutions provide subordinate or concessional loans, or guarantees and thereby make the risk of RE-projects acceptable for commercial banks and institutional investors, which in turn creates leverage on their investments.[35]

Public financial institutions play a significant role in RE-financing. When looking at the top 5 of project and asset financing arrangers by the deal credit, the European Investment Bank with USD 3.870 million outranks all other investors in total deal size in 2014. The European Bank for Reconstruction and Development ranks 5th [36].

Top 5 Lead arrangers by deal credit in 2014

1. EIB	20 deals	USD 3.870 million
2. Nord / LB	11 deals	USD 1.027 million
3. Natixis	37 deals	USD 913 million
4. Deutsche Bank	8 deals	USD 748 million
5. EBRD	11 deals	USD 713 million

35 Clean Energy Pipeline (2015). Clean Energy Europe Finance Guide.
36 Clean Energy Pipeline (2015). Clean Energy Europe Finance Guide.

Example Public Involvement In Innovative Fund

A Danish renewable energy and infrastructure fund manager, the Copenhagen Infrastructure Partners, started an innovative fund for renewable energy projects; the 'Copenhagen Infrastructure II'. The main innovative force of this fund is that it is planning investments with considerably lower levels of leverage than similar funds. This attracts the low risk profile of institutional investors who therefore already have put 2 billion euro of institutional investment into the fund for RE projects and new energy technologies. If this innovative lower level of leverage wasn't considered this amount of money would not have been available, since the projects that this fund invests in are normally considered as too risky for institutional investors. Furthermore, the first equity participation of the European Infrastructure Bank (EIB) through the European Fund for Strategic Investment (EFSI) was taken in this fund, adding another 75 million euro to it. This equity participation further strengthens the confidence of the institutional investors. On the other hand, with the combination of EUR 5 billion of its own resources and a EUR 16 billion European Commission guarantee, the EFSI enables the EIB to make investments it would previously not have done. An additional benefit for the participation is that it ensures the EIB to have an active voice in the way the fund is structured and run. The 'Copenhagen Infrastructure II fund' is currently investing in amongst others a British biomass power plant (100% ownership) and a German offshore wind park of over 400 MW (250 million euro stake in a 1.9 billion euro project).

http://www.eib.org/infocentre/stories/all/2015-december-04/low-leverage-draws-high-investment.htm

Also on a regional scale, public parties are seeking ways to support RES in a revolving way, in order to increase the impact they can have (by spending money more than once). Additionally, also market incentives are included more often.

Example Public energy fund Overijssel (EFO)

In the Netherlands 13 regional funds have been established by regional and local authorities that provide debt and guarantees. Total public resources of these funds add up to 600 million euro, with an average multiplier of three. Hence this leads to an additional investment of almost 2 billion in The Netherlands.

So far, these funds have invested in approximately 200 small scale RES projects (projects with investments varying between some hundred thousand and a few million euros). Results can be seen at the website www.publiekeenergiefondsen.nl.

Interesting development is that some of these funds discuss with EIB on potential co-financing structures.

The funds trigger RES small scale RES investments in a regional/local setting and provide access to capital for project developers on the basis of a mixture of financial (business case) and social-economic (RES, CO2 impact, jobs) criteria. This mixture can be seen as a trigger for the success of these types of funds. Projects deals have been closed, that would not be possible with 100% private financing. Without subsidies, the funds have all revolving structures. They require however lower returns compared to private sector funds.

1.2 Addressing options for an EU 'gap filler' mechanism

1.2.1 Introduction

This chapter analyses options for measures that could be encompassed by a gap filler mechanism for possible inclusion in REDII.

1.2.1.1 Gap filler definition and purpose

The EU is – and by implication Member States (MS) are collectively – bound to reaching a minimum 27% RES target by 2030. Yet no post-2020 RES deployment targets at individual Member State level have been politically sanctioned to be adopted.

The National energy and climate Plans (NECPs) of the MS are foreseen to be the starting point for identifying how this target will be achieved, i.e. what combination of RES technologies will come into play, when and in which MS. However, there may be difficulties in reaching the overall 27% RES target, e.g.:

- The aggregated EU28 RES pledges in NECPs may not match the EU 27% RES target (also referred to as ambition gap);
- In the interim, the MS may collectively divert negatively from the linear trajectory for the EU as a whole towards reaching the 2030 EU target with respect to their actual delivery (also referred to as delivery gap), i.e. actual RES deployment at a lower deployment rate than planned (and lower % RES share due to lower nominator than planned);
- Combination of two bullets above.

Against this background, an EU 'emergency' mechanism (including one or more instruments) may need to be activated in case any of the above-mentioned (or other triggers) come into play endangering the 27% target achievement in 2030. As such, a dedicated gap filler is conceived as (potential) instrumentation that will be triggered by the Commission (hereafter COM). It will have to meet certain pre-set conditions at one or more pre-defined points in time within the 2020-2030 period.

The gap filler mechanism will have the prime objective to enhance/speed up the deployment of RES in order to reduce the gap between actual RES deployment and the RES deployment required to achieve the 2030 target. It will complement ex-ante EU-wide measures[37] (addressed in Chapter 2) which aim at having a long-term effect in supporting MS in fulfilling their contributions towards the overall EU target, addressing in the interim also any ex-post ambition gap that may result from negotiations in the run-up to the official COM proposal for a new Renewable Energy Directive (REDII). In the event that a mid-term evaluation shows a deviation of the EU RES share performance from a pre-set official linear trajectory (as e.g. to be set out in REDII) towards meeting the 2030 EU RES target, this is poised to trigger, upon inclusion and adoption of relevant provisions to that effect

[37] Also referred to as gap avoider measures. Ex ante: adopted for implementation before the start of the coming (2021-2030) decade for implementation starting when this decade commences.

in REDII, a gap filler mechanism to make up for the ex-post emerging delivery gap in the run-up towards 2030[38].

In the context of the revision of the Renewables Directive (RED) and of the coming negotiations of the Multiannual Financial Framework (MFF) 2021-2027, the learning from mechanisms such as the New Entrance Reserve under the ETS Mechanism (NER 300), the Innovation Fund mechanism, the Modernisation Fund mechanism, use of free ETS allowances (Article 10c, ETS Directive), the provisions under Art. 7 Energy Efficiency Directive (EED), and the Structural Fund Regulations with their reserve fund mechanism will be outlined and evaluated. Envisaged is gap filling support with a strong leading role by COM for a gap filling instrument ensuring further cost-efficient RES deployment, encourage regional cooperation and projects, and re-incentivise and support ambitious MS' pledges. In designing the emergency gap filler mechanism two defining new elements are:

i. It is the prerogative of individual Member States to be the "legal owner" of their individual NECP pledges for internal purposes;

ii. It is the *collective* responsibility of Member States to achieve the at least 27% RES target. This would imply the requirement of a strong coordinative role for COM.

Several MS seem reluctant to relinquish national ownership of self-determined, planned RES deployment milestones to COM. Indeed, the typical expectation seems to be that COM is to contribute to an enabling environment in the EU space to facilitate a higher effectiveness of national efforts of the MS rather than to decide what MS have to do regarding, among others, RES deployment. The key challenge is to find a proper, politically feasible, balance between the reluctance of MS to relinquish at least part of their prerogative to fully govern RES deployment policies in their respective jurisdictions and a strong mandate to COM for ensuring in a top-down fashion achievement of the collective RES target, should the envisaged emergency gap-filler measure be triggered by sluggish collective RES deployment progress in the interim.

1.2.1.2 Gap filler criteria

Important criteria for the gap filler mechanism include:

a) it can be **activated at short notice**, for example at least within 9 months, from the date of notification by COM and the activation will not require additional decisions by European Commission or Council;
b) it is **(potentially) instrumental in effectively addressing an ambition gap and/or an unfolding cumulative delivery gap** against the pre-set (linear) trajectory (in RED II) for achieving the aggregate at least 27% RES target at EU level;
c) by implication, compared to alternative instruments deployment of the gap filler mechanism, it is to **result with** (comparatively) **high probability in a large short-term incremental RES deployment volume**;

[38] In principle there might be some overlap between the ex-ante EU-wide measures and the measures comprised by the emergency gap filler mechanism.

d) it should be **robust, credible and flexible**; robust in that it holds MS accountable in the most effective, constructive and politically feasible fashion for achieving the 2030 RES target; credible in that it shows that the Member States are committed to fulfilling their collective 2030 obligation; and flexible in that it allows for adapting to changing circumstances.

e) it can be **implemented with** (comparatively) **administrative ease.**

1.2.1.3 Key gap filler issues and considerations

Additionally, important considerations to take into account in the design and implementation of the gap filler mechanism include:

- The mechanism should contribute to cost-effective target achievement. However, since this is an emergency measure, covering a gap in order to reach the EU-wide 2030 RES target may have a higher priority than cost-efficacy, i.e. the mechanism should be effective in closing the gap at least cost, however, these costs may be higher than those if the deployment were to be successfully triggered from the very beginning (the efficiency criteria does not become less important, but the objective has changed, i.e. to meet the target in a short time frame);
- Ex-ante EU-wide measures (we will also refer to them as Tier 1 measures) and the "threat" that emergency gap filler measures (Tier 2[39]) should together incentivise MS (i) to pledge (in their NECPs) high or at least avoid any negative impact on pledges and (ii) to perform according to pledges.
- The gap filler mechanism should not replace or disrupt, but rather reinforce the efficacy and effectiveness of national support schemes aimed at increasing the deployment of RE;
- MS are reluctant to giving up their sovereignty and have a strong preference to opt for the least intrusive options as the ones most likely to succeed. As such, a delivery gap resulting from 'deviation' could be dealt with bilaterally between COM and MS, e.g. with soft persuasion with best practice lessons and convincing outreach on the non-negligible net benefits of RES for the MS economies and – if and when feasible - access to EU financial facilities upon de facto putting adequate domestic resources to effective RES deployment use. Only in the event of systemic factors (e.g. EU-wide economic recession) the emergency gap filler mechanism may cover part of the delivery gap. The gap filler should not be a mechanism for MS to renege on fulfilling self-committed promises (in NECPs).
- It is paramount that COM has an adequate degree of control on the operation, monitoring and supervision of the emergency gap-filler mechanism. Hence, as distinct from long-term RES deployment, any instrument that leaves choice and operation basically to each of the MS are presumed to be less suitable for application as a gap filler mechanism.

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[39] Tier 1 ex-ante gap fillers (part of gap filling) would be applied at MS levels with soft encouragement towards regional/EU-wide convergence. Emergency gap filling measures are Tier 2 measures harmonised to the extent possible at least at the regional level.

In addition to the gap filler criteria and considerations mentioned above, important questions that need to be addressed with respect to the gap filler mechanism include:

- Should it include a single instrument or package of instruments? A related question is whether there should be separate instruments for each of the three sectors?
- What is the purpose of benchmarking? Should benchmarks e.g. be used to define RES contribution per MS or region?
- Should the gap filler instrument(s) be geared towards MS that are underperforming, or all MS irrespective of over-/underperformance?
- Should the (emergency) gap filler mechanism build on existing instruments, including EU-wide measures, or consist of new and separate instruments?
- Should the gap filler mechanism be implemented on an EU-wide basis, regionally or be focused on MS that underperform against a pre-set benchmark? If regionally defined, how should the regions be defined?
- Is funding needed for the individual instruments? If so, how should it be sourced?
- What are the key timing and procedural aspects with regard to the gap filler mechanism?
- Should the gap filler mechanism be composed of instrument(s), covering large scale RES installations and decentralised, small-scale systems, or both?
- If MS and/or EU agencies are to contribute to funding, how should this contribution be shared?
- What should the threshold gap be for activating a gap filler mechanism?

These questions will be addressed in the various sections below.

1.2.1.4 Methodology

Existing instruments as well as the long-term EU-wide (no-regret) options covered in chapter 2 are an important starting point for defining the gap filler mechanism. The approach to assess gap filler instruments will include listing the key options and identifying their pros and cons. No detailed modelling is foreseen, assessment will be based on qualitative considerations. However, an excel-based spreadsheet tool has been developed to simulate hypothetical case illustrations yielding approximate projections of total support cost needs, but more importantly possible distributional effects and other relevant impacts of different design elements of a possible gap filler.

1.2.2 Benchmarks

1.2.2.1 Benchmark options

In this sub-section selected general benchmarking methods are set out and assessed in a qualitative fashion. An overview of benchmarking options is given first with our assessment of the options following suit. Additional details on benchmarks are provided in ANNEX A.

1.2.2.1.1 Framing the benchmark options

Given that the EU is now opting for an EU-wide binding RES target for 2030 rather than nationally binding RES targets, in the case of a gap in the interim with respect to the target trajectory it would be necessary to have an approach for identifying what is creating the gap in reaching the 27% RES target at EU level. Ensuring that the EU-wide binding 2030 target is met could be linked to the introduction and implementation of indicative benchmark trajectories. These benchmark trajectories could be determined per Member State and through aggregation by pre-defined regions.

To assist COM, a review is made of selected benchmarking options below. However, the need for benchmarking as such is concisely set out first.

In the governance process, a first major step will be the submission of NECPs per MS, based on a well-designed template by COM. For each MS, the respective NECP should include among others the projected GDP, gross final energy consumption (GFEC), RES volume broken down by sector and main sectoral technologies and the scheduled RES share in GFEC, all for target year 2030. For COM it is essential in guiding the next negotiation steps, in the event that aggregated figures add up to less than the at least 27% RES headline target at EU level, to have an overview at hand of the corresponding figures that would be consistent with preferred benchmarks disaggregated at MS level. This will enable COM to pinpoint where (major) shortfalls in the initial MS NECPs occur and formulate suggestions for improvement. Benchmarking could also play a prominent pre-set transparent role both in triggering and calibration of EU-wide measures to incentivise enhanced RES deployment as from 2021 as well as in the implementation of an emergency gap filling mechanism, if and when needed. We revert to this issue in Sub-section 1.2.3 below.

1.2.2.1.2 Overview of options

Options for allocating the EU *at least 27%* RES target to the MS, based on the projected/assumed 2030 MS levels of inflation-adjusted[40] GDP, population, GFEC and RES potentials have already been investigated under the EU-funded project Towards2030[41]. Zehetner et al (2015) assume that MS will reach their 2020 RES targets[42] and that in the baseline these 2020 RES shares will be maintained to 2030: see options 1-6 below. In the ensuing overview we have added two additional benchmarking options, in which the (Public) Debt-to-GDP (ratio) plays a role. Debt-to-GDP is taken as an indicator[43] of the capacity of the government and energy users to contribute to financing the incremental investments[44]:

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40 It is an issue whether or not to adjust for purchasing power parity as well. To keep it simple, we will assume that GDP projections used by PRIMES do not warrant further PPP adjustments. This assumption might imply somewhat overstated "real" growth of the domestic economies of low income (relative to the EU average GDP p.c.) MS.

41 Zehetner et al. (2015): *The EU 2030 Framework for renewables – effective effort sharing through public benchmarks*. Issue paper No, 4 of IEE Project Towards2030-Dialogue, 5 June 2015, Vienna.

42 Directive 2009/28/EC, Annex I.

43 In fact, this indicator is of a more direct nature than for instance GDP per capita of a nation's capacity to pay for rendering its energy mix more renewable. GDP (per capita) is correlated with (per capita) energy needs and the incremental RE volume (per capita) required to raise the RE share by e.g.7 %. Yet Debt-to-GDP gives a more direct indication of the capital (per capita) the public sector and/or end users are able to raise collectively through mandatory surcharges or voluntary actions to make a 7% RES share increase happen. Voluntary actions relate to voluntary private-sector decisions in favour of direct investment funding or indirect funding through premium payments on green energy products.

44 Note that the incremental operating cost of RE, with the *possible* exception of biomass-based RE, tend to be negative once the typically positive incremental initial investment costs have been made and the RE installations commence commercial operations. In addition, highly indebted MS, which do not meet the Stability Pact criterion of a Debt-to-GDP ratio of 60% or lower, have to pursue retrenchments in public expenditure and to jack up their tax revenue base. These contractionary fiscal policies tend to curtail disposable incomes of the lion's share of the average citizen/household

1. *The allocation method used for the 2020 target.* Each Member State is scheduled to increase its share of renewables by a set percentage points number (3.5%), applicable to all MS, plus a MS-specific percentage points number reflecting its welfare level, indicated by GDP p.c.[45]
2. *Pure flat-rate.* Each Member State is scheduled to increase its share by the same percentage points number, i.e. 7%.
3. *GDP-based.* Each Member State is scheduled to increase its RES production according to its share in the EU-level GDP, such that in year 2030 the EU-level RES share of 27% will be achieved.
4. *GDPpc-weighted*. Applying the MS GDPpc (GDP per capita) index (relative to the EU GDPpc) as weight to a flat rate percentage points number, equal for each MS, such that at EU level a 7% higher share and consequently a 27% share in 2030 will be reached.
5. *Potentials-based.* Using the Green-X model and RES cost assumptions and assumptions about minimum and maximum RES potentials in target year 2030, based on FH-ISI database on Member State potentials in the electricity, heating & cooling, and transport fuels sectors to arrive at a least-cost allocation of the required additional RES production among the MS.
6. *Combination of flat-rate and potentials-based.* Each Member State is scheduled to increase its share by the same percentage points number, i.e. 3.5% plus half the percentage points numbers resulting from the potentials-based method.
7. *Debt-to-GDP-ratio based.* The calculation of the percentage points by which each MS is scheduled to increase its share follows a two staged approach. In the first stage: a Member State with a Debt-to-GDP ratio in the base year:
    - of up to 60% inclusive is allotted a standard weight factor of 1
    - in between 60% and 220% is allotted a weight factor reduction of 0.00625 times the percentage points their Debt-to-GDP ratio exceeds 60%
    - of 220% or more is allotted a weight factor of 0.[46]

    All resulting weight factors are multiplied by 7% to arrive at the scheduled stage 1 increase of the RES share of the MS. In stage 2 the scheduled stage 1 incremental RES shares of each MS are multiplied with a factor m (m>1)[47], such that the (projected) incremental RES share for the EU at large reaches the 7% level, so that the EU will meet its 27% (=20% + 7%) RES target of year 2030.
8. *Combination of flat-rate and Debt-to-GDP-based.* Each Member State is scheduled to increase its share by the same percentage points number, i.e. 3.5% plus half the percentage points numbers resulting from the Debt-to-GDP-based method.

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in the MS concerned, unless very propicious GDP growth rates can be realised. However, warranted fiscal policies tend to exert a negative effect on GDP growth. This applies *a fortiory* to excessively indebted MS with Debt-to-GDP rations exceeding 100%. If most of the sovereign debt is financed by the national private sector (households, financial institutions such as pension funds), this mitigates the negative impact. This relates to didvidend payments and bond redemptions flowing back to the domestic private sector. For example, Japan and Italy have extremely high sovereign debts which are mainly owed to domestic lenders.

45 This is in fact the "modified GDP-based benchmark" allocation method used as the deficiencies of the actually applied 2020 allocation method would be amplified when applying it for 2030 benchmarking: see (Zehetner et al., 2015). Deficiencies relate to the possibility that a relatively high energy intensity (relative to the EU rate concerned) dominates relatively high GDP per capita levels (e.g. Sweden, Finland, Luxembourg) or the opposite i.e. a relatively low energy intensity dominating a relatively low GDP per capita level (e.g. Malta).

46 To date, the Debt-to-GDP ratio of the highest indebted Member State, Greece, is approximately 180%. We have chosen 0.00625 as reduction factor leading to MS classes with respect to Debt-to-GDP ratio of ratio≤60%; 60%<ratio<220%; ratio≥220%. Taking for instance 0.005 as reduction factor leads to the follwing classification: ratio≤60%; 60%<ratio<260%; ratio≥260%. Hence the choice for a certain reduction factor is a choice for the desired differentiation power with respect to capacity to pay: a higher reduction factor (here: 0.00625 as against 0.005) yields higher differentiated results.

47 Parameter m stands for the required multiplier factor of initial MS RES shares so as to arrive at the *at least* 7% incremental EU share, yielding the at least 27% RES headline target.

1.2.2.2 Assessment of benchmarking options

A deviation of a MS RES deployment trajectory could allow for COM to trigger remedial actions at EU or regional level in the case that such a deviation would endanger the EU as a whole in meeting the 2030 binding RES target. A second approach would be to impose (binding) quota obligations on sector players, e.g. electricity suppliers, heating and cooling suppliers, or suppliers of biofuels to end consumers. However, setting quota obligations will not require use of benchmarks.

For reaching political agreement on envisaged normative or indicative breakdown by MS or multi-MS regions and transparent triggers for setting in motion possible gap filling actions a "fair" allowance for the following considerations would seem warranted:

a) Unanimous political agreement that apart from the potential *incremental* costs of investing in RES deployment which need to be duly allowed for, *every MS* is significantly more resilient socio-economically and correspondingly better off when it has materially reduced the dependence of its economy on fossil fuels by 2030[48].

b) The method of choice for the incidence of gap avoiding and, when needed, emergency gap filling measures is readily understandable for EU policy makers and unambiguously based on historical data and/or pre-set projections.

c) Low-income MS facing high macroeconomic challenges have lower capacity to invest in RES deployment than high-income MS with relatively solid macroeconomic framework conditions[49].

d) RES deployment should ensure balance between *RES dispersion* (among regions and MS), *cost efficiency of RES deployment at EU level in both static and dynamic perspective*, and *capacity to pay.*

All considerations a-d are to be factored in the assessment of the 8 benchmarking options, following suit.

Table 1 Pros and cons of different benchmark approaches

Option #	Method	Assessment
1.	*The allocation method used for the 2020 target*	*Pro:* • A proven method • Transparent and comprehensible • Accounts more indirectly for capacity to pay • High RES dispersion *Con:* • Fairly low differentiation of RES shares • Does not initially, contingent on implementation (see next sub-section), allow for cost-efficiency **Note: it is assumed that the adjusted 2020 method**

[48] Socio-economic benefits include: higher competitiveness of the national economy on account of lower carbon intensity; less prone to stranded carbon assets; less prone to geopolitical instability; RE deployment creates higher overall net employment, i.e. employment increase in sunrise RE-linked industries dominates employment reduction in sun-set fossil-linked industries, enhanced public health, etc.

[49] See also footnote 44.

		applies (See footnote 45 above)
2.	*Pure flat-rate*	*Pro:* • Most simple method • Transparent and comprehensible • Very high RES dispersion *Con:* • No allowance for capacity to pay and cost-efficiency
3.	*GDP-based*	*Pro:* • Transparent and comprehensible • Some allowance for capacity to pay *Con:* • No allowance for cost-efficiency
4.	*GDPpc-weighted*	*Pro:* • Transparent and comprehensible • High (indirect) allowance for capacity to pay *Con:* • No allowance for cost-efficiency
5.	*Potentials-based*	*Pro:* • At least in theory, high allowance for cost-efficiency *Con:* • Modelling is less comprehensible for non-experts • Non-transparent (determination of potentials is based on inherently subjective expert opinions with an embodied "adding apples and oranges" problem) • The unavoidable modelling stylization of future cost-efficiency evolution is likely to diverge significantly on an ex post basis from what the complex real-world market forces will deliver • No allowance for capacity to pay nor for dispersion • Technology progress allows for more efficient use of RES technologies even under less optimal potential conditions when compared to former technologies
6.	*Combination of flat-rate and potentials-based*	*Pro and con:* Resembles the points under option 5, but for dispersion. Dispersion is higher under this option. *Note: It is valuable in its own right to compare the outcomes of notably option 6 with those resulting from the other options, notably the seemingly most attractive options, i.e. options 1 and 8.*
7.	*Debt-to-GDP-based*	*Pro:* • Transparent and comprehensible • High (direct) allowance for capacity to pay *Con:* • Poor dispersion (fat high and low tails) • No allowance for cost-efficiency
8.	*Combination of flat-rate and Debt-to-GDP-based*	*Pro:* • Transparent and comprehensible • In policymakers negotiations, alternative reduction factors may be used to find the consensus value • Accounts more directly for capacity to pay • High RES dispersion *Con:* • Contingent on the reduction factor chosen, a fairly low differentiation of RES shares • Does not initially, contingent on implementation (see next sub-section), allow for cost-efficiency

1.2.3 Use of benchmarks

1.2.3.1 Benchmarks and incentives (carrots and sticks)

This section provides a brief overview of the various options to combine benchmarks, pledges and the use of carrots and sticks with respect to incentivising MS to submit sufficiently high pledges (i.e. avoid an EU ambition gap) and live up to their pledges (i.e. avoid a delivery gap).

Figure 15 gives a schematic overview of possible (combination of) options and how they may incentivise with respect to reaching the two defined objectives:

- Objective 1: MS should pledge high enough to ensure that the EU collectively meets its 27% target.
- Objective 2: MS must comply with their pledge/benchmark.

Columns 1-4 and refer to the pledging phase and columns 5-12 to the delivery phase.

The incentives to pledge high enough to meet collectively meet the 27% target and to meet the pledges (or benchmarks) are contingent on several aspects, such as the use of carrots vs sticks, what will happen if MS meet their pledges or fall behind, and whether the national pledges become the benchmark or not.

If we look at the use of carrots and/or sticks in the pledging phase, we can generally draw the following conclusions:

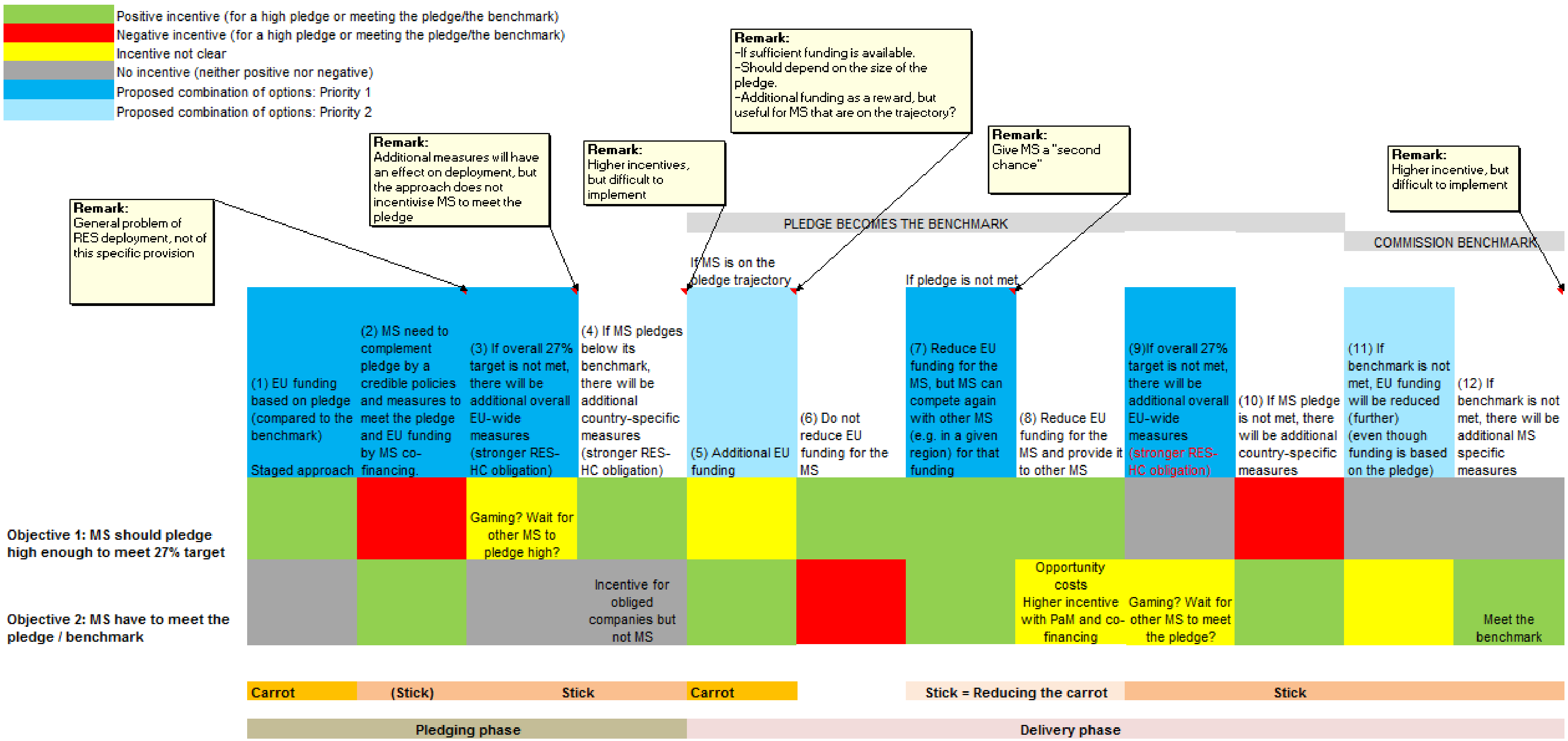
- Direct carrots could be provided, e.g. in the form of EU funds allocated to MS on the basis of pledging against a benchmark (i.e. the higher a MS the pledge against a given benchmark the more EU funds are made available to this MS), whereas sticks, e.g. imposing increased RES HC obligations in MS which pledge below benchmark would act as positive incentives to pledge high.
- If the pledges have to be matched with credible policies and support, this in turn create a negative incentive to pledge (in accordance with a benchmark). However, this is related to the general problem that any required national effort to develop RES may outweigh potential benefits for MS through EU funding. Yet in order to not just incentivise high pledges, but also to increase the chance of high delivery, it is necessary to require credible policies.
- If use of sticks is EU-wide rather than directed towards those MS with low unsatisfactory pledges (against a benchmark), the incentives is no longer clear as strategic behaviour may be triggered, i.e. MS may rely on other MS to contribute to the overall EU-target achievement.

Looking at the delivery phase, the following incentives could be foreseen:

- If the pledge becomes the benchmark, positive incentives to meet the pledge could occur if additional EU funds are made available to those MS staying on their pledge trajectory, but also in a situation where an MS risks losing its EU funding if it falls behind its trajectory. Here the stick would be to potentially loose the carrot, i.e. additional EU funding, that was given to the MS in the first place. A portion of EU budget allocated to RES could be transferred from MS falling behind their trajectory and placed in a (regional) tender. The MS has the opportunity to 'win' it back through commitment to increase RES deployment but may also loose the funds to a MS with more attractive RES deployment proposition. There is a stronger (positive) incentive to stay on the trajectory in this case compared to a situation where the funds are automatically reallocated away from MS falling behind their trajectories to those MS who are on or ahead of their trajectories.

- Similar to the situation in the pledging phase, if an EU-wide instrument (increased RES HC obligation) is triggered in the case that trajectory pledges are being met, the incentives are not clear as one may see strategic behaviour from MS.
- Introducing MS specific measures, e.g. increased RES HC obligation applicable in those MS falling behind their pledge/benchmark trajectory would normally create positive incentives for meeting the pledge/benchmark.

Figure 15: Overview of objectives, combination of options, and impact on incentives in pledging and delivery phases



1.2.3.2 Use benchmarks in a regional approach

When elaborating the possible uses of benchmarking, one should take into account that there are different options for designing and delivering the collective EU target of at least 27% RES target. This section elaborates on how benchmarks could be applied, with particular emphasis on a regional approach. Five different options are discussed briefly in this sub-section. These include:

1. MS agree on a regional approach based on agreed pre-set, non-overlapping multi-country regions, with pre-set binding aggregate regional targets.
2. MS agree on a regional approach based on agreed pre-set, non-overlapping multi-country regions with pre-set regional indicative targets.
3. MS do not adequately agree on a regional approach (option 1 or 2).
4. Intensification of ex-ante measures targeted at mature RES technologies, i.e. RES technologies with a low/medium levelised cost of energy (LCOE).
5. New or stringent intensification of existing, EU-wide renewable quota schemes.

When discussing the options above, a distinction is made for technologies in the RES-E sector:

- category A established/mature RES technologies with, to date, a low/medium levelised cost of energy (LCOE) cost gap, and
- category B emerging, innovative RES technologies with, to date, a high LCOE cost gap to commercial maturity.

For implementation of ex-ante EU-wide measures focusing on group A (mature) RES technologies, it is also assumed that agreement could be sought between MS with strong encouragement by COM on the formation of pre-set non-overlapping multi-MS regions. COM could seek agreement on the adoption of preferably binding or at least indicative regional targets for aggregate deployment of group A technologies. For group B (emerging) RES technologies, COM could encourage ad hoc regional approaches based on horizontal agreements between MS with the pre-set multi-MS groupings as fall-back. For the RES-HC sector and the RES-T sector also EU-wide measures are envisaged as will be explained in Sections 2.2 and 2.3.

Discussion/elaboration on the five options follows below.

Option 1) MS agree on a regional approach based on agreed, pre-set non-overlapping multi-country regions with pre-set binding aggregate regional targets.

This option entails an agreement to be reached among the MS, within each given region, specifying a regional target and stipulating that each MS will ensure its due contribution towards reaching the regional target. To that end, joint RES support auctions will be organised, either based on joint regional RES support schemes or superimposed on (preferably converging) national support schemes.[50] Target

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50 The German government has proposed as one of the options for joint auctions with randomised ex post allocation of awarded bids to the national support schemes of the partner MS of joint auctions. See: André Poschmann, *Cross-Borders Renewables Auction*, PPT presented at EU Sustainable Energy Week, Brussels, 16 June 2016

setting could be done either on the basis of collective NECP intentions with an agreed benchmark to be defined in REDII as default method. In the event a delivery gap emerges in one or more regions, that goes above possible target overshooting in other regions the MS concerned are accountable. This would need to be stipulated in REDII as well. It might be considered to communicate ex-ante in the REDII impact assessment that potential investors in MS planning a lower national contribution to the collective EU target in their final NECP will have less than proportional access to any EU co-funding facilities earmarked for investments in category B technologies. As in the awarding of bids for investments in category A technologies, pure cost-effectiveness criteria will be applied in joint regional tenders. Any EU co-funding facilities to support investment in category A technologies will be distributed by pre-set region, broadly proportional with the aggregated regional 2030 RES benchmarks. This is to foster cost-effectiveness of RES deployment at least at regional level and across the EU. The agreeing MS will also integrate the cooperative approach in the design of their National Programmes under ERDF, etc.

Option 2) MS agree on a regional approach based on agreed, pre-set non-overlapping multi-country regions with pre-set regional indicative targets.

In each region, an agreement among the MS is to be reached specifying the regional target and stipulating that each MS will contribute with best efforts. The determination of pre-set *indicative* regional targets can proceed similar as under option 1. The resulting regional indicative targets are to be specified in the RED II as well, with specification that MS are not legally bound to their achievement but committed to implement appropriate policies. This would be similar to the approach taken in the 2001 RES-E Directive (directive 2001/77/EC), although this directive focused on MS-level *indicative* targets not regional targets.

Option 3) MS do not agree to an adequate extent on a regional approach

This option entails that COM would have to resort to soft persuasion and to the creation of enabling conditions to prod the MS to collectively achieve the at least 27% RES target. To the extent that EU funding can be made available, COM may resort to carrots and sticks as regard allocation of co-financing of investments in category B RES technologies. For realising substantive progress towards the collective EU target, it would seem logical that for category A technologies measures fostering cost-effective RES deployment, at least at the regional level would be envisaged by COM harnessing available low-cost potentials throughout the respective regions. For assessment of MS performance, COM could use its preferred benchmark to be specified in the Impact Assessment accompanying the REDII proposal. The resulting 2030 RES share benchmarks per MS might also be published in this Impact Assessment. As for RES-E, joint regional auctions could be a preferred way to stimulate deployment of category A RES technology. When this turns out to be not politically feasible, then on the basis of requirements e.g. stipulated in the forthcoming, revised state aid guidelines (presumed to enter into force in 2021), national support schemes of the MS may have to open up in a non-discriminatory way, but based on reciprocity, to eligible RES-E installations in other MS. Also MS mutually opening up their respective national support schemes in national RES support auctions need to reach a priori framework cooperation agreements.

Presence of an ex-post interim collective delivery gap

The following could be foreseen in the case of an ex-post interim collective delivery gap: REDII stipulates exactly the conditions under which the emergency gap filler mechanism will be triggered and its timing. The REDII also makes a provision that COM will be entrusted with the overall governance of its implementation in close collaboration with the MS. One or a combination of measures might be taken recourse to. If and when feasible, a combination of RE-specific measures is preferable in order to make the impact of the emergency gap filler mechanism more robust in ensuring achievement of the collective 2030 RES target. Moreover, other climate and energy framework conditions beyond the scope of this report, i.e. a stringent ETS fostering high carbon prices and effective energy efficiency enhancement reflected in significant reduction of final energy demand will be helpful. It stands to reason, that measures will be focused on readily and large-scale deployable category A technologies.

In addition to the three options discussed above, two key emergency gap-filler options are included below.

Option 4 Intensification of ex-ante measures targeted at category A RES technologies

Again, as for RES-E, joint regional auctions are the preferred way to stimulate deployment of category A RES technology. When this turns out to be not politically feasible, then it is recommended that COM introduces conditions for auctioning scheme sin general in REDII. There COM should call for a minimum percentage of opening of auction mechanism to the neighbouring MS. COM should then later COM up with a Q&A or a specific communication on best practices for opening of auctioning mechanisms. Both joint auction schemes and mutually opening up their respective national support schemes in national RES support auctions have to be based on framework agreements between the cooperating MS. Use of benchmarks would not strictly be required in this option.

Option 5 New, or stringency intensification of existing, EU-wide renewable quota schemes

An EU-wide renewable quota scheme could be implemented, however, its implementation will meet a number of challenges, as discussed in sections 2.2 and 2.3. In order to not inhibit short-term increasing RES-E deployment, such a scheme should not replace existing national support schemes but rather co-exist in a mutually reinforcing way. Moreover, an EU-wide RES-E support scheme should allow for interconnectivity constraints. Two alternative, candidate schemes might be considered that would operate along with existing national feed-in support schemes:

- *EU-wide joint auctions*. MS may propose binding limitations in terms of siting and aggregate capacities of installations to possibly be awarded on their jurisdiction, allowing notably for local grid and other constraints, including environmental, zonal planning and public acceptance constraints. Such constraints would have to be compatible with EU competition law. The German and Danish governments have developed a detailed design proposal for joint auctions which might serve as point of departure for further negotiations.[51]

- *An EU-wide hybrid renewable quota scheme*. Such a scheme would present EU-wide certificates-based support as an overlay upon national feed-in premium support schemes. It could be targeted at category A RES-E technologies but might include category B RES-E technologies as well. By modulation of national support scheme levels, net cross-border certificate flows could be influenced with due allowance for interconnectivity and capacities of national transmission grids. Moreover, similar siting constraints as under joint auctions could be implemented, subject to the same EU competition law caveat.

An assessment of, *inter alia*, these alternative schemes is made further down below in this chapter in Section 1.2.4 as well as in Annex B. A provision in REDII would be needed to create the legal possibility of timely preparations and introduction of the chosen EU-wide RES-E scheme as an emergency gap filler measure if and when needed.

A RQS for the RES-HC sector is proposed as an option as an EU-wide ex-ante measure in Section 2.2. A provision in REDII would be needed to create the legal possibility of timely intensification of the variant chosen for implementation as an emergence gap filler measure if and when needed. See Section 1.2.4.5 for further elaboration and assessment.

As for the RES-T sector, in Section 1.2.4.6 an explanation is given that it less suitable to use a possible ex-ante measure towards a renewable quota scheme for transport fuels as a potential measure under the umbrella of an emergency gap filler mechanism.

The functions of indicative REDII benchmarks at MS level would be to provide unofficial indications of the ambition level of possible normative benchmarks at multi-MS regional level and to monitor RES deployment progress at MS level. To start the REDII negotiations in tandem with the governance process, COM might start as the best option to put the most preferred benchmark method on the negotiation table, i.e. to gauge MS opinions on *normative* MS-specific benchmarking leading to normative MS targets which are poised to meet the aspired *at least 27% RES share* at EU level. Given the strong resistance against adoption of national binding targets on the RES share in gross final energy consumption, there will be challenges in reaching political agreement on introducing MS-specific RES share targets, which may be perceived as mandatory, through the backdoor by way of normative MS-specific benchmarking. Moreover, such an approach might be at odds with the transition towards an internal energy market (IEM) as national targets may result in spatial RES deployment patterns at odds with EU-wide cost-effective spatial RES deployment patterns.

On the other hand, the energy infrastructure is still in the process of becoming fully capable to endorse the IEM. Moreover, there are still major, and partly

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[51] BMWi, Pilot Opening Auction for groun-Mounted PV to Bidders from Other EU Member States. Concept Note Berlin, 4 March 2016 and André Poschmann, Cross-Borders Renewables Auction, PPT presented at EU Sustainable Energy Week, Brussels, 16 June 2016.

interregional, divisions between MS as to the sense of urgency to speed up decarbonisation and RES expansion in their respective jurisdictions.

Therefore, COM could consider to strongly encourage the use of an agreed benchmarking method to assist the adoption of a regional approach. More specifically, benchmarking might be used in determining in a transparent way normative – that is either preferentially legally binding or second-best indicative (subject to naming and shaming) – regional core figures for the allocation of regional RES deployment and, if and when needed, gap filler instrumentation. These might be complemented with EU-wide instruments to (partially) address the aforementioned inadequate-delivery event. Consistent with this point of embarkation, the benchmarking method of choice is to be applied at MS level in order to arrive at benchmarks at the level of pre-defined non-overlapping multi-MS regions through aggregation of the calculated MS benchmarks by region. The defined regions should preferably cover the whole of the EU. Regional agreement between participating MS would be necessary to encourage/ensure commitment.

A supplementary consideration on regional RES stimulation approach as distinct from a national approach is that this expands the pool of RES resources from which to draw from for COM-induced cost-efficient RES deployment. To determine the ambition level of (possibly) proposed normative regional benchmarks in horizontal regional negotiations between MS, indicative MS benchmarks might be aggregated to arrive at "unambitious", "reasonable" and "ambitious" levels for a (possible) normative regional benchmark, resulting from an accepted benchmarking method. In the allocation of the suite of EU RES investment finance contributions, COM may reward:

- regions, to which all MS agree to participate in on the basis of a an adequate horizontal agreement between participating MS (with MS retaining their various competences (e.g. spatial planning/site restrictions)[52];
- such regions which a high aggregate 2030 ambition versus the aggregate 2030 benchmark figure and/or with a high interim delivery result versus the aggregate linear target trajectories with bids from project developers of category B generation technologies in all participating MS for dedicated auctions with access to dedicated investment financing facilities, managed by the EIB with COM as principal.

A COM-proposed classification of MS into non-overlapping MS groupings could set in motion negotiations between MS to reach an agreement on the final classification to be specified in REDII. Four alternative scenarios might emerge:

1) all MS agree to become part of non-overlapping multi-MS groupings (preferred outcome),
2) several MS agree to become part of non-overlapping multi-MS groupings,
3) scenario 2 above *without an adequately robust coverage* of the EU by multi-MS groupings
4) no agreement will be reached.

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52 As will be the case with the Danish-German cooperation on pilot auctioning schemes.

The seemingly option of choice is a *normative* regional benchmarking approach, leading preferably to a legally binding, but at least to indicative, a regional 2030 RES target. To that effect, outcome 2 of REDII negotiations on a possible regional approach may still yield adequately robust multi-MS groupings complemented with a rump grouping of MS that do resist to become part of a regional approach. Then there would still be sufficient scope to adopt the regional approach with the non-inclusive countries opting out. A key challenge would be to decide on how to deal with the opt-out countries with respect to access to EU investment funding facilities. Opting-out MS might be denied any access to EU concessionary RES investment funding facilities or face hard access conditions. For example, they might have to accept bilateral supervision on the design and implementation of effective national RES deployment policy with focus on category A technologies. If any such Member States are facing harsh internal financing framework conditions, then they would need to commit earmarking part of revenues from ETS allowances auctions and their share in EU Structural and Cohesion Funding for RES deployment support. This would be disbursed among others to fund their respective national support schemes, to the extent that adequate (100% support expenditure covering) surcharges to final energy users are not feasible.

However, outcome 3 or, even less desirable, outcome 4 might finally result from the negotiation table. This, in turn, would necessitate the third-best default scenario for exercise of the EU mandate by COM of a weaker form of carrots and (legally feasible) sticks. These are to be administered by COM to the MS in seeking to reach the *at least* 27% RES target. This would at the same time necessitate development of indicative MS-level benchmarks. We will elaborate suggestions on the regional benchmarking approach first. Next we set out our suggestions on an indicative MS-level benchmarking approach.

Operationalising a regional normative benchmarking approach

Recent quite diverging and unanticipated evolutions in the MS of population levels, GDP levels, resulting GDP per capita levels, intervening stress levels of public finance and public indebtedness, RES deployment, gross final energy consumption, ex-post utilised RES potentials point at the risk of (over-) reliance on modelling projections for setting future benchmarks. Assuming, with allowance for recent experience gained, a preference for basing benchmark setting primarily on historical data, a possible regional normative benchmarking approach is described in the following steps:

- Step 1 of the normative regional benchmarking approach could be to apply COM's benchmarking method of choice at MS level and aggregate MS benchmark shares times MS projected gross final energy consumption (GFEC) levels in target year 2030 to multi-MS regional level targets. This yields absolute normative year 2030 RES volumes at regional level[53].
- Step 2 is to aggregate respectively provisional year 2030 projections of normative regional RES volumes as well as the projections of regional GFEC

[53] Dividing these volumes by the projected regional GFEC levels concerned (obtained from aggregation of projected MS GFEC levels) yields the provisional normative regional benchmarks. This calculation could be justified given that unequal sizes of MS in the aggregation phase small deviations may arise.

up to EU level. Dividing the first by the second aggregate should yield an EU RES share $s_{p(rovisional)}$ close to 27% (an incremental EU RES share close to 7%). If S_p shows a negative deviation from 27%, the ratio

- $r_{(adjustment)} = s_p/27$

will be used to calculate the adjusted normative year 2030 RES volumes at MS and regional levels. Subsequently, the final indicative MS benchmarks and proposed normative regional benchmarks can be calculated.

- Step 3 encompasses both intra-regional MS negotiations and negotiations between each regional grouping with COM that should result in public agreements between intra-regional partner MS to commit to the respective proposed normative regional benchmarks or a slightly deviating share subject to approval by COM.

A precious asset for shaping and forging the regional approach would consist of the availability of an attractive aggregate amount of EU funding to be sub-divided between two funding windows.

- a window for technology-neutral RES development investment co-financing of category A RES technologies. This window could be envisioned to accommodate EU-wide RES deployment at lowest short-term cost. Inter-technology competition and intra-technology competition both stimulate cost reducing innovations. To account for different cost profiles, periodic sequels of auctions with ascending ceilings for reference price bids might be implemented as currently applied in the Dutch SDE+ scheme.
- a window for co-financing investments in RD&D and deployment of emerging but to date still high-cost category B RES technologies.

If a complete regionalised approach is opted for in achieving the 2030 RES target, regional allocations from each of these two windows to be used by EIB representative regional offices on behalf of COM, are earmarked in principle for funding of RES projects, subject to the level of pledges to signing up to regional approach by the MS concerned. Allocations from *the first window* could be used for staged cycles of technology-neutral auctions with ascending production premium ceilings for each successive auction in a certain auction cycle with pre-set funding limits per auction, e.g. similar to the Dutch approach. The EIB representative offices are mandated to advise the MS concerned, in close liaison with COM, how to improve their investment climate in competition with other intra-regional MS to boost RES investments by project developers within their respective jurisdictions.

It might be considered to introduce a consultative apex unit to the EIB agencies consisting of MS expert representatives. This may enrich the knowledge of EIB staff of local conditions, smoothen the communication with the MS concerned and given the MS concerned a direct channel to foster due allowance for MS concerns in the operations of the EIB representative offices. Moreover, this might facilitate full regionalisation of RES support policy post 2030.

COM, in close collaboration with the EIB, could ensure that RES project developers also bid into dedicated auctions of relatively small size in territories encompassed by MS resisting a regional approach, i.e. in MS that consent with such dedicated auctions. An alternative would be the option to grant each MS of this group access the nearest regional auction for willing MS. MS that will be resistant to any form of cross-MS cooperation altogether might be denied access to any EIB gap filling finance.

As explained above, an alternative or supplementary approach would be to implement EU-wide measures such as imposing EU-wide (binding) quota obligations on sector players, e.g. utilities supplying electricity, heating and cooling suppliers. In fact, setting quota obligations will not require use of benchmarks. Using (binding) quota obligations, on heating and cooling suppliers to end consumers, as gap filler instruments is discussed further in sub-section 1.2.4.5.

Evidently, *the second window* needs a fair degree of flexibility to allow for cost-effective technology specific tenders which might be partly cross-regional in order to enable a wider dispersion of innovative emerging RES technology among MS with low-cost resource potentials and/or MS that wish to make co-financing contributions to realise their respective industrial development agendas. Hence, alternatively EU-wide technology trajectory benchmarks would disentangle funding through the second window into technology-based renewable energy technology RD&D and pre-commercial deployment with associated technology-based targets.

Operationalising the last-resort carrots-and-sticks approach based on merely MS-level indicative benchmarking

The procedure for determining indicative MS RES share benchmarks has already been set out above. In the event that insufficient political support can be garnered in favour of one of the regional approaches (Option 1 or 2) as explained in the beginning of this section, two possible EIB RES investment finance windows might be used as carrots to stimulate RES financing in MS that are on track to achieve their respective indicative benchmarks as well as their level of pledging. COM might still opt in a less strict way for regionalised tenders to promote dispersion of RES deployment across the EU. MS that are significantly, say at least 20%, below their respective trajectories to meet their indicative benchmarks may be subject to MS-specific ceilings of EIB funding for RES projects in their respective jurisdictions. It is difficult to mitigate "freeriding" MS. But at least a minimum norm would reduce the freeriding space. Alternatively, one could opt for more of a staged approach, i.e. the more you stay below the trajectory, the more funding will be reduced.

1.2.4 Addressing options for an EU 'gap filler' mechanism

1.2.4.1 Introduction

This section describes possible gap-filler instruments covering the RES-E, RES-H/C and RES-T sectors. These largely build on already existing instruments as well as proposed gap avoider instruments, see chapter 2. This section also discusses the possible scope for cross-cutting gap filling instruments.

Three gap-filler options are assessed for further consideration:

I. Auctioning scheme with Feed-in Premium (FiP) or investment subsidy.

II. A certificates-based uniform Renewable Quota Scheme (RQS)[54].

III. Financial instrumentation, e.g. debt guarantees offered by the EIB.

These three instruments are well understood. The focus will, therefore, not be on describing these instrument in detail but rather addressing whether or not they could be applied as sensible gap filler instruments.

Their main advantages and drawbacks are presented below, with an additional assessment of detailed design features presented in ANNEX B.

1.2.4.2 Auctioning + support payment

An auctioning scheme coupled with a support payment, e.g. (FiP), is a well understood instrument for supporting RE, particularly for RES-E. An important question concerning an auctioning scheme is whether a FiP is better suited as a gap filler instrument than an auctioning scheme with an investment subsidy.

The following considerations might be taken into allowance in the choice of auctioning with/FiP vs auctioning w/investment subsidy:

- The advantage of investment support is that apart from the technology composition of the installed RES-E capacity, the merit order is not affected by public interventions. Investment subsidies involve less distortion to the market and possibly less. Additionally, with a FiP commitment the public sector takes on a long term commitment, i.e. +/- 15 years. This is not very popular; especially when technologies become much cheaper.
- Drawbacks of investment subsidies include:
  - Prone to fraud with name plate capacity
  - Biomass (solid/liquid/gaseous)-based technology tends to have low CAPEX needs but to be relatively expense-intensive
  - A focus on investment support will reduce the certainty to achieve set RES targets unless large overshoot risks are taken with commensurate risks of surging support budgets. This applies to a much lesser degree for production (FiP) support.
- Distortive effects of premium subsidies can be reduced by a suite of market integration conditions such as balancing responsibility, a (partial) repeal of priority access, and reduction (absence) of the right to premium at power trading periods with low (zero/negative) average power prices.

Auctioning w/FiP or w/investment subsidy could in principle be applied to all technologies, however, one has to take into account support measures already in place in MS. This brings us to the more fundamental question: Is an EU-wide/regional auctioning scheme a sensible “gap-filler” instrument?

Two arguments related to this question include:

- First of all, experience from MS show that designing such an instrument is administratively challenging. Additional challenges in designing an EU-

[54] Sometimes also abbreviated as QO and RQS.

wide/regional scheme are the different markets and maturity of technologies in the different MS.

- Secondly, an 'additional' EU-wide/regional system may risk interfering with the functioning and the success of this instrument at national level.

Additional pros and cons are summarised in the table below.

Table 2 Pros/cons of an auctioning + FiP as a gap filler instrument

Pros	Cons
▪ High effectiveness under competitive conditions. ▪ Higher regional dispersal possible through application of resource availability adjustment factors to strike price bids. ▪ More flexibility to speed up initial technological learning of high cost emerging technology through technology-specific auctions. ▪ Relatively higher investor certainty. ▪ Most widely applied (to production rather than investment support) and therefore the option of choice, should horizontal intra-regional negotiations not lead to unanimity on option choice. ▪ Flexibility to open separate window for small-scale technology and local community RES projects**.**	▪ Designing an auctioning scheme is administratively challenging. ▪ Possible negative effects on national auctioning/FiP schemes, i.e. gaming. ▪ Fair extent of certainty but less than 100% under competitiveness. ▪ Less static efficiency resulting from design features which lead to less static-optimal technology mix (e.g. strike price locational adjustment factors; technology-specific auctions; less socially-optimal bidding strategies) and less optimal project siting ▪ May only work for electricity, less suitable for renewable fuels nor RES-HC. ▪ Depending on the methodology for calculating funding contribution as well as the geographical scope of auctioning, the EC could be accused of bringing back "national targets through the backdoor". ▪ An important challenge would be related to how to distribute contributions to fund the mechanism. However, The randomisation option in the German proposal mitigates this challenge ▪ Care would have to be taken with regard to design features to avoid free riding and avoid penalising best performers.

Design considerations are briefly presented in Table 3 below.

Table 3 Design considerations for auctioning + support payment as gap filler instrument

Possible design considerations
a. Can be implemented on a region-by-region basis. A regionalized approach with EU topping-up funding will (also) make consideration for disparities between regions as regards (i) capacity to pay for RE(S-E) deployment stimulation, (ii) the willingness of participating MS to jointly pledge meaningful volumes of RE(S-E) production (TWh) or production capacity (MW) and (iii) renewable energy resources. **b. When intra-regional interconnectivity between participating MS is adequate, one regional benchmark reference electricity price might be desirable. For regions with poor interconnectivity between participating MS, national benchmark electricity prices might be opted for. In the event of an EU-wide scheme (upon adequate EU-wide interconnectivity), an EU-wide electricity benchmark price made be considered, such as the EPEX Phelix Day Ahead price.**

c. **Harmonized FiP design with moderate region-wide adjustment factors for support levels based on average natural resource availability (e.g. for onshore wind and solar PV) in a trade-off between achieving a fair extent of deployment dispersion all over the regions and cost-effectiveness of intra-regional deployment patterns.** [55]

d. **Given lessons learnt with the volatility and poorly anticipated direction of electricity market prices, resulting in either over-compensation or under-performance regarding RE(S-E) deployment in fixed premium schemes, floating premium FiP schemes should be assumed. Given the impact on project WACCs in upward direction because of more investor uncertainty, no premium ceiling nor negative premia could be assumed.**

e. **Longer price reference periods (≥ 1 month) may stimulate the provision of system services and hence network system flexibility, contingent on progress regarding enhanced electricity market design**

f. **Small-scale projects and civil-society community projects might be included under a special window, granting specific preferential treatment to such projects[56]. However, revolving funds might be a preferred option for small-scale and civil society community projects.**

g. **To reduce project development costs, the RE(S-E) support operating agent could undertake generic project preparatory investigations and introduce one-stop qualification and permitting shops.**

1.2.4.3 Renewable Quota obligation (RQO)

An RQO scheme entails a legal obligation mandated on the demand-side (e.g. energy suppliers/large-scale electricity consumers) to supply a certain % of their energy supplies/consumption to be based on RE. RES producers are awarded tradeable certificates for each unit of RES produced. A penalty is usually defined for non-compliance. An RQO scheme is being considered as an ex-ante EU-wide mechanism for RES-HC (see chapter 2.2) and RES-T (see chapter 2.3), to be introduced in the REDII proposal.

It would seem appropriate to consider interactions of an RQO with existing national support schemes. When the existing (main) national support scheme is an RQO this national support scheme would be fully superseded by the EU-wide or region-wide RQO. However, when the (main) national support scheme is a FiP scheme or a mixed FiP/tendering scheme such as e.g. in the Netherlands, there are two options:

1. The EU-wide or region-wide RQO fully supersedes the national support scheme concerned;

2. The EU-wide or region-wide RQO is superimposed on the national support scheme concerned as an extra support layer. When for a certain supported RES-E technology the reference cost would be larger than the sum of the average benchmark power price and the average RQO certificate price (all on a per MWh basis) is positive, then the resulting positive amount would be the ex post premium level. When the latter amount would be negative, no premium will be granted during the reference period concerned.

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[55] See (BMWi, 2016: 6, Standortqualität figure) for an example of location adjustment factors for onshore wind integrating both considerations (locational resource base and cost-effectiveness). Moreover, locational network cost considerations would ideally need to be allowed for by time-contingent locational use-of-system charges. On the latter aspect, quite some regulatory reform enabled by warranted IT advances are still in the offing.

[56] See BMWi document referred to in the previous footnote.

Notably if an EU-wide RQO scheme were to be implemented, option 2, which encompasses hybrid support from the RQO and the national support scheme concerned, would seem to be the option of choice:

- National feed-in support schemes remain in place, only premium (or tariff) support levels would go down
- Relatively expensive emerging technologies can still be promoted through the national support scheme
- All supported technologies are competing with each other, where the national support schemes concerned would in theory level the playing field in terms of unit cost, net of support from the RQO and the national support scheme concerned.
- Market outcomes reveal for technologies supported supplementary by the national support scheme concerned which national support levels can be reduced (i.e. when the technology concerned saw a strong recent rise in market share) and which other national support levels might be considered as to whether these would deserve to be revised upward (when the technology concerned had a poor recent market performance, whilst expert judgment suggest the technology to be "promising").

Introducing an EU-wide RQO scheme following option 1 as an emergency gap filler measure could backfire in terms of actual impact on RES-E deployment. The discontinuation of national support schemes could render the RES-E investment market in disarray.

Currently, RQO schemes are not widely used among MS to promote RES-E[57] nor RES-HC, however, widely used for RES-T.

Table 4 Pros/cons of an RQO scheme as a gap filler instrument

Pros	Cons
▪ Theoretically, a strict target compliance enforcement, including high penalties for non-compliance, could render a further strengthening of the obligation unnecessary. ▪ Theoretically, a strengthening of the RQO could provide a basis for filling a gap with a high degree of certainty. ▪ Public funding would not be needed as funding would be provided through surcharges on the energy/electricity bills to final consumers.	▪ Would provide less investor certainty compared to auctioning w/FiP, however, RQO beneficiaries could mitigate cash flow risks through long term PPA for combined sale of power and RQO certificates. ▪ Less suitable as a gap filler instrument geared to the RES-E sector, given the dominance of (auctioning +) FiP in this sector and the administrative complexities of combining an RQO and (auctioning +) FiP scheme. ▪ Would create a combination of national (auctioning +) FiP scheme and RQO in many MS, which could create extra administrative costs.

57 In recent years MS have replaced QO schemes primarily with (auctioning +) FiP.

1.2.4.4 Financial instruments

To what extent certain financial instruments could be implemented as 'gap filler' instruments is actually the result of conditions applied. Lower interests, additional risk acceptance and/or a larger share of subsidies (compared to loans/equity) delivers stronger incentives for project development, compared to instruments that act on a level similar to that of regular private financing. A flexible fund would be able to 'push the buttons', depending on the market conditions within the EU but also within a certain region/MS, in particular debt financing guarantees, debt co-financing for high-WACC MS with a poor capital market limited equity is important.

A list of gap filler measures can include financial instruments that are already existing today, such as loans, guarantees, and equity under attractive conditions, either directly from the EIB or through national intermediaries.

EIB has a leading role to mobilise finance for the transaction to a low carbon and climate resilient economy by "lending, blending and advising" in the EU. However, in the funding practice the world looks very different. Typically RES projects face bottlenecks that do not match with EIB conditions that in the end can be very similar as those of private banks. Typically the administrative burden of innovation subsidies is far from efficient related to the size of projects. Rather than constructing a proper business case, initiatives focus on conditions and procedures in lengthy subsidy procedures. Combined with the availability of EU/EIB funds this combination is effective to lower the costs of capital.

Table 5 Pros/cons of a 'boosted' financial instrumentation as a gap filler

Pros	Cons
▪ No distortion of electricity markets. ▪ Compatible with national/regional support schemes. ▪ Flexible design (eligible technologies and level of support can easily be changed).	▪ This instrument would not automatically guarantee that the 27% will be met. ▪ Council and EP will potentially request a guarantee fee reflecting different country risk, where Chances that guarantees will be exercised are larger in high-risk countries. ▪ Such an investment help could take too long to become effective short-term if missing of deadline becomes apparent.

1.2.4.5 Applying an RQO in the RES-HC sector as a gap filler

As discussed in chapter 2.2, national RES-HC obligations could in principle be designed as a self-standing EU level measure included in the REDII from the outset (2020). Two key options are being considered in this respect are:

- Option 1: Member States would be required to ensure that their fuel and energy suppliers for heating and cooling are obliged each year from 2021 to 2030, to add an additional share of at least 1% of renewable energy in the total volume of fuel and energy sold to end-consumers for heating and cooling. A tradable certificate scheme would stimulate an EU-wide cost-effective implementation of the obligation.

- Option 2: An EU-wide renewables heat and cooling obligation, requiring Member State fuel and energy suppliers for heating and cooling to achieve an equal level of at least 27% of renewables in the share of heating and cooling supplied to their final customers in 2030.

It is technically possible to reinforce options 1 and 2 mentioned above as a gap filler instrument.

Using national RES-HC obligations as potential gap filler would require some considerations concerning the system design and minimum requirements that would have to be integrated in the forthcoming REDII. It is foreseen that a minimum set of design requirements would be set in the REDII, whilst leaving a number of specific choices, such as exemption rules for small scale operators, to the MS in their actual implementation. Therefore, it should be noted that the assessment in this section of an increase in the obligation as a gap filler instrument is done without knowing the final design details of the 'self-standing long term' obligation instrument.

Furthermore, the question remains open as to how energy suppliers could comply with these obligations. Options include:

1) physical integration of renewables in their fuel mix sold to customers (fulfilment by supplying RES fuels),

2) through own mitigation measures (being part of company's own business portfolio) such as highly efficient RES technology installation in buildings and or for industrial processes (fulfilment by RES-C technology implementation), or

3) through tradable certificates proving compliance with the quota obligation through support to indirect mitigation measures (carried out by another economic operator such as independent RES technology installer or ESCO providing RES installation services).

1.2.4.5.1 Target setting and distribution among MS

As mentioned already, the RES-HC obligation could be a self-standing EU level measure included in the REDII from the outset. Target setting by the EU would be inevitable if the instrument was intended to be activated as a gap filler.

It needs to be decided how a potential reinforcement is distributed among MS. Options include, for instance,

- an even reinforcement of the effort level for all MS (e.g. reinforcing the level of RES-HC share to be reached by each obliged supplier by 2030 from 27% to 30%) or
- a reinforcement that only applies to MS where suppliers are not fulfilling their obligations (thus potentially creating a delivery gap).

Regarding the second option, it would be necessary to decide a-priori on how to deal with suppliers that go for buy-out instead of quota fulfilment through RE. A buy-out strategy by suppliers would mean that this instrument would not work as a gap filler. At the outset, an even reinforcement across all MS would seem unfair to those MS with 'satisfactory' pledges, i.e. pledge in accordance with a given benchmark or higher. On the other hand, imposing reinforcements on suppliers only in those MS with 'unsatisfactory' pledges, i.e. pledges below a given benchmark, would create an uneven playing field among suppliers across the EU

MS. Differences in obligations would constitute a non-level playing field for suppliers. In a worst case scenario, if the differences in obligations are large enough, suppliers might have an incentive to relocate their businesses to neighbouring countries with lower obligations.

In addition, even reinforcement could encourage unwanted strategic behaviour, which should be avoided. For example, if a MS knows in advance that it will be faced with a 'stick', i.e. an increase in its RES-HC obligation, in the event that other MS under pledge and create a gap in reaching the EU-wide 27% target, this MS may then decide to under pledge as well (prisoners dilemma).

Concerning the use of 'boosted' obligations to address a delivery gap, the same arguments presented above would apply with respect to an even reinforcement across all 28 MS vs. reinforcement only in those MS where a so-called delivery gap occurs.

1.2.4.5.2 Timing

The timing aspect is of importance when assessing how an initial RES-HC obligation could be boosted to act as a gap filler. Activating the obligation as a gap filler could be applied either at the start of the period, if MS pledges do not add up to 27%, and/or it could be implemented following COM's mid-term assessment around 2025 revealing a delivery gap. Activating an obligation "boost" at the start of the period would allow obligated suppliers to factor in measures they need to take in order to fulfil their obligations over the period to 2030. Reinforcing these measures at the outset is easier than later in the period.

Increasing the obligation significantly within a rather short time period would mean that it would be necessary to deliver a substantial additional RES-HC volume to the heating and cooling market on a rather short term. The main contributors to RES-HC are biomass, deep geothermal, heat-pumps and solar thermal. Usually small biomass boilers, heat pumps and solar collectors are installed when constructing a new building or at the end of the technical lifetime of an existing heating system. In many MS, natural restrictions exist due to the low new building rate as well as the limited replacement rates of existing heating systems. If a (certain) gap was to be filled by small scale installations that would mean to realize a substantial number of small scale projects on a rather short term. For example, in order to deliver 1 Mtoe RES-H from solar thermal about 3 million roof-top collectors à 10 square meters collector area would be necessary.

Another option to boost the RES-HC share would come from increasing the renewable share in DHC systems. This mainly applies to biomass, geothermal, large heat pumps and large solar collector fields. For these large scale installations restrictions and delays frequently occur due to lengthy planning and permitting processes.

To conclude, while RES-HC use obligations in theory might be appropriate to act as gap-filler in practice restrictions exist for small as well as large scale RES-HC installations regarding the question how fast substantial additional deployment can be realized. The RES-HC sector therefore lends itself more to a gap filler that is activated at an early stage. Another argument for activating a RES-HC obligation as gap filler at an early stage is that obligated suppliers will have the opportunity to plan in necessary measures to ensure that they can fulfill the obligation, despite if it is a 2030 obligation or a progressively increasing obligation over the 2021-2030 time period. If the obligation is boosted following a mid-term review, say in

2025, obliged suppliers will have to reinforce measures. This would be in conflict with the aiming of providing a high level of planning security.

From a technical perspective the least problematic option to deliver additional RES-H in a short term would be biomass co-firing in existing fossil fueled (often inefficient) installations. While this might be an acceptable option for an interim period reliance on biomass only might be in conflict with cost optimal resource allocation in the mid- to long-term (see below). The efficient use of biomass could be ensured by linking biomass eligibility to minimum efficiency standards.

Moreover it should be considered that if the gap cannot be filled by additional RES-HC on short notice this would result in a sharp increases of the certificate price. Implementing price caps (as some form of cost control mechanism) would be in conflict with the instrument's ability of achieving the target.

1.2.4.5.3 Dynamic efficiency

Depending on the specific state of market development different RES-HC technologies differ in their specific production costs. In order to allow all technologies to contribute to the obligation (not only the least cost options such as biomass co-firing or heat pumps, see below) it could be considered to set technology specific sub-targets (e.g. specific targets for biomass, heat pumps, solar thermal, geothermal). Regarding the role as potential "gap-filler" technology specific sub-targets could be adapted as to ensure that the obligation delivers the desired RES-HC volumes to fill the gap. Another option would be the introduction of weighing/banding factors. Weighing factors or banding would intend to balance cost differences between different eligible technologies or energy sources depending upon their relative maturity, development cost and associated risk. Weighing factors could be set by the EU (harmonized approach) or it could be left to the MS to decide whether such banding should be introduced on a national level. In any case, weighing factors might hamper achieving a defined target precisely as 1 kWh of RES-HC would be accounted for differently depending on the weighing factor applied for the respective technology the kWh is coming from.

1.2.4.5.4 Additional considerations

There are a couple of other design elements that need to be assessed when designing a RES-HC obligation. Although these elements do not specifically address the potential gap-filler role of the instrument they are still relevant when the obligation will be reinforced at a certain stage:

- It needs to be thoroughly assessed whether RES-E that is used for heating and /or cooling purposes should be eligible to contribute to the obligation. Apparently in many MS the role of electricity in the heating and cooling market will increase in the long-term due to resource and technology restrictions for the "classical" RES-H/C technologies. Using RES-E in the heating and cooling market might also help to integrate intermittent RES-E generation in the energy system. However, converting electricity to heat can vary in efficiency depending on the temperature output and technology applied (e.g. electricity to operate a heat pump vs. direct electrical heating). It should be considered whether RES-E that is used for heating/cooling purposes should be eligible under the quota in any case or be restricted to specific efficiency requirements.

- In addition in countries that have adopted sector specific targets for RES-E and RES-HC (e.g. Germany) there is a risk that renewable electricity that is consumed for covering heating or cooling demand (e.g. PV production operating a heat pump, RES-E grid delivery for running a compression cooling device) would be accounted for twice, against the RES-E and the RES-HC target. Clear rules need to be defined to avoid double counting and at the same time to achieve the overall target covering all sectors. In addition the relationship to existing support instruments for RES-E needs to be sorted out (e.g. how to deal with RES-E generation that receives production support while it is used in the heating market contributing to the RES-HC obligation).
- In 2014 biomass was by far the largest contributor for RES-HC production in the EU (roughly 85% including solid, liquid and gaseous biomass, excluding the renewable fraction of waste; Eurostat 2016a). Biomass is a rather common energy source for space heating in rural areas (where local biomass is available). Moreover in many Member States biomass heating is much cheaper than most other heating technologies (e.g. solar thermal). Implementing a RES-HC obligation without technology specific requirements might mainly be fulfilled by an increased use of biomass. This might enhance the implications on other sectors (RES-T and RES-E) as the sector allocation of limited biomass resources might be shifted towards RES-HC.
- Usually obligation schemes are facilitated with a scheme of tradable certificates. Regarding a EU wide RES-HC obligation pros and cons of the introduction of a EU wide certificate trade need to be thoroughly analysed:
  - Pros:
    - Highest static efficiency as RES-HC potentials could be exploited EU wide; as a result RES-HC potentials could in principle be exploited at lowest costs
    - Higher market liquidity than for national (not connected) certificate schemes
    - Regarding implementation costs higher cost efficiency as only one certificate scheme needs to be put in place
  - Cons
    - Fair balance between regional allocation of costs and benefits not ensured
    - Interaction with GoO and other certificates for RES (e.g. RES-E) needs to be clarified
- The relationship to Art 7 EED needs to be clarified. Some MS have implemented energy efficiency obligation schemes that allow RES-HC measures to contribute to the energy savings targets (e.g. in Italy the installation of a solar collector). Particular attention should be paid to the risk of double counting, as the evaluation of Art. 7 EED highlights (Ricardo AEA et al. 2015).

1.2.4.6 Applying a RQO in the RES T sector as a gap filler instrument

Similar to a RES-HC obligation to promote use of renewable energy in the heating and cooling sector, this option has been considered as a long term measure to promote advanced renewable fuels in the transport sector. A quota obligation could in principle also be used as gap filler if and when there is a gap to achieve the 27% RES target.

1.2.4.6.1 Considerations

- Assuming that an EU-wide quota scheme would be implemented as a EU-wide/no-regret option for RES-T, increasing the level of a quota obligation could in principle be implemented in case there is an ambition gap.
- However, setting an obligation level for the advanced biofuels (particularly for cellulosic biofuels) is already foreseen to be difficult. Increasing this level adds to this difficulty.
- Currently, production of renewable advanced biofuels is very limited[58]. An advanced renewable fuel obligation is not likely to result in significant quantities of energy production and consumption as many of the innovative technologies are either in the R&D or demonstration stage[59].
- It should also be noted that the level of RES in the transport sector has always been slow and lacking behind the set targets. In 2014 the level of RES in transport sector was projected to be 5.7%, meaning that there is still a long way to reach the overall 10% target in 2020. The total amount of biofuels in 2013 was around 13 Mtoe (Eurostat).
- In the US the renewable fuel standards (RFS) has been mandating the volume of biofuels that must be blended into transportation fuels each year. Cellulosic bioethanol mandates have been revised downward in each year and the cellulosic biofuel has widely missed its original targets. This had to do slower than expected commercialization of the industry[60].
- In this respect, a gap filler mechanism in the form of boosting the level of quota in transport sector is very risky. Instead, it might be preferred to be kept as a long term measure in which the quota level for advanced biofuels are set low at the start and gradually increased up to 2030.
- The cost efficiency of a gap filler on advanced biofuels would be a rather low. The costs and benefits need to be compared with the other gap filler options
  - for instance a 2% target for advanced biofuels in transport sector will require around 5.7 Mtoe in 2030, which is roughly less than 0.4% of total energy demand.[61]
- A quota obligation will need to be supported through a high level of recourse to financial instruments for investment risk reduction and confidence building in early stages of commercialization.
- Conventional (food crop-based biofuels) is not included in the assessment of applying a RQO in the RES T sector as a gap filler instrument due to the sustainability discussions around these.

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58 90% of the consumed advanced biofuels in Europe has been based on biodiesel produced from animal fat and UCO.

59 Second generation ethanol is in early commercialization stage and even if all the existing demo plants become successful and the production costs decrease there is the issue of the EU market's dependence on diesel not gasoline.

60 The American Petroleum institute (API) has been filling lawsuits against the EPA criticizing the cellulosic biofuels mandates as unattainable.

61 The transport sector may account for (not more than) 20% of the total final energy demand

In case there is no EU-wide mechanism for RES-T and the commitments from the MS result in very low level for advanced biofuels a gap filler option for this sector can be considered supported with high level of financial support.

1.2.4.7 RES-E: Small scale vs. large scale

One question for the RES-E gap filler mechanism is whether it should comprise instrument(s) covering large scale RES installations or decentralised, small-scale systems, or both? The following arguments look at this mainly from the perspective of small-scale plants, but the general conclusion is that neither large-scale nor small-scale plants should be excluded from gap-filler mechanisms, but the full potential should be used. At the same time, specific provisions that promote additional objectives like actor diversity become less relevant in the case of a gap-filler instrument, where the focus is on efficient short-term deployment for a – small – part of overall RES deployment.

1.2.4.7.1 Small-scale plants can contribute to efficient gap-filling

The deployment of small-scale RES installations can be based on two objectives: First, some small-scale plants as such can make a contribution to an efficient RES deployment. Second, small-scale plants can also contribute beyond the mere perspective of economic efficiency, e.g. to increase the acceptance of RES deployment, promote regional deployment or to broaden actor diversity. It is important to keep these objectives in mind when designing RES instruments, not the least because they can eventually also facilitate RES deployment.

If Member State pledges do not add up to the 27 % target, any European instrument that is put in place should take into account the role of small-scale plants.

If there is a delivery gap, an efficient deployment of RES in a short timeframe becomes more important, while other objectives such as the ones mentioned above become relatively less important as far as filling the gap is concerned. The question is what this implies for small-scale plants.

First, small-scale plants can play an important role in this context. While in the case of large-scale plants, only a relatively small number of plants may be needed to fill the gap, promoting a larger number of smaller plants can reduce the risk that the failure or delay of some projects puts the gap filler mechanism at risk. More importantly, if plants are to be developed in a short timeframe to fill the gap, small-scale plants can have an advantage, as their planning and permitting time is usually shorter – even more so if faster and simplified permitting procedures for small-scale plants are put in place.

Second, in terms of auction schemes as a RES-E gap filler, there is a general discussion to exclude small-scale plants from auction schemes in order to promote small-scale plants and /or small-scale actors. Generally, there can be two approaches: First, small-scale plants can be exempted entirely from the requirement to participate in auctions, and are rather covered under a separate support scheme, like an administratively defined market premium scheme. Second, small-scale plants need to participate in the auction, but are subject to favorable conditions. In both cases the objective is to reduce the risk and associated costs for small-scale plants that result from auctions.

In the case of the gap filler, if small-scale plants are excluded upfront without any alternative support scheme, this does not help small-scale plants, but rather excludes them from an additional support mechanism without providing an alternative. Nor is it useful from a gap-filler perspective, as some plants that could be used to fill the gap are not allowed to participate. If there is a gap filler auction, all plants should be able to participate and small-scale plants should not be excluded ex-ante. Whether or not they can compete to fill the gap should then be decided within the auction. It would indeed be strange to have exemptions for small-scale plants in "normal" auctions and then exclude them entirely from gap filler auctions.

1.2.4.7.2 Exemption rules for small-scale plants should not delay overall deployment

A second question is whether small-scale plants should be subject to specific rules under the auction scheme. This is a useful approach for standard auctions. The approach can be useful in a gap-filler auction as well – but here, additional conditions apply. During a gap-filler auction, the main objective is to enable short-term efficient deployment, and the promotion of specific types of plants or actors becomes less important. Certain exemptions for small-scale plants may delay overall deployment, especially if the exemption rules specify that small-scale plants have more time available to realise successful bids (for example four years instead of two years in the German draft auction scheme). These types of exemptions should not be used in a gap-filler auction.

1.2.4.8 Scoping the gap filler mechanism

To date, the implementation of support measures to promote RES in the three sectors are distinctively different. This is largely due to the very different nature and characteristics of the three sectors. Whilst for example the electricity sector is a homogeneous sector with transportation via national grid as well as interconnections across EU MS, the heating and cooling sector is characterised as a rather heterogeneous sector with numerous uses, transportation and storage options. Furthermore, the generation and distribution of biofuels in the transport sector is distinctively different from that of RES-E and RES-HC. To date, the most commonly used support instrument for RES-E are FiT and FiP, in some cases coupled with tendering schemes. For biofuels, a quota obligation is commonly used (with tax benefits), whilst in the RES-HC sector no such common support perspective seems to occur at present. Ad hoc subsidies to individual technologies tend to be applied most in the RES-HC sector.

Given the different approaches to support policies for RES-E, RES-T and RES-HC, a single gap filler instrument covering one sector only is likely easier to design & implement than if it covers two or more sectors, and would enable separate policy instruments to be used that are most suited to the characteristics of the electricity and fuels markets. In addition, it would enhance the robustness of the gap filler mechanism. Whilst a sector neutral gap-filler mechanism would enable higher cost-efficiency, a clear disadvantage is that it would entail greater design and administrative complexity compared to a single sector approach. It would also entail more difficulties to agree on benchmark in the absence of sectoral sub-targets in the legislation. In addition, a gap filler instrument geared to increase the share of RES-T is not expected to have any effect anyway (see 1.2.4.5). Finally, a cost-efficiency would be contingent on accurate modelling results with respect to cost-supply of RES technologies in the 2020 – 2030 timeframe. Table 6 summarises pros and cons of a single sector vs. multiple sector gap filler mechanism.

Table 6 Pros and cons of a single sector vs. multiple sector gap filler mechanism

	Pros	Cons
RES-E only	• A single gap-filler instrument covering one sector only is likely easier to design & implement than if it covers two or more sectors	• Would not support potentially more cost-efficient contributions from RES-H/C and/or RES-T sector(s)
RES H/C only	• A single gap-filler instrument covering one sector only is likely easier to design & implement than if it covers two or more sectors	• Would not support potentially more cost-efficient contributions from e.g. RES-E sector
RES T only	• A single gap-filler instrument covering one sector only is likely easier to design & implement than if it covers two or more sectors	• Would not support potentially more cost-efficient contributions from RES-H/C and/or RES-E sector(s)
All RES, separate instruments for electricity and fuels	• Enables the contribution of various RES to the 27% target in a way that is close to the initially planned trajectory (initially thought to be cost-efficient) • enables separate policy instruments to be used that are most suited to the characteristics of the electricity and fuels markets • Enhances the robustness of the gap-filler mechanism	• Greater design and administrative complexity compared to one sector only • Difficult to agree on benchmark in the absence of sectoral sub-targets in the legislation • May not lead to most cost-efficient target achievement if modelling is inaccurate
All RES, common instrument across all RES sources	• Enables most cost-efficient achievement of the 27% target, taking into account changes (technological/LCOE progress) compared to initial forecast/assumptions	• Greater design and administrative complexity compared to RES-E only • Limited choice of instruments, as the supplier obligation maybe the only option that would work across all sectors

1.2.5 Funding the gap filler mechanism

The funding needs of a gap-filler instrument depend on the projected gap to fill and the choice of gap filler instrumentation. Additional RES support to cover an ambition/delivery gap could either be covered by public financing or via the energy bill of energy consumer, or both. These options would be application of an auctioning + FiP/investment subsidy scheme, or also possible for boosting (existing) publically available financial instruments.

If an RQO scheme is used as a gap filler instrument, funding would not be needed from EU or national level, e.g. when income would be generated via certificates which would ultimately be passed on to energy consumers through their energy bill or to be absorbed to some extent by energy suppliers themselves (in an attempt to gain market share under conditions of cut-throat competition).

1.2.5.1 EU funds

EU provides a range of subsidy programmes and funds which are used to facilitate investments in RES. EU-funding of RES projects is mainly channeled through EIB, EFSI and the ESI Fund, which mainly focus on the deployment of (mature) technologies. In addition, there are the NER300 (funded through the ETS allowances) and the InnovFin (under H2020) which focus on innovation and demonstration projects. A significant portion of all the above-mentioned funds are directed towards funding RES projects in the various MS, particularly the EFSI.

EU funding needed to facilitate an auctioning process, be it investment subsidy or FiP, or boosting financial instruments could be channeled through the EIB. Also regional structural funds might be applied for this purpose. As for the contributions by MS necessary to access some of the ESI Funds, the less prosperous MS might need a limited earmarked credit line from the EIB to enhance the funding of (regional) RES gap filler instruments. EFSI and ESI Funds may cover different risks and support different or same parts of the capital structure of a project or layered investment platform (e.g. equity or debt financing) provided that the rules on double funding and preferential remuneration are complied with[62].

EFSI and ESI Fund are quite different in character, they also complement each other. Table 7 below gives a brief overview of the main characteristics of the two funds.

Table 7 Main characteristics of the EFSI and ESI Funds

	EFSI	ESI Fund
Objective	Launched jointly by COM and EIB to overcome current investment gap in the EU by mobilising private financing for strategic investments and SMEs.	Contribute to EUs strategy for smart, sustainable and inclusive growth, with a majority of the funding directed to the less developed/transition regions in the EU
Investment mobilisation goal	€ 60.8 bn of additional financing by EIB, € 315 bn in investment in the EU	€ 454 bn delivered (or € 637 bn in total, including national co-funding) through nationally co-financed multi-annual programmes
Available funding	EU guarantee (€ 16 bn) complemented by an EIB capital contribution € 5 bn	Under the Cohesion Fund, targeted achievement for 2014-2020 for RES capacity is 7 669 MW, and € 2.7 bn in investment spending (public and private)[63]
Timeframe	3 years from mid-2015, with possibility of extension	2014-2020

[62] http://ec.europa.eu/regional_policy/sources/thefunds/fin_inst/pdf/efsi_esif_compl_en.pdf, page 10.
[63] See https://cohesiondata.ec.europa.eu/overview. Additional funds for RE deployment are also made available under the ERDF.

Eligibility	EFSI has no geographical or sectorial allocation or quotas	Focus on less-developed countries/regions
Thematic coverage	None specific	Includes 11 thematic themes, several relevant for RES (e.g. research and innovation, sustainable transport, low carbon economies)
What does it provide	Mainly loans, guarantees and equity investments. No grant funding is provided	Support mainly in the form of grants but also through financial instruments (e.g. loans, guarantees and equity investments)

Table 8 below provides an overview of examples of projects funded under EFSI.

Table 8 Examples of projects receiving funds under EFSI[64]

Country	Project	Capacity (MW)	EFSI financing	Total investment
UK	Galloper – offshore wind	340	€ 314 mill.	€ 1.6 bn.
UK	Beatrice – offshore wind	600	€ 292 mill.	€ 2.4 bn.
BE	Nobel – offshore wind	165	€ 100 mill.	€ 542 mill.
BE	Rentel – offshore wind	294	€ 250 mill.	€ 1.1 bn.
PT	Biomass power plant	15	€ 50 mill	€ 95 mill.
AU	Bruck – onshore wind	39	€ 40 mill.	€ 65 mill.

Table 8 provides an overview of RES projects approved or currently under assessment for approval for EFSI financing, the picture shows that the financing focus is on large scale offshore wind.

Whilst a target for RES deployment capacity under the current Cohesion Fund is close to 8 GW[65], during the 2007-2013 period 3.8 GW new capacity was funded. Table Table 8 provides an overview of Polish RES projects which received funding under the 2007-2013 ESI Fund period. The total investment costs of these projects varies somewhat, however, the CF or ERDF funding was generally around € 10 mill.

64 Source: http://www.eib.org/efsi/efsi-projects/index.htm.
65 See Table 7.

Table 9 Examples of Polish projects receiving support under the 2007-2013 ESI Fund (Cohesion Fund (CF) and ERDF)[66]

Project	Capacity (MW)	EFSI financing	Total investment	Funding source
Kolobrezeg - wind	28	€ 59 mill.	€ 10 mill.	CF
Golice – wind	38	€ 55 mill.	€ 10 mill.	CF
Dolnośląskie province - wind	34	€ 56 mill.	€ 10 mill.	ERDF
Dolnośląskie province - wind	45	€ 71 mill.	€ 10 mill.	CF
Pelpin - wind	48	€ 82.5 mill	€ 10 mill.	CF
Biomass boiler	50	€ 69 mill.	€ 9.8 mill.	CF

A summary of possible pros and cons of using EFIS and ESI Funds to finance a gap filler mechanism (i.e. auctioning w/FiP or investment subsidy, or financial instrumentation) are presented in Table 10.

Table 10 Pros and cons of sourcing funds for a gap filler mechanism from EU funds

Pros	Cons
▪ Established income source for project funding, increasingly used for climate protection policies, including and RES and efficiency, in MS. ▪ Will not require direct budget transfers from MS ▪ EU funds are an EU-wide instrument, therefore suitable to apply these to an EU-wide gap filler mechanism.	▪ May be difficult to secure funding, particularly if there is no dedicated or earmarked money for a RES gap filler mechanism in the next MFF time period. ▪ Depending on the size of the gap, could be difficult to secure all the required funding through the EU funding pipeline alone.

A further income source for a gap filler mechanism could be generated from new provisions under the allowance mechanisms under the Emission Trading regime and its auctioning revenues. According to COM, the total revenue from the auctioning of EU ETS allowances amounted in 2014 to € 3.2 billion.[67] Following the current EU ETS Directive, MS should use at least 50% of auctioning revenues or the equivalent in financial value for climate and energy related purposes. However, this source of funding would be used for gap filling measures by the MS itself and COM would not have a direct influence on this part. Currently, this revenues from the ETS allowances are used for innovative projects. Given the objective of a cost-efficient delivery of the 2030 target, a focus on deployment of mature technologies would seem more appropriate for the gap filler mechanism.

The Commission could think about using a further reform amendment to NER 300 and the Innovation fund. Under the NER 300 programme, 38 renewable energy

66 Source: http://ec.europa.eu/regional_policy/en/projects/major/

67 See COM(2015) 576 final Report from the Commission to the European Parliament and the Council - Climate action progress report, including the report on the functioning of the European carbon market and the report on the review of Directive 2009/31/EC on the geological storage of carbon dioxide, page 12 cons.

projects and one CCS project were selected by COM for funding in 20 MS. Total NER 300 funding is currently estimated at € 2.1 billion, which is expected to leverage an additional € 2.7 billion of private investment.

The October 2014 European Council conclusions invited COM to renew and extend the NER 300 programme beyond 2020. The new innovation fund proposed as part of the revised EU ETS Directive would have 400 million allowances plus 50 million of unallocated allowances.[68] It would build on the NER 300 programme while extending its scope to low carbon innovation in industrial sectors. Under the RED amendment process the EU COM could link gap filling tendering under the NER 300 programme by that ensuring also that MS will be involved in the selection process.

Given the objective of a cost-efficient delivery of the 2030 target, a focus on deployment of mature technologies would seem more appropriate for the gap filler mechanism, in which case the a reform of the NER and introduction of a new innovation fund would have to open up for deployment of (mature) technologies.

1.2.5.2 National contributions

An option could be to request MS to (partially) fund a gap filler mechanism via specific contributions from their national budgets. Different options for defining MS national contributions could be foreseen. Requesting direct transfers from national budgets to cover a gap filler mechanism could however be challenging. Options are addressed in section 1.2.6.

1.2.5.3 Consumer surcharges and other non-MS funding opportunities

As for the funding requirements of MS, a preferred option might be to boost gap existing support measures, such as a FiP schemes which is funded through surcharges passed on to electricity consumers. In case of support auctioning, energy consumer surcharge per kWh consumed seems preferable from an equity perspective: less well-to-do consumers tend to consume less power.

Regarding the RQS instrument no need for public funding arises, as ultimately energy consumers pay for the RQS certificates cancelled in compliance with annual RQS targets. MS (i.e. ultimately their final energy consumers) contribute their agreed target contribution to the overall target. The default would be a harmonised target (expressed as a proportion of inlands gross electricity consumption). Based on the projected RQS certificate price, the annual RQS surcharge per kWh consumed can be established for each MS ahead on a year-by-year basis. When the regional target is fully harmonized, the electricity consumer in each participating MS would contribute the same on a per kWh basis. The RQS surcharge should be moderate so that difficult discussions on exemptions for national industrial actors can be avoided.

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[68] See figures from COM(2015) 576 final Report from the Commission to the European Parliament and the Council - Climate action progress report, including the report on the functioning of the European carbon market and the report on the review of Directive 2009/31/EC on the geological storage of carbon dioxide, page 12 cons.

To the extent that support auctioning will be applied as a gap filling in the RES-E sector, a large extent of public financing support has to accompany equity plus debt funding from the private sector to bring about sufficient financial closures of new RES-E projects. Especially the lower-income and heavily indebted MS will face major problems in raising incremental public means to contribute all the public funding needed to realise sufficient RES-E projects in their jurisdiction. Moreover, credit enhancement activities by the EIB, e.g. applied to bond issues of designated regional or national development finance intermediary agencies or to bank loans extended to such agencies (a small additional EIB loan or EIB loan guarantees) can improve loan ratings and hence the WACC cost of designated development finance intermediaries. In turn, these intermediaries can pass this on to lower the average WACC financing cost of RES-E gap-filler projects in the MS concerned. For this purpose it might be considered that the EIB commits a limited allocation of the EFSI by order of COM, mandated by Council Decision. Moreover, the EIB in turn can bring in the expertise EIB has to fine-tune the use of EFSI money through EIB's suite of financial instruments as well as to advise MS, regional RES gap-filler finance agencies, development finance intermediaries and other relevant actors on use and structuring of financial instruments. Another possibility for acquiring the necessary financing means is emission of long-term bonds by the EIB. These bonds could be bought by the European Central Bank in the frame of the expanded asset purchase program. The main advantage of this approach is that budgets of MS would not be directly affected.

1.2.6 Options for empowering COM to implement a gap filler mechanism

A gap filler mechanism will need a strong coordinating role by COM to ensure a high level of certainty that the 27% target will be met. Thus, a fair amount of discretionary coordinative power directly or indirectly vested with COM is needed. In view of the EU Policy TFEU concerning energy policy which reflects a <u>shared competence</u> between the Union and the MS under Article 4 Para 1 and 2 (i) and Art. 194 Para 2 TFEU, this section assesses options for an EU-wide gap filling mechanism under the responsibility of COM. This would, for example, be in line with manifold experience gained over many decades e.g. under the Common Agriculture Policy mechanisms (CAP) or in view of the Performance Reserve under the ESIF funds.

In order to find the best applicable way for COM to directly use gap filler instruments one could focus on instruments already established. With regard to ensuring sufficient funds, i.e. a gap filler fund (GFF), for common RES auctioning for targeted areas. However, if the gap to reaching the 27% target in 2030 is sufficiently large there is the risk that a GFF is not sufficient. Additional instrumentation would then be necessary, such a boosting an ex-ante EU-wide RES-HC obligation. Against this background, this section will assess (pros and cons) of the following options:

- Option 1: GFF à la NER300
- Option 2: GFF à la National Energy Efficiency Fund (NEEF)
- Option 3: Attaching GFF to the existing ESIF framework
- Option 4: Increasing the level of obligation under the ex-ante RES-HC obligation

1.2.6.1 Option 1: Gap Filler Fund à la NER300

Regarding the use of money from a GFF and in order to ensure that the binding EU-level target of 27% is met, one could think of a common organization of a gap filling EU auctioning for RES capacity (Common RES auctioning), for all MS and all sectors, or alternatively for specific MS or a region of a MS, or even several neighboring regions of MS.

The details on the organization of such auctioning would be subject to an EU Parliament and Council Regulation on the establishment of a common organization for specific tendering procedures for new capacity of the underperforming RES sector/MS/region. Depending on the chosen set-up, this could even be the same regulation than the one on the financing of the GFF.

Against this background, the NER300 program could potentially serve as an example for a GFF structure, and serve as a basis for a Common RES auctioning.

Article 10a, paragraph 8 of the modified ETS Directive has now a special mechanism for financing commercial demonstration projects that aim at the environmentally safe capture and geological storage of CO_2 ("CCS demonstration projects") and demonstration projects of innovative RES technologies ("RES demonstration projects") introduced. For the operation of this mechanism, COM had to define both the rules and the criteria for the selection and implementation of these projects and the basic principles for monetization of allowances, management of revenues and payment by the MS to the selected projects.

The mechanism under Art. 10a includes, in particular, how many of the unused emission trading allowances from the reserve for new entrants in this context are to be auctioned, i.e., the "financial scope" of the funding respectively funds, as well as the purpose of such funds raised.

In short, a first to the way to set up the fund could include:

- Directive under the ordinary legislative procedure as a legal basis containing the terms of reference for Commission;
- Herein especially "establishment of the fund"
- Commission decision to implement a delegated act within the regulatory procedure with scrutiny;
- Cooperation Agreement with the EIB;
- Commission decision on the selected projects;
- Formalized payment request of the respective MS (based on Payment Request Template the EU Commission) for the selected projects.

Further details are provided in a separate BBH paper developed within this project. In this section, we focus on presenting the pros and cons of this option.

Table 11 Pros and cons of Option 1: Gap Filler Fund à la NER300

Pros	Cons
▪ Can build on existing procedures, e.g. selection of supported projects is made at EU level, with the EIB performing inter alia the tender and due diligence for the proposed projects ▪ The Fund could be channelled through the EIB, with established experience and experience on financial terms and conditions for RES projects. The EIB already acts in a similar capacity in the context of the NER300 program. ▪ This type of funding is not a part of the general budget of the EU, i.e. the MFF. However, it could potentially be combined with e.g. the Structural and Cohesion Fund, and the European Energy Programme for Recovery (EEPR). ▪ Could also be combined with loan finance provided under the Finance Facility Risk Sharing, which was set up by the Union and the European Investment Bank (EIB).	▪ Would be subject to EU Parliament and Council Regulation, e.g. fair tendering procedure rules. However, for certain aspects and the tendering conditions and rules the Commission could be authorized to adopt implementing or delegated acts on the details of the auctions. ▪ The grounds for an EU Parliament and Council Regulation would need to be outlined in the new REDII, which will have to pass comitology. ▪ Projects would most likely have to be co-financed by the MS, this requires a willingness from MS to allocate funding as well as to cooperate with the EU/EIB in promoting projects. ▪ Amount of funds available from the emission trading allowance is at this stage unknown. If the gap towards the 2030 RES target is large, funds that could be made available for a Gap Filler Fund via auctioning of ETS allowances may prove to be insufficient. ▪ A NER300-like Gap Filler Fund may not be able to provide sufficient funds to close a gap in the trajectory towards the 27% RE target.

1.2.6.2 Option 2: Gap Filler Fund à la National Energy Efficiency Fund (NEEF)

Here we consider the current Energy Efficiency Directive (EED)[69] Art 7 (Energy Efficiency Obligation Schemes) and its fund solution. The EED outlines a choice for the implementation of the EED by putting into operation one or a combination of the established policy measures: (i) energy efficiency obligation schemes and/or (ii) alternative policy measures. The EED has established a set of binding measures for the Member States. Article 20 (4) to (7) EED is dedicated to the conditions for a National Energy Efficiency Fund[70]. The following key principles have to be applied by the MS under the EED and its Art. 7:

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[69] Directive 2012/27/EU of the European Parliament and of the Council of 25 October 2012 on energy efficiency, amending Directive 2009/125/EC and 2010/30/EU and repealing Directive 2004/8/EC and 2006/32/EC, OJ L 315, 14.11.2012, p 1

[70] The 2012 Energy Efficiency Directive establishes a set of binding measures to help the EU reach its 20% energy efficiency target by 2020. Under the Directive, all EU countries are required to use energy more efficiently at all stages of the energy chain from its production to its final consumption.
Art. 20 (4) to (7):" 4. Member States may set up an Energy Efficiency National Fund. The purpose of this fund shall be to support national energy efficiency initiatives.
5. Member States may allow for the obligations set out in Article 5(1) to be fulfilled by annual contributions to the Energy Efficiency National Fund of an amount equal to the investments required to achieve those obligations.
6. Member States may provide that obligated parties can fulfil their obligations set out in Article 7(1) by contributing annually to the Energy Efficiency National Fund an amount equal to the investments required to achieve those obligations.

- Establish the total quantity of energy savings that has to be achieved and its spread over the obligation period;
- Decide whether to use energy efficiency obligation schemes or alternative policy measures, or both, and, while designing the schemes or measures, ensure that certain criteria are met;
- Establish which sectors and individual actions are to be targeted so that the required amount of energy savings is achieved;
- Establish how energy savings from individual actions are to be calculated;
- Ensure control, verification, monitoring and transparency of the scheme or alternative policy measures; and
- Report and publish the results.

NEEF is one of the instruments to be used by the MS laid down under the EED.

According to the EED and explanation by COM, this can be any fund established by a MS with the purpose of supporting national energy efficiency initiatives[71].

The funding needs to come either only from public sources (European or national or combined) or from a combination of public and private (e.g. banks, investment funds, pension funds, obligated parties) if these explicitly focus on the realization of individual actions that lead to end-use energy savings. The obligated parties under EED are e.g. those who would have efficiency obligations measures to fulfill but who instead pay into the respective national fund (sort of indulgence trade). The payment scheme could be used especially for the REDII when considering shortcoming in RQS for RES-HC.

A translation into the REDII proposal could thus impose:

1.) The definition of the identification occurrence of a gap be it ambition gap or delivery gap in the REDII

2.) The establishment of an Art. 7 EED mechanism into the REDII.

3.) A set up obligation for all MS for a (reserve) National Renewable energy obligation Plan with a National Fund as binding measure besides further instruments to his liking and preference.

4.) In case of use of EU funding for the National fund, the obligation of the MS to coordinate with COM and to obey to signals from COM in case of gap occurrence in time frame between 2021 and 2030 to use the money allocated in the fund for specific gap filling actions will be laid down in the RED II as well.

5.) The right for all MS to link such a gap fund directly with other established funds, alimented by EU and/or national funds and with or without link to private fund mechanisms under the donations that all are defined in a way as to strictly focus on RES deployment as only or one of the objectives. In

7. Member States may use their revenues from annual emission allocations under Decision No 406/2009/EC for the development of innovative financing mechanisms to give practical effect to the objective in Article 5 of improving the energy performance of buildings."

71 The relevant requirements for the fund are laid down in Art. 2 (159, (17) and (19); Art. 7 (9) – (11), Art. 20 (6) and Annex V, parts 1, 2 and 4 of the RED

case of partly alimentation form EU funds the coordination obligation as outlined under 4) will set in as well.

6.) The right for MS to supplement funds to a dedicated EU gap filling fund directly with means from the national income pathway and to earmark this money in its National Renewable Energy Obligation Scheme as money to be paid into the EU fund following the conditions established in REDII thus not establishing an own fund mechanism on national level.

7.) The clear definition of money needed in relation to the analyzed gap to be prescribed in the RED II/ANNEX.

8.) Clarity in REDII and in the National Renewable Energy obligation Scheme that the fund is triggering additional "income" for gap filling, no counting of measures from other mechanism e.g. RES support programs.

9.) The new REDII could enumerate all possible links for the National Renewable Energy Obligation schemes and e.g. the EU/or National gap filler fund by starting from the established link under Art. 20 (7) EED and bridge to all relevant EU funding schemes already available.

   a. Art. 20 (7) EED already links to the possibility of MS "to use their revenues from annual emission allocations under Decision No 406/2009/EC[72] for the development of innovative financing mechanisms..."

   b. At present, MS shall devote at least 20% already of the European Regional Development Fund allocation for 2014-2020 in more developed regions, 15% in transition regions and 10 to 12% in less developed regions, to RES and energy efficiency.

   c. Performance reserve (see options 3 for further elaboration).

10.) Another quality would be appearing if Europe would introduce a new and specific instrument or EU RES (target achievement) fund 'sui generis. Such a new EU RES Fund sui generis under the REDII could be integrated and would need an own set of articles.

The funding needs to come either only from public sources (European or national or combined) or from a combination of public and private (e.g. banks, investment funds, pension funds, obligated parties) if these explicitly focus on the realization of individual actions that lead to end-use energy savings. The obligated parties under EED are e.g. those who would have efficiency obligations measures to fulfill but who instead pay into the respective national fund. The payment scheme could e.g. be used especially for the REDII when considering shortcoming in quota obligation in the heating and cooling sector.

[72] Decision No 406/2009/EC of the European Parliament and of the Council of 23 April 2009 on the effort of Member States to reduce their greenhouse gas emissions to meet the Community's greenhouse gas emission reduction commitments up to 2020.

Table 12 Pros and cons of Option : Gap Filler Fund à la NEEF

Pros	Cons
▪ Similar to the NER300-like option above, the funding sources in this option would not be a part of the EU budget, i.e. MFF. ▪ Numerous possible sources of funds which could pay into the NEEF, e.g. banks, investment funds, pension funds, obligated parties.	▪ If voluntary, as is the case under the EED, there is the risk that MS may not establish such a fund and money for common RES auctioning would then not be available. ▪ Grounds for establishing a NEEF-like GFF would have to be laid down in REDII, and pass comitology.

1.2.6.3 Option 3: Attaching the GFF to the existing ESIF framework

Another option would be to use existing fund structures to finance Common RES auctioning. Here, one could also think about a "carrot and stick" approach, through re-shifting money. Less ambitious MS might see themselves getting less access to money they initially paid into the EU budget, i.e. would pay – though more indirectly – for the Common RES auctioning. One interesting example to be adapted is the so-called Performance reserve under the Art. 20 cons. of the Structural Funds Framework regulation where "6 % of the resources allocated to the ERDF, ESF and the Cohesion Fund under the Investment for Growth and Jobs goal referred to in point (a) of Article 89(2) of this Regulation, as well as to the EAFRD and to measures financed under shared management in accordance with the EMFF Regulation shall constitute a performance reserve which shall be established in the Partnership Agreement and programmes and allocated to specific priorities in accordance with Article 22 of this Regulation."

In order to implement a GFF into the existing ESIF framework, one might provide for example for a stronger earmarking, particularly for RE, in the CPR. This could be done e.g. through the introduction of a new objective "program to reach the EU-level renewable energy target of at least 27% by target 2030". The regulations on the different funds could then provide that a certain percentage of the money should be dedicated to that objective, similar to what Art. 4 of the ERDF Regulation is currently already doing. By those means, one would create sort of an extra fund.

Similarly, for regional cooperation projects, one might want to tap specifically the ETC or have another dedicated objective in the CPR, in order to encourage MS to join their efforts in RES development and to get to more funding sources.

MS would then in their partnership agreements under the CPR have to explain first, how to use the money from the funds for RES development and link the use of the money to their (indicative) targets under the RED II. If they fail in doing so a gap occurs, the Commission could be allowed to use the untapped money for Common RES auctioning, the latter being stipulated already in the RED II. One could even imagine a system, in which the MS could declare that they will not claim the earmarked funds, allowing the Commission to start with the Common RES auctioning already at a fairly early point, and thus increasing security in achievement of the EU-level target.

Table 13 Pros and cons of Attaching the Gap Filler fund to the existing ESIF framework

Pros	Cons
▪ The ESIF already "earmarks" certain resources for inter alia RE projects	▪ The ESIF falls under the EU budget (MFF). Additional earmarking for RES would not take place under REDII, for this a CPR would be required.

1.2.6.4 Option 4: Increasing the level of obligation under the ex-ante RES-HC obligation

This option is addressed under sub-section 1.2.4.5 above.

1.2.7 Timing and procedural aspects

It is assumed as point of departure that adequate remedial actions will be part of the NECPs, subject to iterative MS-Commission communication in the framework of the governance process. Furthermore, it will be assumed henceforth that REDII will stipulate that each MS shall elaborate RES deployment actions that will go adequately beyond just maintaining its 2020 RES target share, such that all MS will collectively reach the aggregate at least 27% target RES share for the EU as a whole. This formulation would imply that (i) MS are not allowed to backtrack from their respective 2020 RES target share and (ii) MS are bound to an effort commitment, i.e. to submit plans to make meaningful contributions on top of their 2020 targets such that iterative negotiations under the governance mechanism will lead to adequate collective ambitions towards achieving the stipulated target trajectory towards reaching the at least 27% EU-level RES target share.

As from the introduction date of the gap-avoider measures (foreseen at the beginning of year 2021), their impact may start to take off. By the 1st quarter of year 2024 the results of the actual average EU RES share for years 2021 and 2022 will be available.

Table 14 depicts a possible timeline for implementation of a gap filler mechanism.

Table 14 Possible timeline for implementation of a gap filler mechanism

Milestone #	Timing	Possible event	Implication	Leading actor(s)
1	Q4-2016	Publication draft REDII	Sets in motion comitology process	Council and Parliament
2	2016 – 2018	Timeline for development of NECPs	Finalisation and submission of NECPs to the Commission	MS monitored by the Commission
3	Q1-2018	Political agreement on adoption of final draft REDII	REDII transposition in nat. legislation (incl. gap filler provisions) and implementation	MS monitored by the Commission
4	Q1-2020	First period of iterative energy governance process	EU-wide (gap avoider) measures introduced on 1-1-2021, facilitated by RES financial instrumentation	Horizontal MS negotiations, chaired by the Commission
6	Q1-2024	Negative deviation 2021-22 avg (aggregate) RES share from REDII specified target trajectory	Gap-filler mechanism is triggered to become active by 1-1-2025, facilitated by RES financial instrumentation	MS under strict regime described transparently in RED II, guided by the Commission (enforceable contingent on REDII stipulations)

During an interim REDII impact assessment in the first 3 months of 2024 the deviation will be established of the actual average 2021-2022 RES share from the REDII target achievement trajectory, poised to be stipulated in REDII[73]. In case of a negative deviation, a delivery **gap filler mechanism** could be triggered. The mechanism needs to be laid down in REDII. It could be organised in a similar way as under Article 3 Directive 2001/77/EC on the promotion of renewable electricity in the internal energy market[3] with its reporting duties for MS and Commission and the provision that in case that the MS do not reach the indicative targets the Commission could propose stricter legislative proposals. In our case a predefined mechanism for gap filling auctioning under REDII would kick in, once the gap is likely to occur and likely to prevent target reaching on EU level.

[73] It might or might not be possible to achieve political agreement on a requirement in REDII of introducing harmonised and interlinked national systems of mandatory comprehensive guarantees of origin for (at least) renewable energies (RES-E, RES-H/C, RES-T). If possible indeed, a decision to trigger the gap-filler mechanism might be based on a negative deviation with the RES target share trajectory of actual average RES share in gross final energy consumption in a later period, e.g. Q1, Q2, Q3,Q4 of 2023 and Q1 of 2024. In the main text reliance on Eurostat data rather than on RES-GO data is assumed. EU-wide implementation would imply acceptance that RES-GO will be used for target accounting purposes on top of disclosure of energy mixes of suppliers and energy products. A legal issue will be how cross-border transfers of RES-GO will relate to "statistical transfers".

The **gap to be filled** might be projected to assume the size of **m**[74] times the absolute % deviation established by the interim REDII impact assessment times the baseline projection of the EU gross final energy consumption projection in 2030 ($PFEC_{2030}$):

$$G_{2030} = m * D_{2021-20122} * PFEC_{2030}$$

Options for the value to be given to parameter **m** could be: 5 / 5.5 / 6

1.2.8 Cost sharing and impact assessment

The aim of this section is to show the distributional effects, in terms of shares of additional RES deployment per MS and in terms of funding, under different assumptions.

1.2.8.1 Methodology and assumptions

As mentioned in the description in Annex D, user defined parameters in the excel tool include:

- **Choice of ambition or deliver gap**: this parameter enables analysis of approximate policy cost deviation for instance even if the amount of the gap is equal both for ambition and delivery gap.
- **Technology portfolio as gap filler**: this parameter allows for sensitivity analysis with respect to cost impacts when different technologies/sectors are selected.
- **List of MS participating to funding and/or receiving the benefits**: this parameter allows the user to design the options i.e. EU versus regional approach.
- **Choice of allocation rule**: the allocation of the benefits (the fund and the project implementations) can be done using different benchmarks, from flat rate to GDP to cost-efficiency potentials or the combinations of each.

Countries that may cause the gap is also user-defined. The effects of different benchmarking methodologies in respect to which MS may cause the gap, what the amount of gap would be and which sector(s) may cause the gap are not included to this tool.

We look at 4 different scenarios (Table 15) and 10 sensitivities. The scenarios are based on the two key uncertainty factors that are the level and the type/timing of the gap. These two key uncertainty dimensions are hence the basis for building as well as describing 4 different scenarios. Table 16 presents the default assumptions applied to 4 scenarios. It also presents the sensitivity parameters the cases focus on.

[74] M is used to extrapolate the % gap in the first biennial implementation period to the year 2030

Table 15 Scenarios

Scenarios	Level of gap (%)	Gap in 2030 (TWh)[75]
A. Ambition gap, High	3%	377
B. Ambition gap, Low	0.6%	75.5
C. Delivery gap, High	3%	377
D. Delivery gap, Low	0.6%	75.5

Table 16 Default assumptions and the sensitivity parameters

	Default assumptions	Sensitivity parameters
Sector focus	• RES-E (onshore wind, solar top PV and biomass)	• RES-E technologies only, i.e. 50% on-shore wind+50% solar • RES-E+RES H/C technologies • All RES-E
Funding	• 100% from countries with deficit (GDP per capita + amount of deficit)	• 20% EU funds +80% deficit country contributions • 80% EU funds + 20% deficit country contribution • 100% EU funds
Receiving the benefits	• Regional approach to distribution of funds	• EU approach to distribution of funds • Only MS above benchmark
Benefit allocation method	• Cost-efficient potential	• 50% cost-efficient potential + 50 % flat rate • 2020 target formula

It should be noted that an important limitation of the excel tool is that is does not differentiate MS-specific investment/operation, but rather unified costs across all MS. Thus, the support costs presented in the case illustrations should be regarded as an upper boundary. In reality the support costs could be (significantly) lower when the locations with the lowest costs are chosen for the new RES deployment to fill the gap. Extensive modelling would be required to provide more exact insights into the required costs and support needs to cover different gaps. Therefore the emphasis of this exercise lies on the distributional impacts.

1.2.8.2 Selection of deficit countries + approach to providing funds

The deficit county selection is based on the 2014 performances of the MS compared to indicative targets set in the RED. The countries that are underperforming are considered as potential laggards. These are France, Ireland, Luxemburg, the Netherlands and the United Kingdom.

In some cases we assumed that deficit countries will provide funding to close the gap. Distribution of the funding is based on the GDP/capita of each deficit country.

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[75] The gap is calculated against the gross final energy consumption (GFEC) using the 2016 PRIMES projections for the GFEC.

1.2.8.3 Benefit sharing + role of allocation method within the regional versus EU approach

While the funding is assumed to be received from the MS causing the gap + EU funds, the benefits are shared among the MS within a targeted region(s) or across the 28 MS. The MS that cause the gap are used as proxy to define in which regions there are still cost-efficient potential so that those regions can be targeted first to deploy RES. Table 17 illustrates 7 regions we consider. According to this table the target regions are region III, IV and V. All of the MS in each region can compete for RES deployment.

The benefit sharing in the scenario analysis is based on the selected allocation method approach. The allocation method options are:

- Cost-efficient potential allocation method: this approach allows the (remaining) least-cost RES potential to be utilised. Therefore, the gap filler funding could be relatively low in this option.
- 50% cost-efficiency potential + 50% flat rate: while this option still targets the cost-efficient potential it reduces the risks and uncertainties related to cost-efficiency potential analysis by spreading the 50% of the benefits flatly among the MS.
- 2020 target formula that combines the flat rate and the GDP

Table 17 Illustration of the countries and thus regions that pledge low

Region I	Region II	Region III	Region IV	Region V	Region VI	Region VII
SE	PL	DE	UK	FR	CZ	IT
FI	LV	AT	IE	ES	SK	SI
DK	LT	NL		PT	HU	HR
	EE	BE			RO	EL
		LU			BG	MT
						CY

1.2.8.4 Defining the MS above benchmark

The selection of the countries that may perform above benchmark is based on the 2014 performances of the MS compared to indicative targets set in the RED. The countries that are over performing are considered as potential above benchmark counties. These are Bulgaria, Croatia Czech Republic, Estonia, Finland, Italy, Lithuania and Romania.

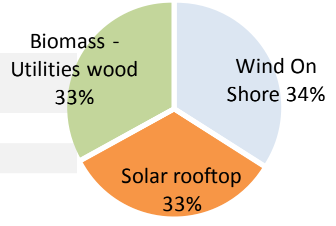
Scenario A: Base case

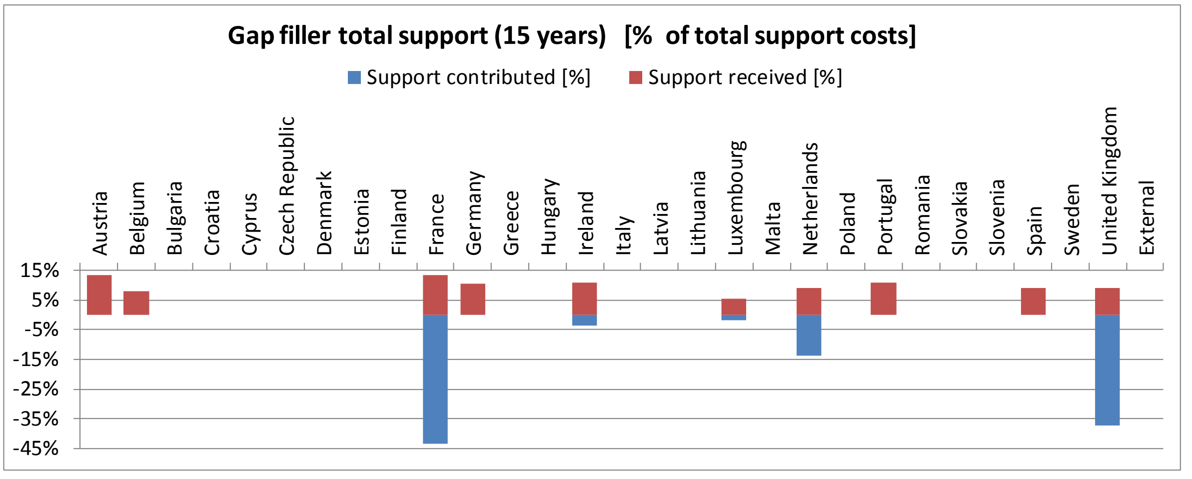
Gap type	Ambition gap
Specify gap at	EU level
Gap size [%]	3.0%
Allocation mechanism	Potential only
Inflation rate	2.0%
Background data	PRIMES projections

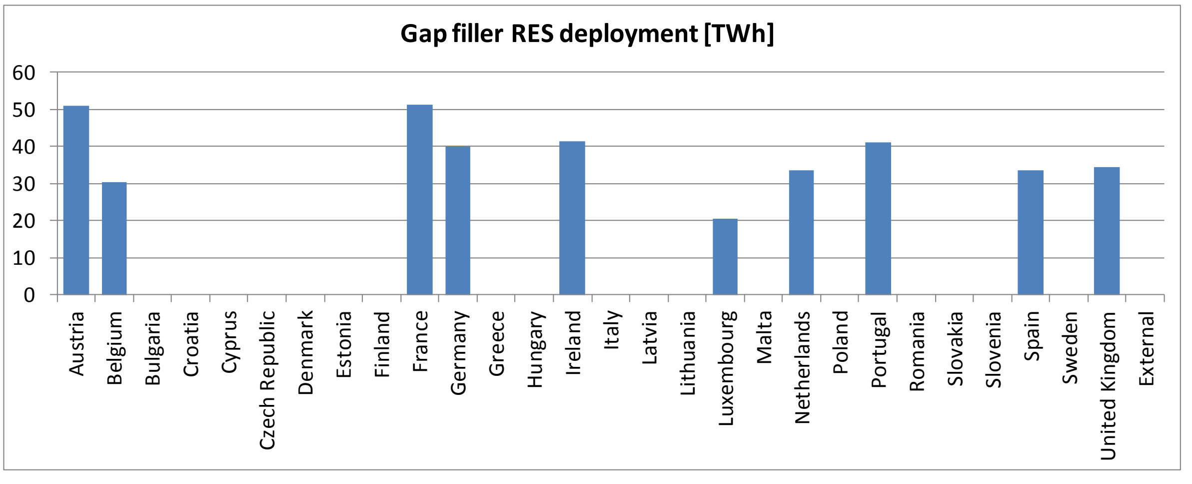
Gap size [%]	3%
Gap size [TWh]	377.3

	infl adj	no infl adj
Yearly support costs [bln€/y]	12.8	10.9
Support costs till 2030 [bln€]	127.8	109.2
15 years support costs [bln€]	191.7	163.8

Support region	FR, IE, LU, NL, UK
Deployment region	AT, BE, FR, DE, IE, LU, NL, PT, ES, UK
Technology portfolio	Wind On Shore, Solar rooftop, Biomass - Utilities wood







Assessment of the results

- Policy support costs (the difference between the average electricity price and the production cost of RE-E)
    - Given the choice of technologies, the yearly support costs needed to fill the ambition gap would very roughly be in the order of 13€ bn/year, implying that total support costs in the period to 2030 would be in the order of 128€ bn. Should the support costs be adapted to the economic lifetime of a project, e.g. 15 years[76], the indicative support costs needed would be in the order of 192€ bn[77].
    - To put these figures into perspective, the order of magnitude yearly investment needs is around 9 times the current average EIB annual investments on RES[78].
- Funding requirements:
    - Above comparison already indicates the financial shortcomings of the current EIB funding.
        - Funding requirements from the MS that 'under-pledge' (in this case 5 under-pledging countries), based on the GDP/capita approach, would be in the order of € 5.55, €0.48, €0.22, €1.76, €4,78 bn/year, for France, Ireland, Luxemburg, Netherlands, and the UK, respectively.
    - As described in Section 1.2.6, these funds e.g. could be taken from MS pre-allocation of EU structural funds and/or EU ETS auctioning revenues (potentially earmarked for RES deployment/gap filler measures).
- Allocating benefits:
    - In this specific case the benefits are allocated to 10 MS, with two countries benefiting the highest. Additional deployment in the countries included in the illustration ranges approximately between 20 - 50 TWh
    - All 5 laggards would receive support for additional RES deployment domestically, but would be net contributors when taking into account their support contributions.
    - The remaining countries included in the example would be net beneficiaries. Their net benefit (support received) would range between approximately 5 – 14% of the total support.

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76 For example, this is common for most technologies under the Dutch SDE+ scheme.

77 We assume 15 years is the economic lifetime of the support, which is in general shorter than the technical lifetime of the technologies involved. Since the 377 TWh are consumed between 2020 and 2030, and the energy consumed afterwards does not count, this example represents a support in the order of 0.29 eur/kWh for 10 years, or 0.029 eur/kWh/y.

78 The EIB has been investing 2-4 € bn per year in RES generation. We considered the average as 3 € bn. According to the tool, the investment cost has been calculated as 27 bn/year, assuming that the investments need to be done between 2020 and 2030.

- Notably, with a regional approach, project developers in the respective regions could compete among each other to receive the benefits, or ideally, define joint projects to share the benefits.

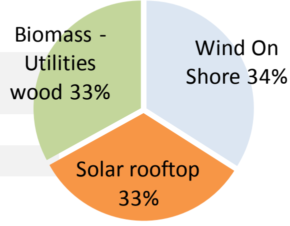
Scenario A_1: RES deployment coverage sensitivity

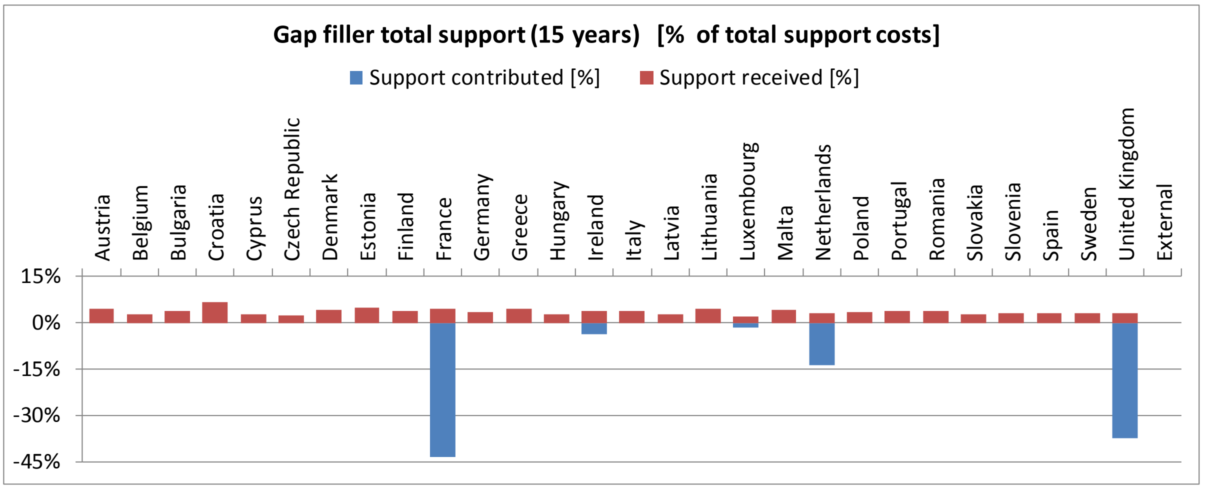
Gap type	Ambition gap
Specify gap at	EU level
Gap size [%]	3.0%
Allocation mechanism	Potential only
Inflation rate	2.0%
Background data	PRIMES projections

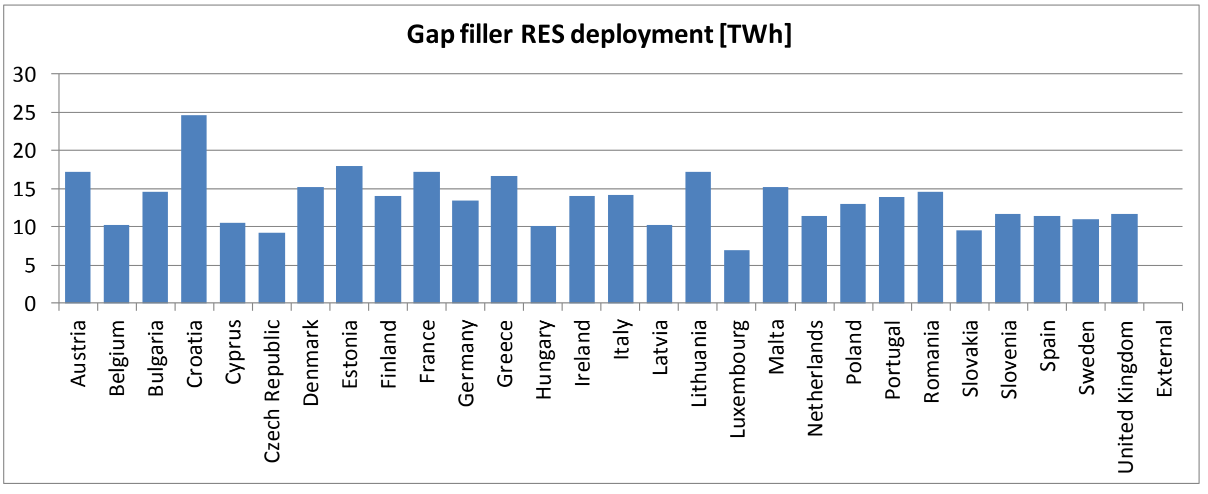
Gap size [%]	3%
Gap size [TWh]	377.3

	infl adj	no infl adj
Yearly support costs [bln€/y]	12.8	10.9
Support costs till 2030 [bln€]	127.8	109.2
15 years support costs [bln€]	191.7	163.8

Support region	FR, IE, LU, NL, UK
Deployment region	Whole EU
Technology portfolio	Wind On Shore, Solar rooftop, Biomass - Utilities wood







Assessment of the results (in comparison to Scenario A base Case)

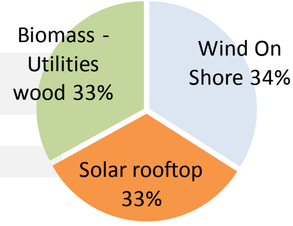
- The main difference relates to the geographical coverage of allocating benefits:
  - In this specific case the benefits are allocated to EU28 based on the cost-efficiency approach. Thus, a wider distribution of RES projects can be observed.
  - The distribution of the additional RES deployment is in the range of approx. 7 - 25 TWh.
  - Compared to the base case, all 5 laggards would receive less support for additional RES deployment domestically, thus increasing the size of their net contribution towards the increased deployment.
  - The remaining countries included in the example would be net beneficiaries. However, since the deployment is assumed to take place in all MS, their net benefit (support received) is in the order of 2-6.5% of total support costs.

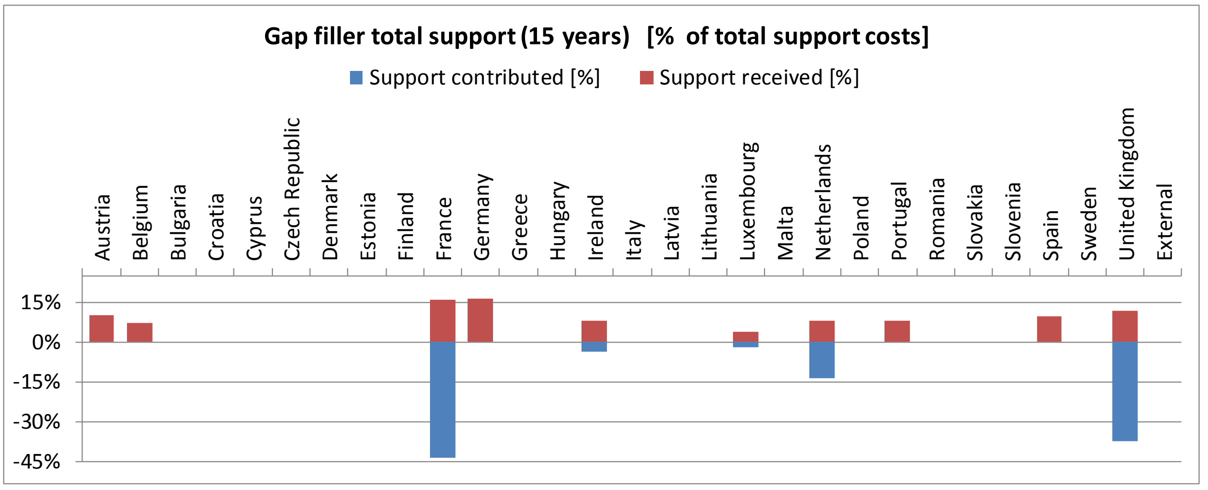
Scenario A$_2$: benefits allocation mechanism sensitivity

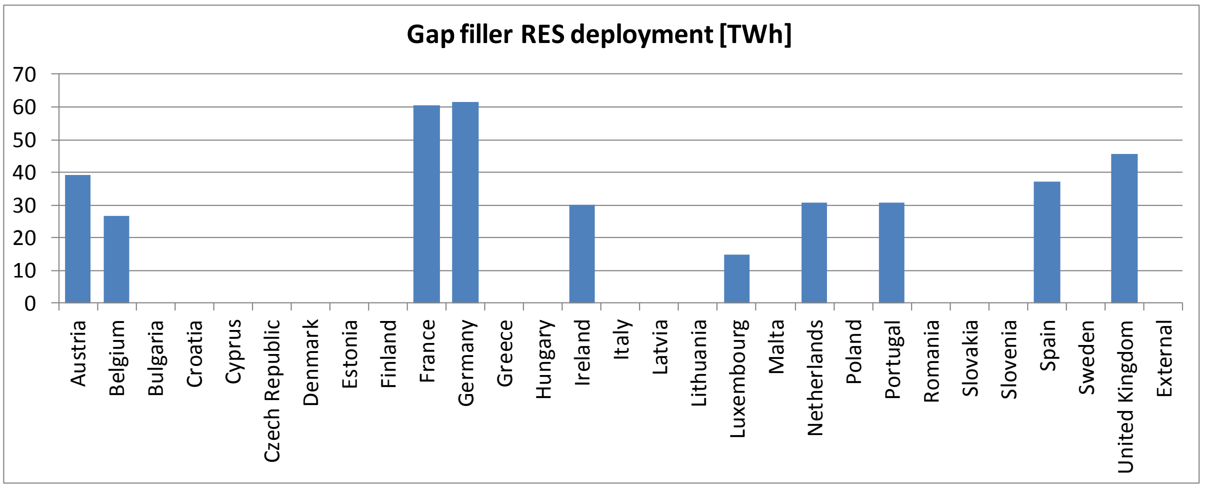
Gap type	Ambition gap
Specify gap at	EU level
Gap size [%]	3.0%
Allocation mechanism	Potential + flat rate
Flat rate [%]	1.5%
Inflation rate	2.0%
Background data	PRIMES projections

Gap size [%]	3%	
Gap size [TWh]	377.3	
	infl adj	**no infl adj**
Yearly support costs [bln€/y]	12.8	10.9
Support costs till 2030 [bln€]	127.8	109.2
15 years support costs [bln€]	191.7	163.8

Support region	FR, IE, LU, NL, UK
Deployment region	AT, BE, FR, DE, IE, LU, NL, PT, ES, UK
Technology portfolio	Wind On Shore, Solar rooftop, Biomass - Utilities wood







Assessment of the results (in comparison to Scenario A Base Case)

- The main difference relates to the approach applied to allocating benefits:
    - When applying an allocation based on a combination of flat rate and potential, this results in a shift in the amount of RES deployment and support received in some countries compared to a potential-only allocation approach.
    - When looking at the laggard countries, France and UK receive higher financial support that results in higher RES deployment compared to the base case. They remain net contributors.
    - Ireland would face the largest decrease in financial support and RES deployment, in comparison to the base case, whereas the Netherlands would face the lowest decrease.
    - When looking at the non-laggard countries in the case example, there is also a shift in the financial support received and RES deployment. Germany receives the highest increase, followed by Spain, whilst the remaining countries (Austria, Belgium and Portugal) would face a decrease compared to a potential-only allocation approach.

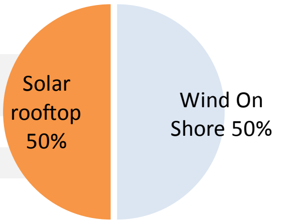
Scenario A3: technology portfolio sensitivity – RES-E only

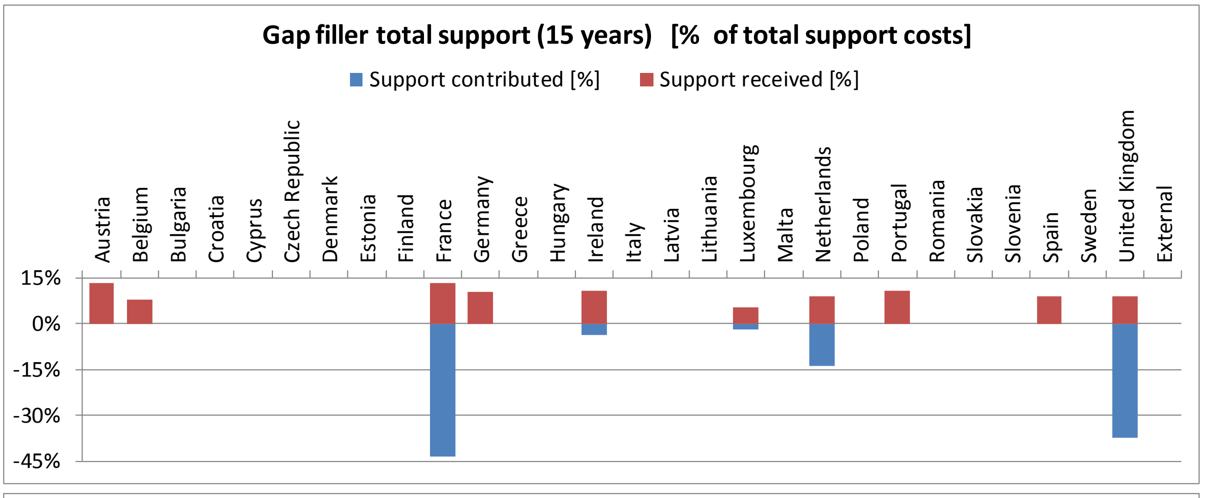
Gap type	Ambition gap
Specify gap at	EU level
Gap size [%]	3.0%
Allocation mechanism	Potential only
Inflation rate	2.0%
Background data	PRIMES projections

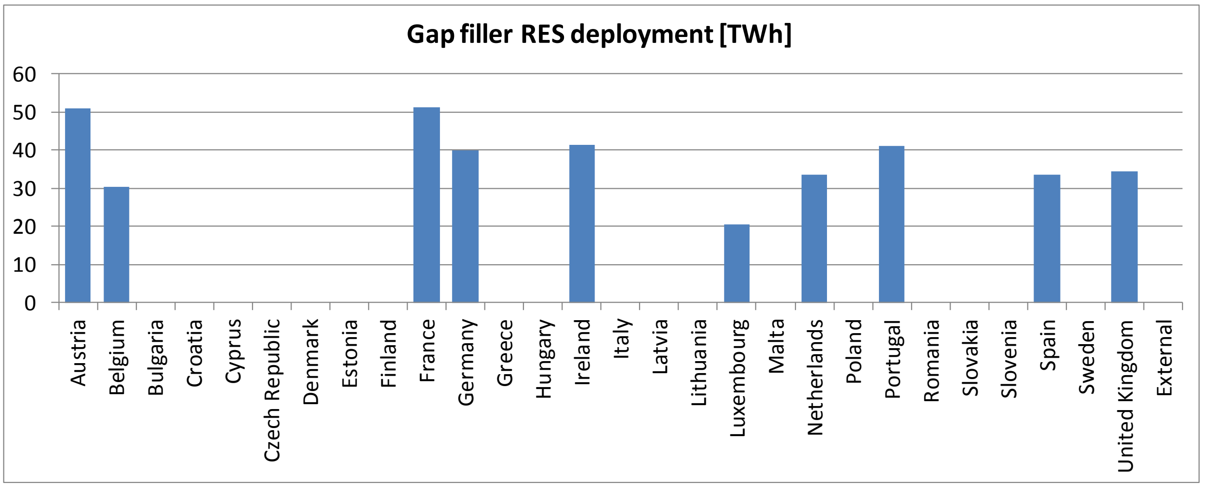
Gap size [%]	3%
Gap size [TWh]	377.3

	infl adj	no infl adj
Yearly support costs [bln€/y]	11.2	10.2
Support costs till 2030 [bln€]	111.9	102.1
15 years support costs [bln€]	167.9	153.2

Support region	FR, IE, LU, NL, UK
Deployment region	AT, BE, FR, DE, IE, LU, NL, PT, ES, UK
Technology portfolio	Wind On Shore, Solar rooftop







Assessment of the results (in comparison to Scenario A Base Case)

- The main difference relates to the required policy support costs:
    - This case example shows that by excluding biomass from the technology mix) the required policy support costs would decrease by around 12.5% compared to the base case. This can be interpreted as how sensitive the required support costs are to the choice of technology.
    - The distribution of financial support (and RES deployment) is not changed from the base case. However, since the overall support costs are reduced, the net contributions by the laggard countries will also be reduced.

Scenario A_4: technology portfolio sensitivity – RES-E & RES-H/C

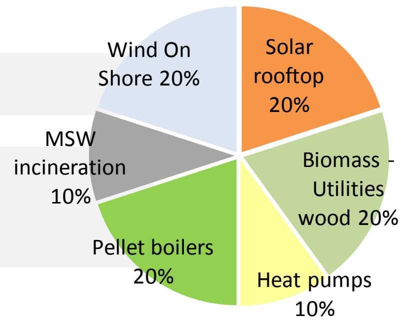
Gap type	Ambition gap
Specify gap at	EU level
Gap size [%]	3.0%
Allocation mechanism	Potential only
Inflation rate	2.0%
Background data	PRIMES projections

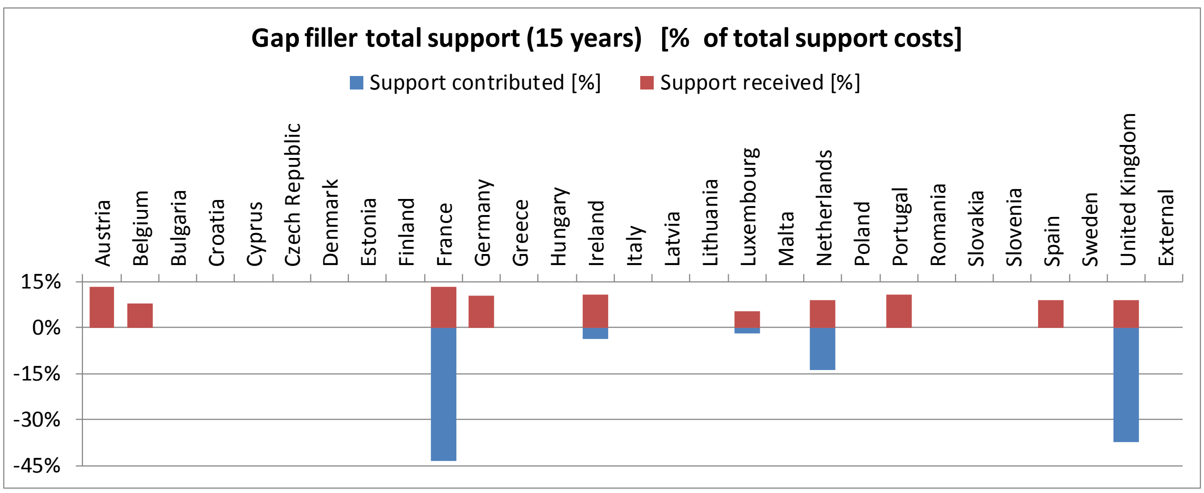
Gap size [%]	3%
Gap size [TWh]	377.3

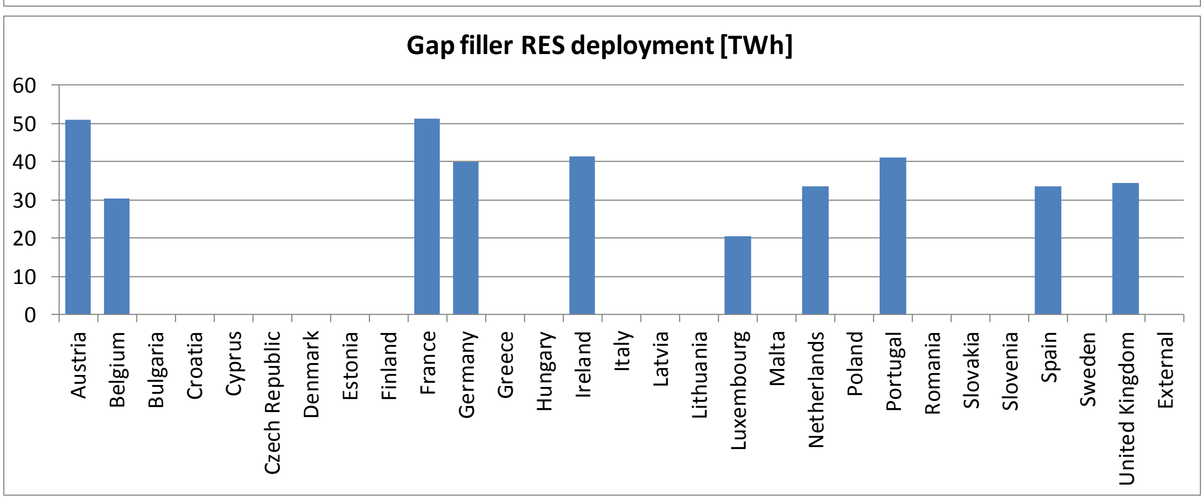
	infl adj	no infl adj
Yearly support costs [bln€/y]	23.7	21.7
Support costs till 2030 [bln€]	237.1	216.7
15 years support costs [bln€]	355.6	325.0

Support region	FR, IE, LU, NL, UK
Deployment region	AT, BE, FR, DE, IE, LU, NL, PT, ES, UK

Technology portfolio	RES-E: Wind On Shore, Solar rooftop, Biomass - Utilities wood	RES-H/C: Heat pumps, Pellet boilers, MSW incineration







Assessment of the results (in comparison to Scenario A Base Case)

- The main difference relates to the required policy support costs:
    - A similar conclusion as the previous case illustration can be drawn: the calculated support costs are very sensitive to the choice of technology.
    - This case example includes a combination of RES-E and RES-HC technologies, the latter being more expensive. When compared with the base case this scenario results in 85% higher yearly support costs, increasing the challenge to gather such high amounts of funding.
    - Similar to the previous case (A_3), the distribution of financial support (and RES deployment) between the MS included in the example is not changed from the base case. However, since the overall support costs are significantly higher, so will the net contributions to be paid by the laggard countries.

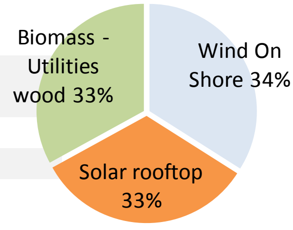
Scenario A$_5$: support region sensitivity – EU (20%) & laggards (80%)

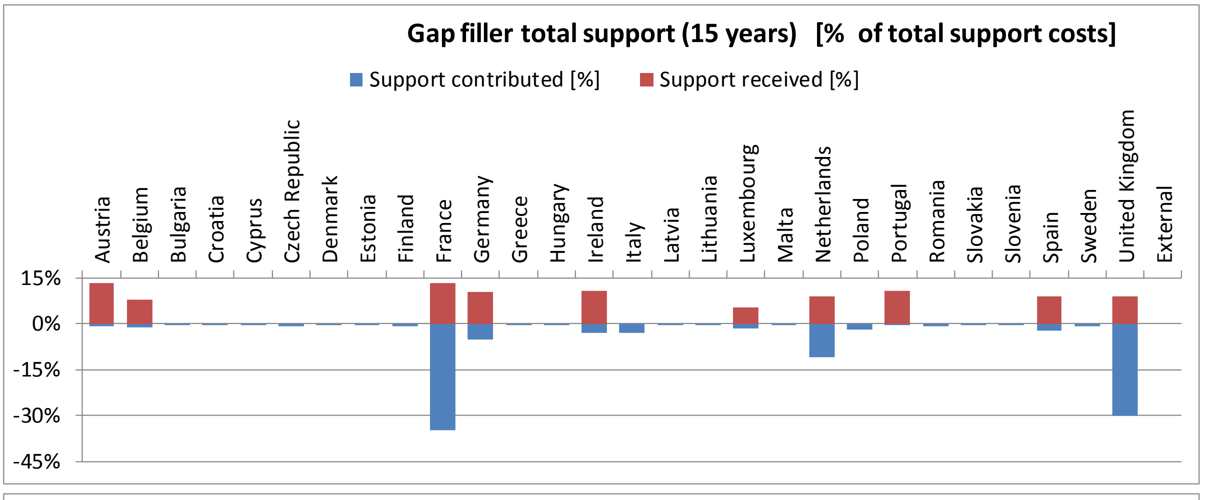
Gap type	Ambition gap
Specify gap at	EU level
Gap size [%]	3.0%
Allocation mechanism	Potential only
Inflation rate	2.0%
Background data	PRIMES projections

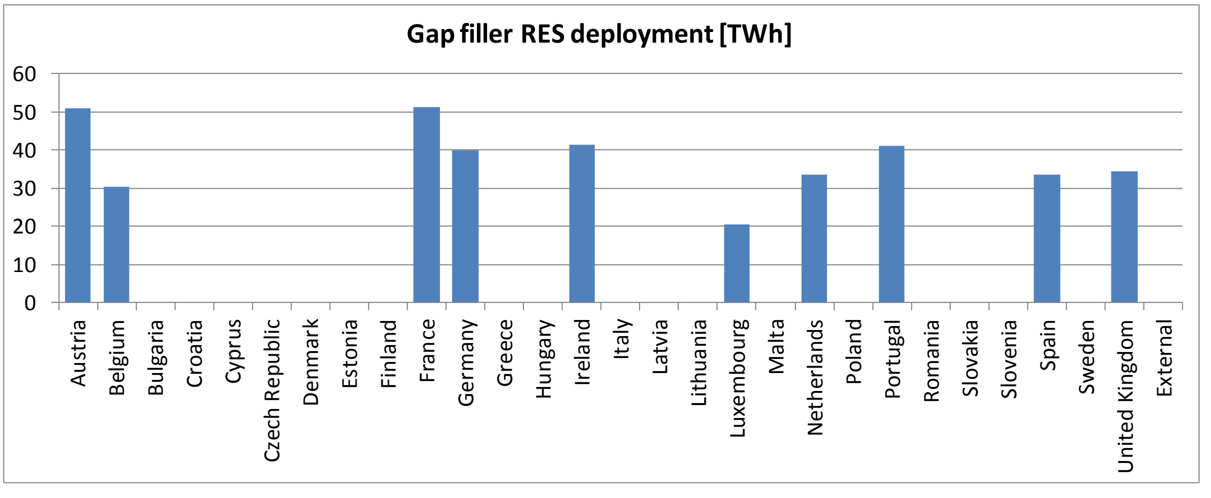
Gap size [%]	3%
Gap size [TWh]	377.3

	infl adj	no infl adj
Yearly support costs [bln€/y]	12.8	10.9
Support costs till 2030 [bln€]	127.8	109.2
15 years support costs [bln€]	191.7	163.8

Support region	80% from FR, IE, LU, NL, UK; 20% from the rest of the EU
Deployment region	AT, BE, FR, DE, IE, LU, NL, PT, ES, UK
Technology portfolio	Wind On Shore, Solar rooftop, Biomass - Utilities wood







Assessment of the results (in comparison to Scenario A Base Case)

- The main difference relates to how the funding can be provided to close the gap:
    - This option assumes a combination of EU funds and the funds derived from the MS that are low in their pledges (in comparison to the selected benchmark methodology).
    - Thus, through EU funds EU28 MS contribute to the 20% and the MS causing the gap contribute to the remaining 80% of the policy support costs.
        - 20% of the support costs is around 2.5€ bn/year and can be received from the existing EIB funds.
        - The remaining 80% is around 10€ bn/year annum. The distribution among the deficit countries is in the range of € 0.2 – 4.4 bn/year , the low end corresponding to Luxembourg and the high end to France.
    - As for the previous cases (e.g. A_3), the distribution of financial support received (and RES deployment) in MS included in the example is not changed from the base case. However, since all MS contribute to the overall support costs, this reduces somewhat the financial burden on the laggard countries.

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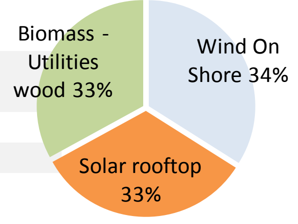
Scenario A_6: support region sensitivity – EU (80%) & laggards (20%)

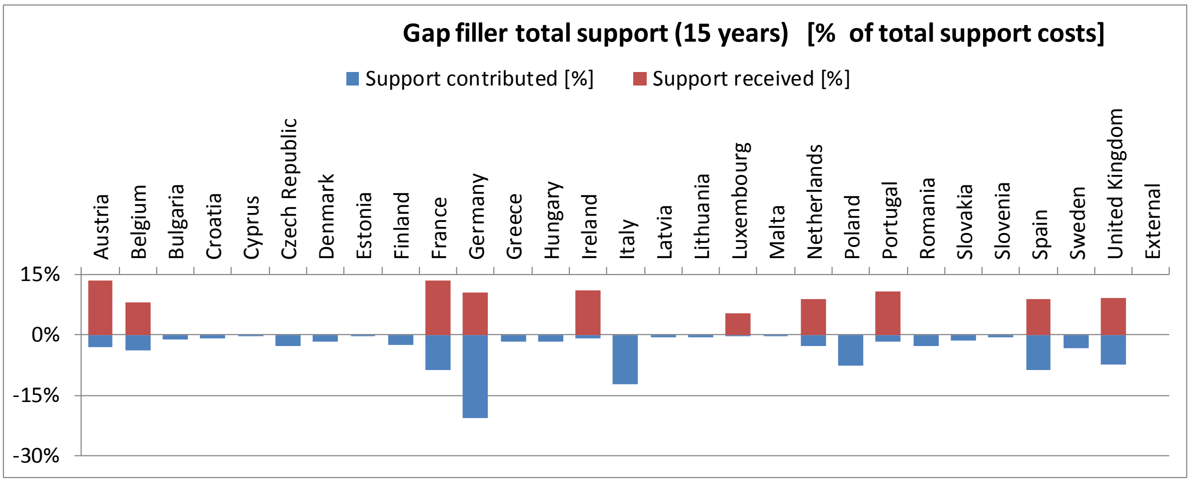
Gap type	Ambition gap
Specify gap at	EU level
Gap size [%]	3.0%
Allocation mechanism	Potential only
Inflation rate	2.0%
Background data	PRIMES projections

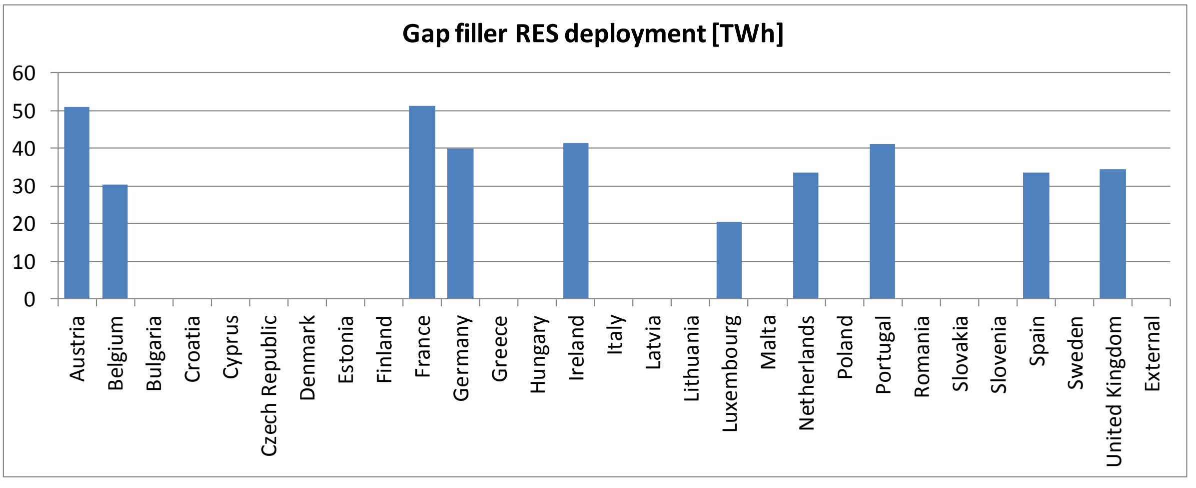
Gap size [%]	3%
Gap size [TWh]	377.3

	infl adj	no infl adj
Yearly support costs [bln€/y]	12.8	10.9
Support costs till 2030 [bln€]	127.8	109.2
15 years support costs [bln€]	191.7	163.8

Support region	20% from FR, IE, LU, NL, UK; 80% from the rest of the EU
Deployment region	AT, BE, FR, DE, IE, LU, NL, PT, ES, UK
Technology portfolio	Wind On Shore, Solar rooftop, Biomass - Utilities wood







Assessment of the results

- The main difference relates to how the funding can be provided to close the gap:
    - This option assumes a combination of EU funds and the funds derived from the MS that are low in their pledges (in comparison to the selected benchmark methodology).
    - Different than the previous one in this case the deficit MS contribute to 20% of the policy support needed and the remaining 80% is closed by the EU Funds.
    - Again, the distribution of financial support received (and RES deployment) in MS is not changed from the base case. As for the previous case (A_6), the financial burden on the laggard countries is further reduced to the extent that all laggard countries now become net beneficiaries.
    - Since this case example still assumes that RES deployment only takes place in the 10 previously mentioned MS, the remaining MS become net contributors.

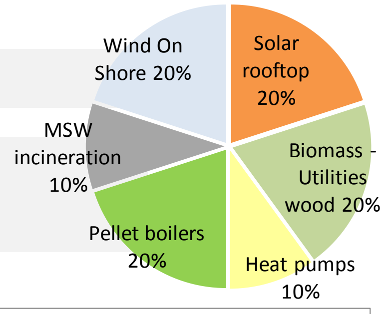
Scenario A$_7$: support region, benefit receiving region & technology portfolio sensitivity – 100% EU fund, EU28 receiving the benefits, RES-E and H/C coverage

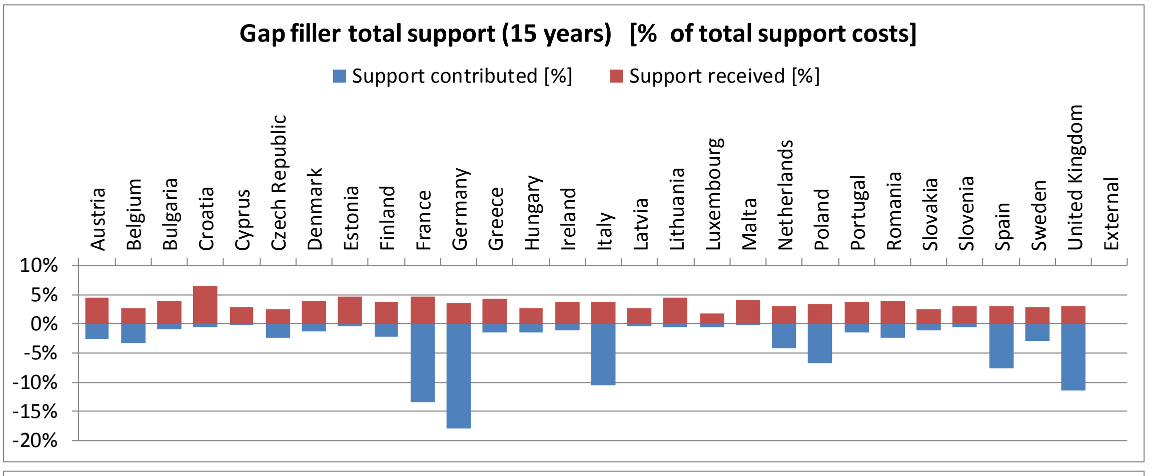
Gap type	Ambition gap
Specify gap at	EU level
Gap size [%]	3.0%
Allocation mechanism	Potential only
Inflation rate	2.0%
Background data	PRIMES projections

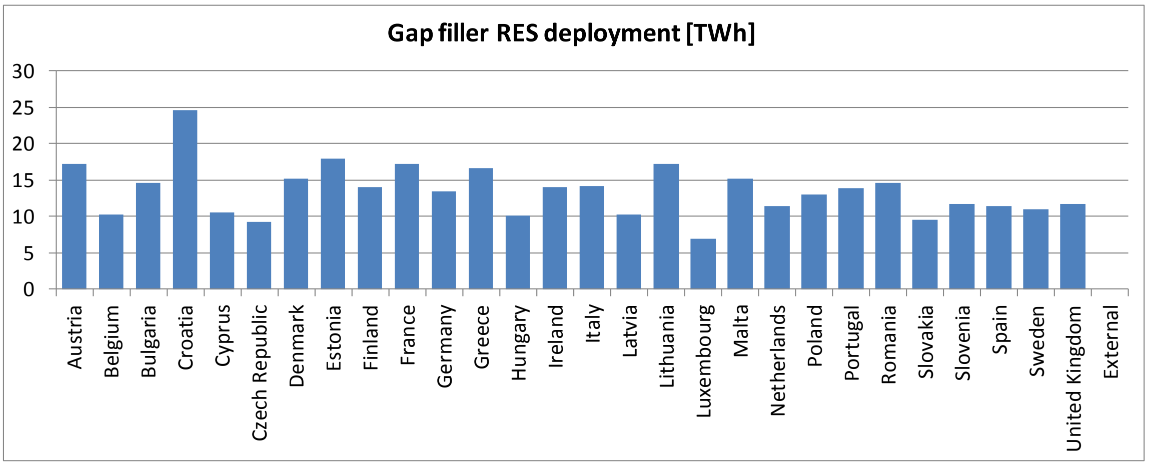
Gap size [%]	3%	
Gap size [TWh]	377.3	
	infl adj	no infl adj
Yearly support costs [bln€/y]	23.7	21.7
Support costs till 2030 [bln€]	237.1	216.7
15 years support costs [bln€]	355.6	325.0

Support region	Whole EU
Deployment region	Whole EU

Technology portfolio	RES-E: Wind On Shore, Solar rooftop, Biomass - Utilities wood	RES-H/C: Heat pumps, Pellet boilers, MSW incineration







Assessment of the results

- In this specific case the benefits are allocated to 28 MS. Additional deployment ranges approximately between 7 - 25 TWh.
- Among the MS countries France, Germany, Italy, the Netherlands, Poland, Spain and the UK contribute more to EU funding than what they receive according to this scenario illustration.
- Belgium, Czech Republic and Sweden receive funding that is equal to their contributions to the EU fund.
- The rest of the countries receive net benefits.
- Among the 5 deficit countries France and the UK enjoy the benefits of this allocation methodology, as their contributions decrease significantly (when compared with scenario A_4 for instance).. Ireland is not very much influenced as the financial contribution of the country to the gap fund is more or less equal to the possible additional RES deployment in the country. Luxembourg and Ireland are among the net contributors.

Scenario A_8: support region, benefit receiving countries & technology portfolio sensitivity – 100% EU fund, above benchmark receiving benefits, RES-E and H/C coverage

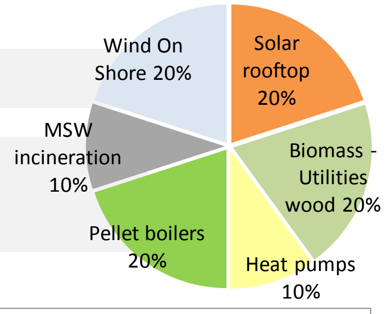
Gap type	Ambition gap
Specify gap at	EU level
Gap size [%]	3.0%
Allocation mechanism	Potential only
Inflation rate	2.0%
Background data	PRIMES projections

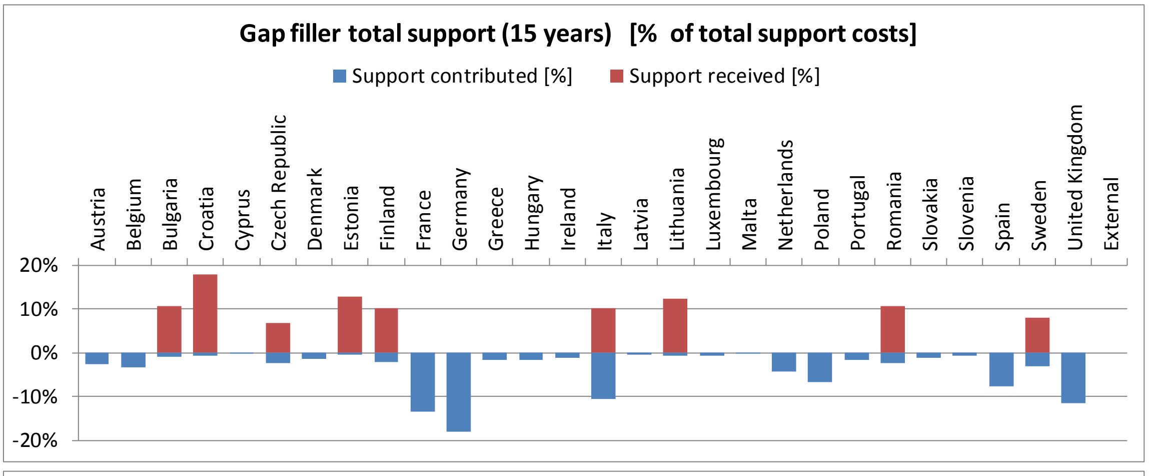
Gap size [%]	3%
Gap size [TWh]	377.3

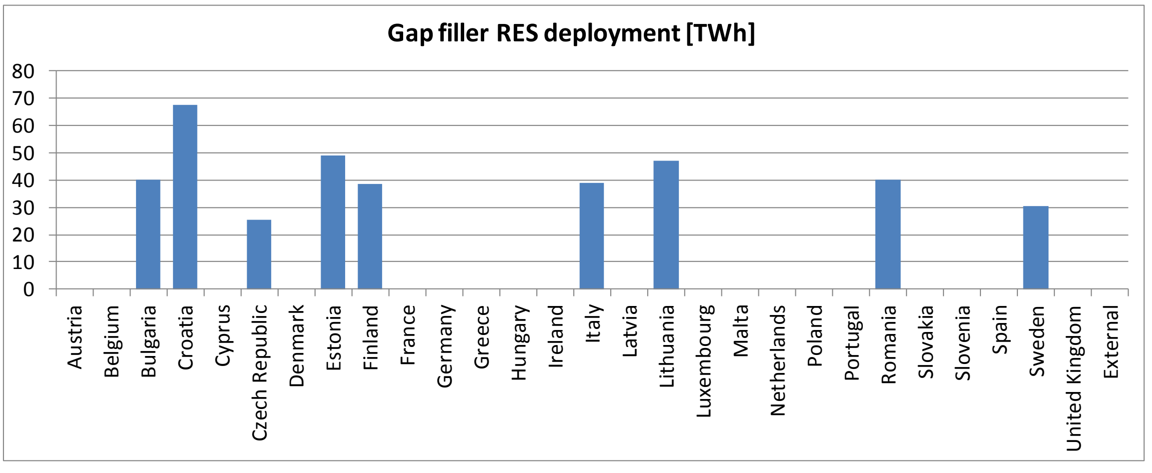
	infl adj	**no infl adj**
Yearly support costs [bln€/y]	23.7	21.7
Support costs till 2030 [bln€]	237.1	216.7
15 years support costs [bln€]	355.6	325.0

Support region	Whole EU
Deployment region	BG, HR, CZ, EE, FI, IT, LT, RO, SE

Technology portfolio	RES-E: Wind On Shore, Solar rooftop, Biomass - Utilities wood	RES-H/C: Heat pumps, Pellet boilers, MSW incineration







Assessment of the results

- Allocating benefits:
    - In this specific case the benefits are allocated to countries that are assumed to pledge above their benchmark, namely Bulgaria, Croatia, the Czech Republic, Estonia, Finland, Italy, Lithuania, Romania and Sweden.
    - The additional RES deployment is approximately in the range of 25.5-67.6 TWh.
    - Croatia, followed by Estonia and Lithuania received the highest fund resulting in larger RES deployment in those countries, thanks to their relatively higher RES potential.
    - Among the EU28 Germany, France, the UK and Italy are the countries that contribute larger support due to their relatively higher GDP per capita and GFEC (the allocation methodology applied to support contribution).

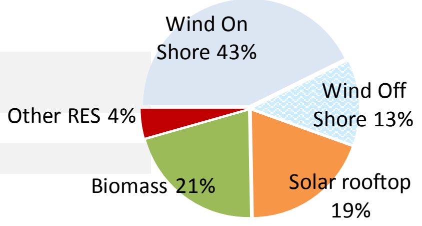
Scenario A$_9$: support region, benefit receiving countries & technology portfolio sensitivity – 100% EU fund, EU28 receiving benefits, all RES-E technologies

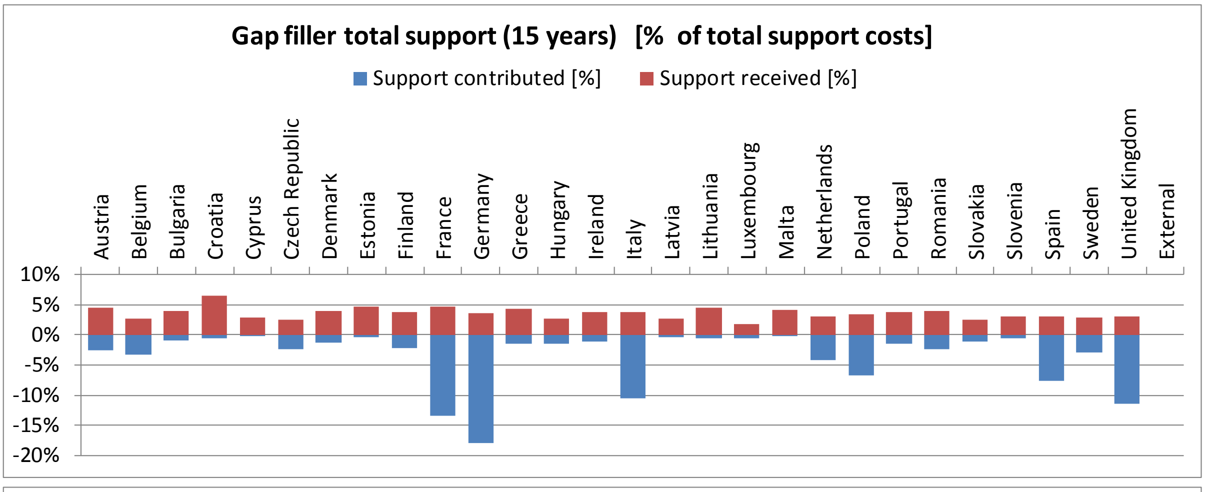
Gap type	Ambition gap
Specify gap at	EU level
Gap size [%]	3.0%
Allocation mechanism	Potential only
Inflation rate	2.0%
Background data	PRIMES projections

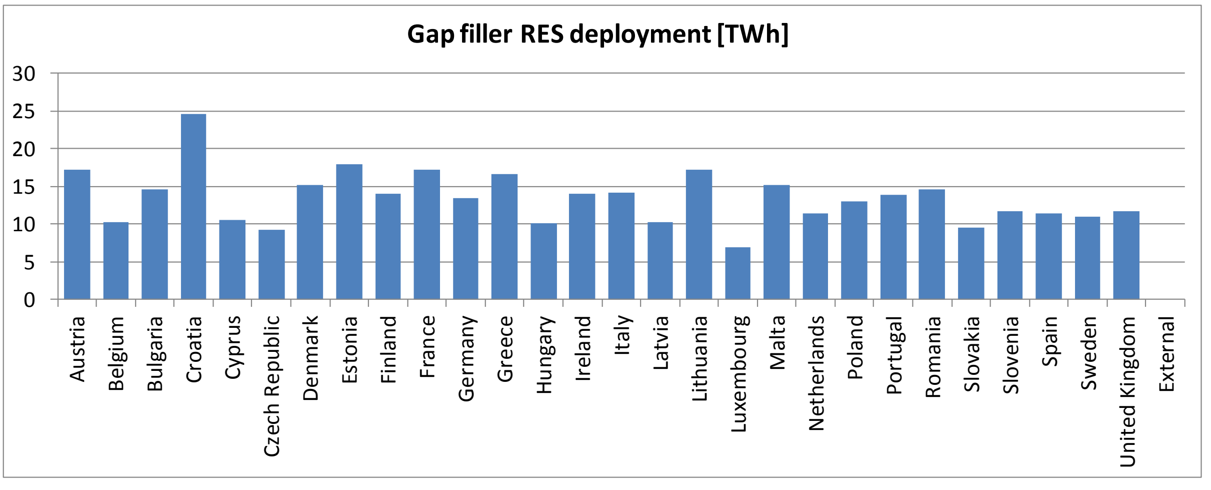
Gap size [%]	3%
Gap size [TWh]	377.3

	infl adj	no infl adj
Yearly support costs [bln€/y]	12.9	11.3
Support costs till 2030 [bln€]	129.2	112.5
15 years support costs [bln€]	193.8	168.8

Support region	Whole EU
Deployment region	Whole EU
Technology portfolio	RES-E: Wind, PV, Biomass, Hydro, Ocean, Geothermal







Assessment of the results

- When compared with A_7 case the main difference relates to the selection of technology composition, thus the level of funding changes drastically.
    - Given the choice of technologies, the yearly support costs needed to fill the ambition gap would be 46% less when compared to the technology portfolio that includes certain RES-E and RES- H/C technologies (yearly support costs decrease from 23.7 €bn/year to 12.9 € bn/year).
    - It is important to highlight that the calculated support costs are very sensitive to the choice of technology. As such, different conclusions can be drawn with different technology mixes.

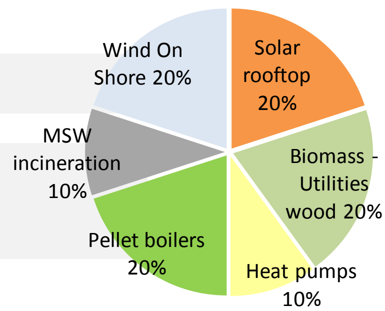
Scenario A_{10}: support region, benefit receiving countries & technology portfolio sensitivity – 100% EU fund, EU28 receiving benefits, benefit allocation based on 2020 methodology

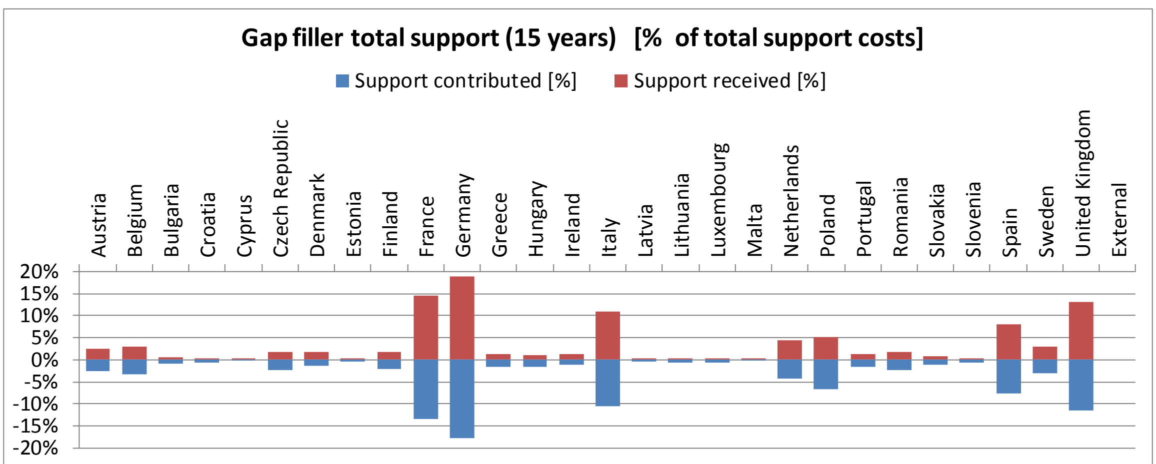
Gap type	Ambition gap
Specify gap at	EU level
Gap size [%]	3.0%
Allocation mechanism	GDP + flat rate
Flat rate [%]	1.5%
Inflation rate	2.0%
Background data	PRIMES projections

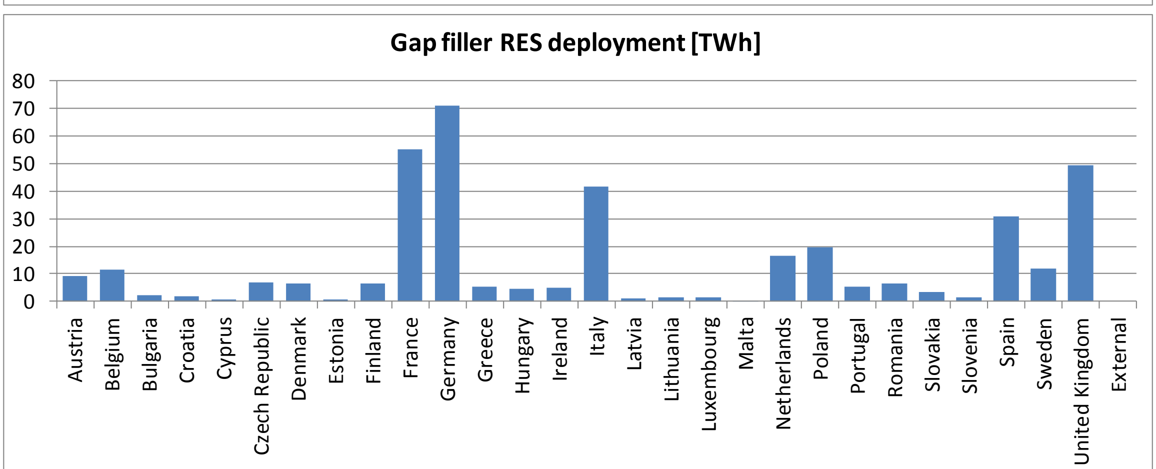
Gap size [%]	3%	
Gap size [TWh]	377.3	
	infl adj	**no infl adj**
Yearly support costs [bln€/y]	23.7	21.7
Support costs till 2030 [bln€]	237.1	216.7
15 years support costs [bln€]	355.6	325.0

Support region	Whole EU
Deployment region	Whole EU

Technology portfolio	RES-E: Wind On Shore, Solar rooftop, Biomass - Utilities wood	RES-H/C: Heat pumps, Pellet boilers, MSW incineration







Assessment of the results

- When compared with Scenario A_7 the main difference relates to allocating the benefits.
  - The 2020 approach that focuses on GDP + flat rate results in quite a divergent RES deployment when compared with the potential-based allocation that resulted in a flatter distribution(see Scenario A_7).
  - The largest deviation occurs in German, the United Kingdom, France, Italy and Spain. The RES deployment in those countries increase more than 150% when compared with the illustration that is based on the potential based approach (Scenario A_7).
  - Croatia, Estonia, Lithuania, Cyprus and Malta face more than 90% decrease in RES deployment (thus funding received) when compared with the potential based approach.

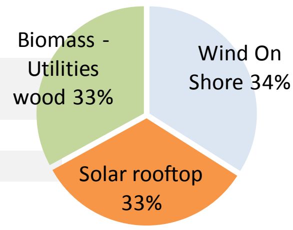
Scenario B: base case

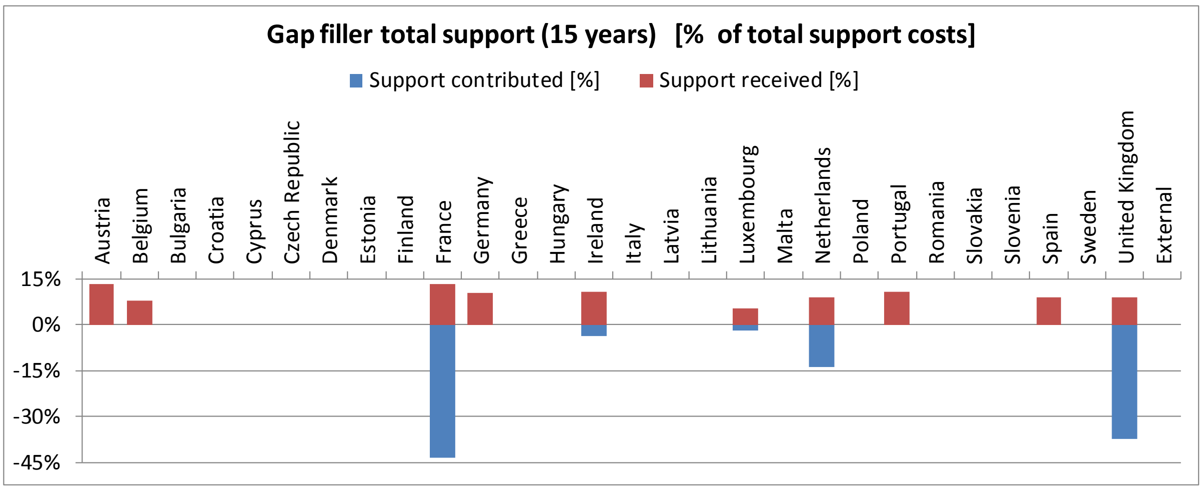
Gap type	Ambition gap
Specify gap at	EU level
Gap size [%]	0.6%
Allocation mechanism	Potential only
Inflation rate	2.0%
Background data	PRIMES projections

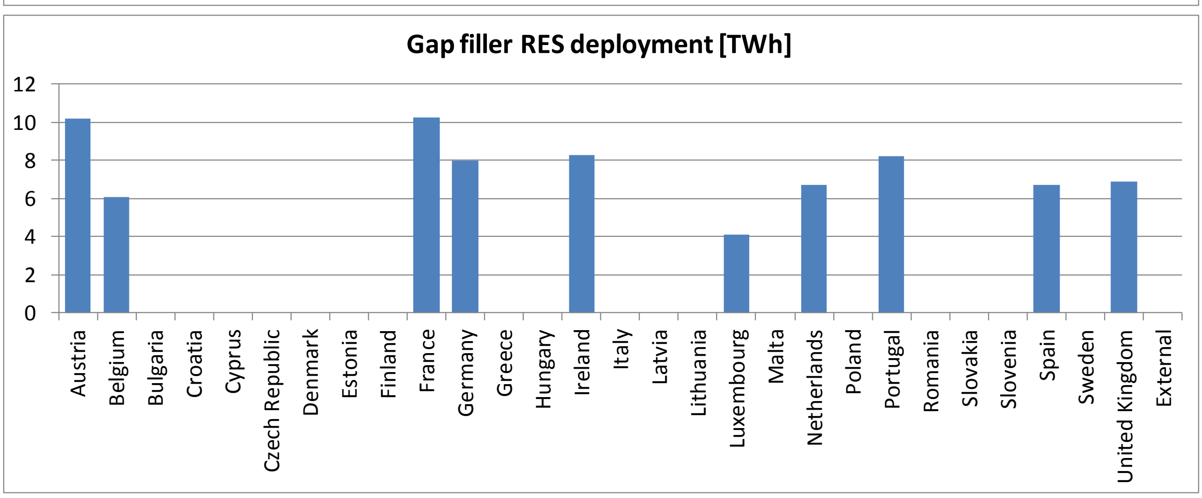
Gap size [%]	0.6%
Gap size [TWh]	75.5

	infl adj	no infl adj
Yearly support costs [bln€/y]	2.6	2.2
Support costs till 2030 [bln€]	25.6	21.8
15 years support costs [bln€]	38.3	32.8

Support region	FR, IE, LU, NL, UK
Deployment region	AT, BE, FR, DE, IE, LU, NL, PT, ES, UK
Technology portfolio	Wind On Shore, Solar rooftop, Biomass - Utilities wood







Assessment of the results

- Policy support costs (the difference between the average electricity price and the production cost of RE-E)
    - Given the choice of technologies, the yearly support costs needed to fill the ambition gap would very roughly be in the order of 2.6€ bn/year, implying that total support costs in the period to 2030 would be in the order of 25.6€ bn. Should the support costs be adapted to the economic lifetime of a project, 15 years (which is common for most technologies under the Dutch SDE+ scheme), the indicative support costs needed would be in the order of 39€ bn.
    - To put these figures into perspective, the yearly investment need is around 1.8 times the average EIB annual investments on RES[79].
- Funding requirements:
    - Above comparison indicates a slightly higher investment derived from for instance the EIB can be sufficient enough to cover the gap.
    - Nevertheless, we assume in this case that the countries causing the gap will contribute to funding the gap. The contributions are based on the GDP/capita of the MS.
    - Funding requirements from the MS that 'under-pledge' (in this case 5 under-pledging countries) would be in the range of 0.04 -1.1 bill €/year.
    - As mentioned in case A above, these funds e.g. could potentially be taken from MS pre-allocation of EU structural funds and/or EU ETS auctioning revenues (potentially earmarked for RES deployment/gap filler measures).
- Allocating benefits:
    - In this specific case the benefits are allocated to 10 MS, with two countries benefiting the highest. Additional deployment ranges approximately between 4 - 10 TWh.

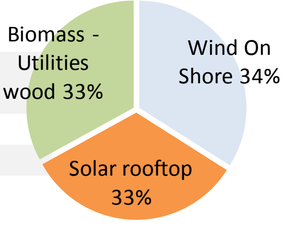
[79] The EIB has been investing 2 to 4 bn € per year in RES generation. We considered the average as 3 bn €. According to the tool the yearly investment needs is around €5.4 bn/year between 2020 and 2030.

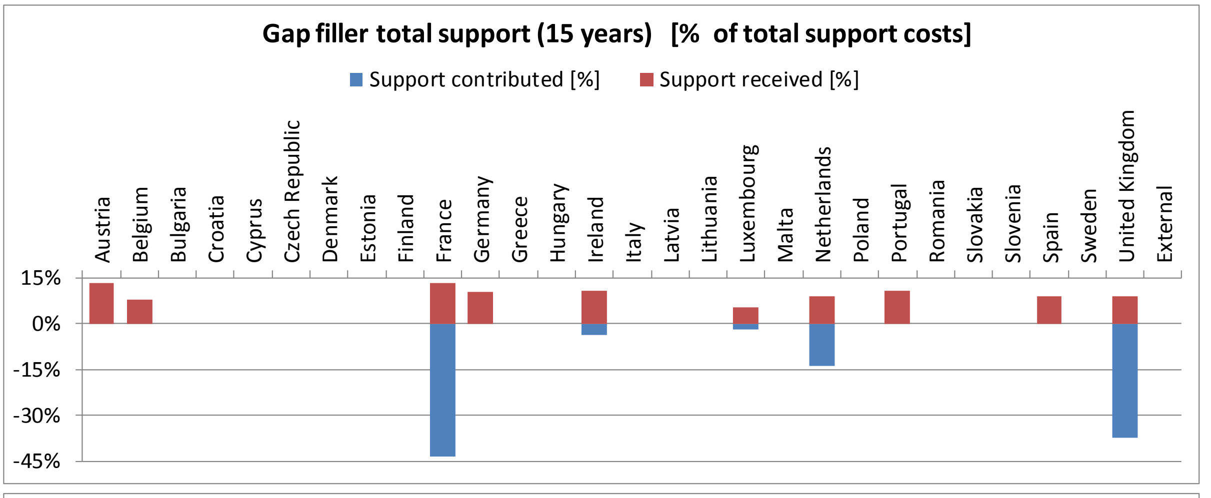
Scenario C: Base case

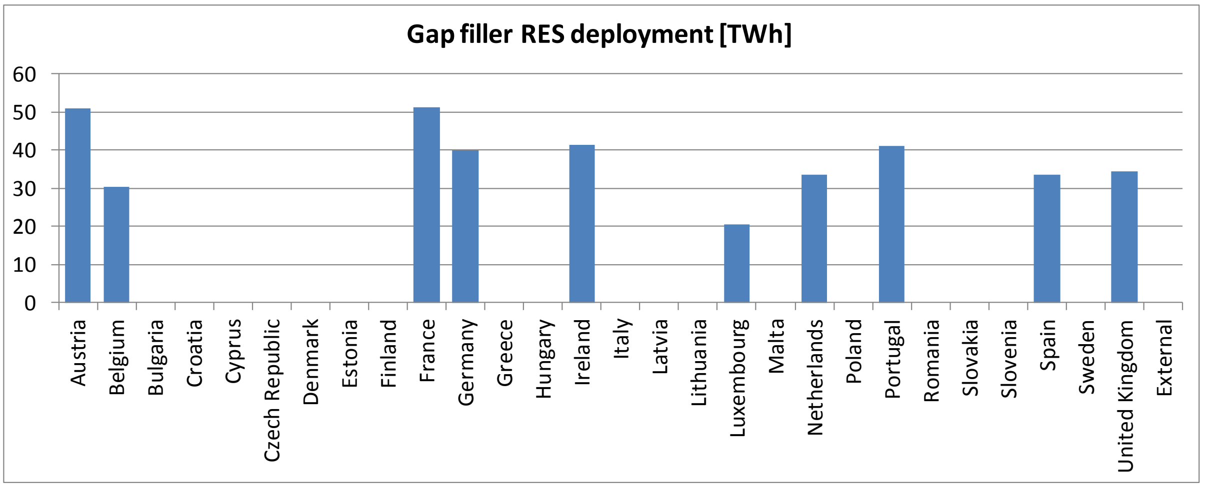
Gap type	Delivery gap (2025)
Specify gap at	EU level
Gap size [%]	3.0%
Allocation mechanism	Potential only
Inflation rate	2.0%
Background data	PRIMES projections

Gap size [%]	3%	
Gap size [TWh]	377.3	
	infl adj	**no infl adj**
Yearly support costs [bln€/y]	6.7	5.2
Support costs till 2030 [bln€]	33.6	26.2
15 years support costs [bln€]	100.9	78.6

Support region	FR, IE, LU, NL, UK
Deployment region	AT, BE, FR, DE, IE, LU, NL, PT, ES, UK
Technology portfolio	Wind On Shore, Solar rooftop, Biomass - Utilities wood







Assessment of the results

- Policy support costs (the difference between the average electricity price and the production cost of RE-E)
    - Given the choice of technologies, the yearly support costs needed to fill the delivery gap would very roughly be in the order of 6.7€ bn/year, implying that total support costs in the period to 2030 would be in the order of 33.6€ bn.
    - Even through the amount of the gap is the same as the ambition gap (both 377.3 TWh) the total investment cost in this case is 7.5% less. This is related to the time perspective. The delivery gap mechanism is assumed to be activated after 2025 and the investment costs of the selected technologies have been reduced due to technology learning.
    - However, the yearly investment needs will be much higher when compared with the base case (scenario A). The investment will need to happen in 5 years' time while the time frame in scenario A was 10 years' to close the gap.
    - This results in yearly investment need that is around 17 times the average EIB annual investments on RES[80].
- Funding requirements:
    - We assume that the countries causing the gap will contribute to funding the gap. The contributions are based on the GDP/capita approach.
    - The policy support costs from the lagging behind countries will be in the range of €0.1-2.9 bln/a to a pool. The high end belongs to France and the low end to Luxemburg.
    - .
- Allocating benefits:
    - In proportion, similar to case A above.

[80] The EIB has been investing 2 to 4 bn € per year in RES generation. We considered the average as 3 bn €.

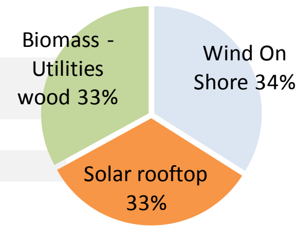
Scenario D: Base case

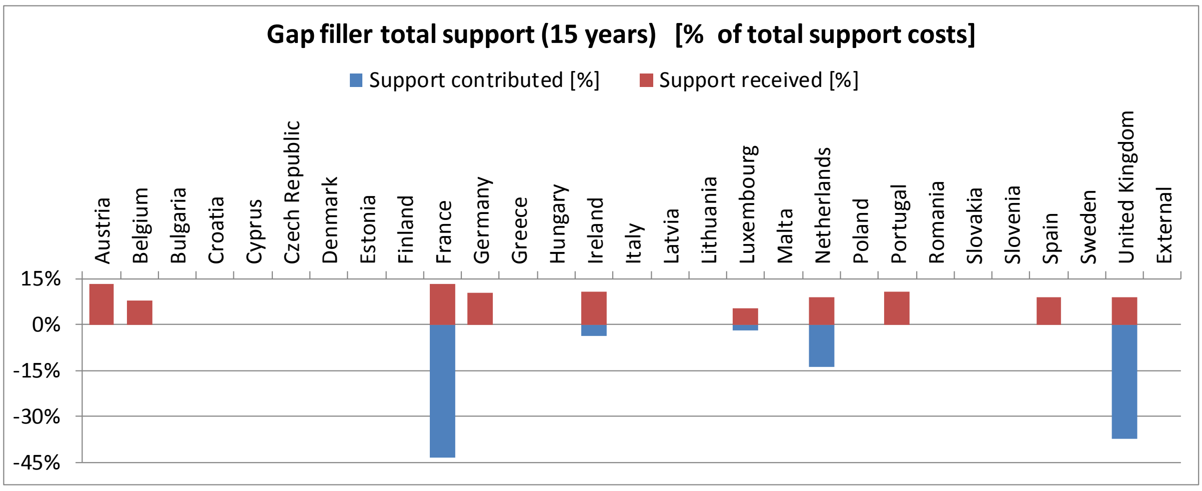
Gap type	Delivery gap (2025)
Specify gap at	EU level
Gap size [%]	0.6%
Allocation mechanism	Potential only
Inflation rate	2.0%
Background data	PRIMES projections

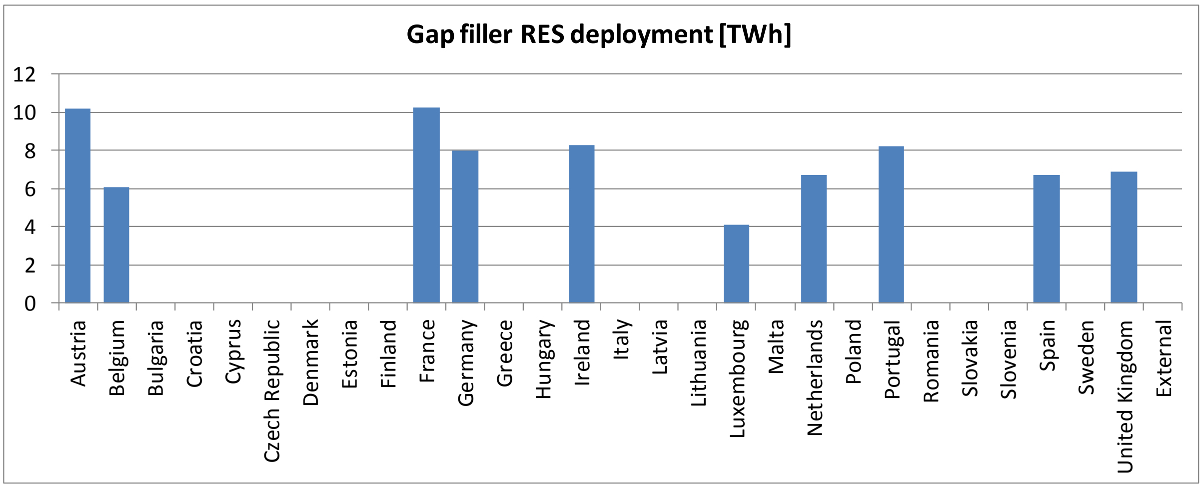
Gap size [%]	0.6%
Gap size [TWh]	75.5

	infl adj	no infl adj
Yearly support costs [bln€/y]	1.3	1.0
Support costs till 2030 [bln€]	6.7	5.2
15 years support costs [bln€]	20.2	15.7

Support region	FR, IE, LU, NL, UK
Deployment region	AT, BE, FR, DE, IE, LU, NL, PT, ES, UK
Technology portfolio	Wind On Shore, Solar rooftop, Biomass - Utilities wood







Assessment of the results

- Policy support costs (the difference between the average electricity price and the production cost of RE-E)
    - Given the choice of technologies, the yearly support costs needed to fill the delivery gap would very roughly be in the order of 1.3€ bn/year, implying that total support costs in the period to 2030 would be in the order of 6.7€ bn. Should the support costs be adapted to the economic lifetime of a project e.g. 15 years, the indicative support costs needed would be in the order of 20.2€ bn.
    - To put these figure into perspective, the order of magnitude yearly investment need is around 3.3 times the average EIB annual investments on RES[81].
- Funding requirements:
    - Funding requirements from the MS that 'under-pledge' (in this case 5 under-pledging countries), based on the GDP approach, would be in the order of € 0.02 – 0.6 bn/year.
- Allocating benefits:
    - In this specific case the benefits are allocated to 10 MS. Additional deployment in those countries would range approximately between 4 - 10 TWh.

[81] The EIB has been investing 2 to 4 bn € per year in RES generation. We considered the average as 3 bn €.

Overall conclusions

- On the funding needs (to cover the support costs), we have to be careful in drawing conclusions given the limitation of the excel tool, i.e. it does not allow for differentiated CAPEX/OPEX costs across the EU. Keeping this in mind, we note that
  - the gap size (and notably how much funding would be need to close the gap) will define the implementation options;
  - our results indicate the importance of the targeted technology portfolio. Including heat technologies into the portfolio has resulted in higher support costs when compared with RES-E only option that included onshore wind, solar rooftop and biomass technologies;
  - however, this result is not sufficient enough to conclude that a sole focus on RES-E can result in lower funding requirements. A different combination of technologies (i.e. including offshore wind and geothermal into RES-E technology portfolio) will provide different outcomes;
  - naturally, the funding needs (support costs) will be lower later in the decade, e.g. in 2025 compared to 2020 for a given gap size and technology portfolio, since we assume technology learning and cost reductions in the period.
  - In spite of these cost reductions, the very short time frame to close the delivery gap will require significantly higher annual investments when compared with an ambition gap of the same size.
- On the cost sharing, we note that
  - putting the full burden of funding the costs of filling the gap on the laggards and allowing MS to compete in a Common RES auctioning to deploy RES to fill the gap is likely to result in the some or all of the laggards being net-contributors;
  - the size of the gap does not change this picture;
  - the more MS participating in the Common RES auctioning, i.e. the wider the spread of RES deployment to fill the gap (the larger the number of beneficiaries), the less RES deployment will take place in the laggard countries, thus increasing the size of their net funding contribution;
  - sharing the burden (funding the costs of filling the gap) across all MS, will change the results with respect to net beneficiaries and net contributors. In our case illustration, if all MS contribute equally, and the gap filling deployment takes place in a few MS including the laggard countries, the laggards countries are no longer net contributors but net-beneficiaries.
  - The approach used to distribute the benefits have a critical role. While potential based approach resulted in more even distribution of RES deployment, the 2020 approach (flat rate + GDP) presented more uneven distribution of the RES among the MS.

2 Task 2: EU wide measures and policies for mainstreaming renewable energy

2.1 Unlocking long-term funding and financing

Unlocking long term funding and financing is strongly related to the risks and returns of RES projects for the investors. In the end, for commercial financial institutions, whether or not to invest in a project, comes down whether the returns cover for the risks they take. The risks are reflected in the interest (in case of debt) or IRR requirements (in case of equity), or, taken together, in the so called cost of capital. Investors will judge whether the revenues from projects will be sufficient and certain enough to cover the risks. Different types of investors judge risks in a different manner: for instance institutional investors highly value certainty and can therefore request for a limited return (interest), while venture capitalists invest in highly risky capital thereby betting on a high return.

From this analysis of risks, a number of bottlenecks to finance RES will follow. The next section will discuss possible categories of measures to cover for the bottlenecks. This section will as well discuss existing instruments in these categories of measures.

Based on the analysis of existing instruments and bottlenecks, solutions to solving the remaining bottlenecks will be discussed at the end of this paragraph.

This analysis is relevant for all RES sectors. However, as paragraphs 2.2 and 2.3 focus on respectively RES Transport and RES Heating and Cooling, the analysis of long-term funding and financing will mainly focus on renewable electricity.

2.1.1 Bottlenecks based on the risks in RES projects

This paragraph will describe the bottlenecks in RES projects from a financing perspective. As risks are reflected in the cost of capital (WACC), we will base the analysis on the categories of risks in the WACC. First we will describe the risks and cost of capital in RES in Europe, followed by different categories of risks and a description of these categories subsequently.

2.1.1.1 Cost of capital for RES projects

RES projects like solar and wind projects have large upfront capital investments in combination with low O&M costs. This frontloaded cost structure makes these RES projects relatively more risky to investors as they have to invest the majority before the system becomes operational and possibly profitable. In comparison to, for instance, fossil fuel based power plants, solar farms and wind farms have a disproportional high amount of capital expenditures compared to operational expenditures, since there are no feedstock cost. Given this risk of upfront capital, investors require relatively high returns which increases the cost of capital. As mentioned above, given the large initial investment, a high cost of capital influences the feasibility considerably. At the same time, these large costs need to be fully recovered by the revenue stream generated by the project. These characteristics mainly apply to RES projects like solar and wind farms, and less for biomass plants. Biomass plants resemble more the cost structure of fossil fuel based power plants, including a feedstock cost, and therefore have a relatively smaller risk of upfront capital.

The project "Policy Dialogue on the assessment and convergence of RES policy in EU Member States", or in short, Dia-Core[82], that is carried out under the Intelligent Energy – Europe program, recently published the results[83] of the study "The impact of risks in renewable energy investments and the role of smart policies". In this study, the current cost of capital of onshore wind projects across the EU is estimated and the impact of different policy designs with respect to lowering the WACC assessed. The main findings of the WACC in the MS are based on a theoretical model that was constructed to estimate the cost of equity and cost of debt. These results were evaluated and tested during interviews with financial experts of 26 MS.

The main result of this study is that the WACC of onshore wind projects in the EU varied across MS between 3,5% (in Germany) and 12% (in Greece) in 2014. The following figure from the Dia-Core projects provides the WACC for each MS.

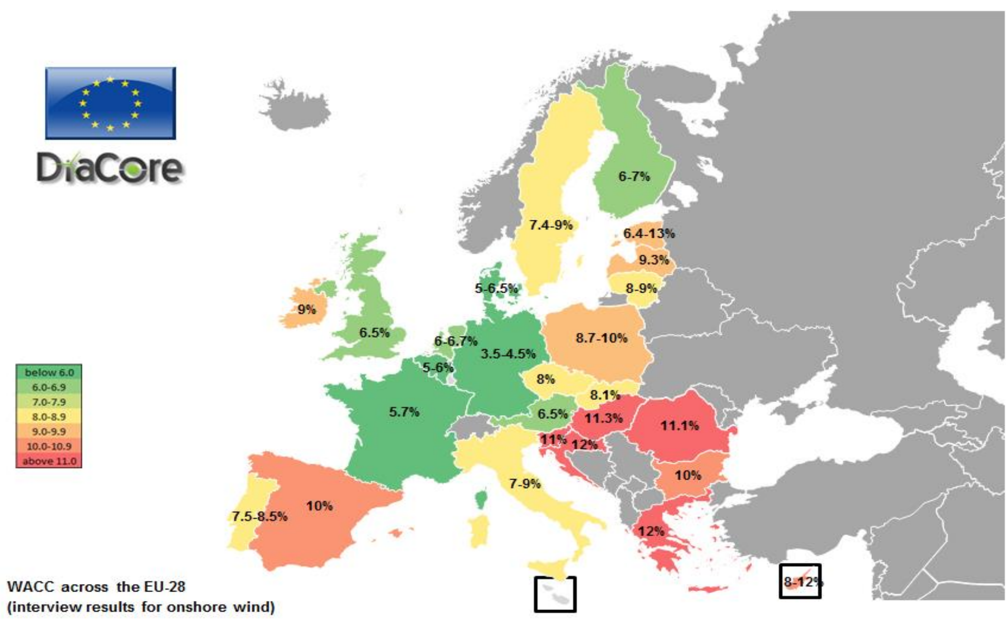


Figure 16 WACC across MS for onshore wind projects in 2014 as published by Dia-Core

Although these main findings are assumed to be correct, they do not give a comprehensive view of how the WACC is built up in the different countries. This is because the whole WACC is aggregated in these figures to a single number representing all the risks, based on only a limited number of projects. Therefore,

82 www.diacore.eu
83 http://diacore.eu/images/files2/WP3-Final%20Report/diacore-2016-impact-of-risk-in-res-investments.pdf

this result is interesting for assessing the differences between the MS but does not provide an insight in the underlying risks and possible risk mitigation measures.

The underlying risks are the most important parameters for the total WACC and are therefore paramount to fully understand. For example, two onshore wind farms of exactly the same size in the same country (and even approximately at the same location) can still yield different WACCs. This could be due to multiple reasons, e.g. different turbine contracts resulting in a different risk profile and therefore a different WACC. But there are plenty of other reasons to think of why this WACC could differ. Therefore, knowing the WACC in the different MS for onshore wind projects is not essential as such, but the underlying reasons and risks are. Only this latter data could provide a solution to understanding the differences in the MS and propose targeted policy measures for each.

Example WACC differences in the Netherlands

To indicate the difficulty of assessing general WACC rates for countries an example between two onshore wind parks and a geothermal project is given here. The onshore wind parks are both in the province of Flevoland, the Netherlands. Both have a similar installed capacity and were planned in the same time period to be constructed. One of the wind parks is planned on a dike, the other is planned on the lake-side of a dike. The risk free rate, country specific rate and even sector specific rate are similar for both projects. However, the project specific rate differs on two points: 1.) The risk of building a wind park on the lake-side of a dike is considered higher than the risk of building a wind park on the dike itself; 2.) In the lake-side project there were three equity shareholders, while in the project on the dike there were 26 equity shareholders. These two reasons contributed to the project specific risk rate of both projects in such a way that the wind project that was proposed on a dike conceived a lower WACC than the project on the lake-side of a dike. However, both the WACC rates are again different in comparison to a geothermal project in the Netherlands. This is not only due to the sector specific rate and the project specific rate, but also because the debt-equity ratio in the geothermal project is different (usually 50-60% equity for geothermal compared to 10% equity for onshore wind), since it is a less proven technology. Thus, the WACC cannot be generalized in each country but is specific depending on the project location, technology and setting.

2.1.1.2 Categories of risks

The cost of capital is basically built on the risk free rate and several premiums reflecting different type of risks. The risk free rate is equal for all member states and projects, and covers, for instance, general inflation risks. Currently, as described in paragraph 1.1.2.1, the risk free rate is extremely low.

We distinguish three main types of risks causing risk premiums, namely:

- Country specific risk: This includes the general investment risk in a country, as well as the risk associated with RES projects in a specific country, such as (RE) policy risks.
- Sector specific risk: This includes the risk that is associated with RES in general, but more specifically with each different RES technology (e.g. wind, geothermal, solar etc.)

- <u>Project specific risk:</u> This risk is dependent on project characteristics such as the geographical location, specific project contracts and the other investors that are involved in the project.

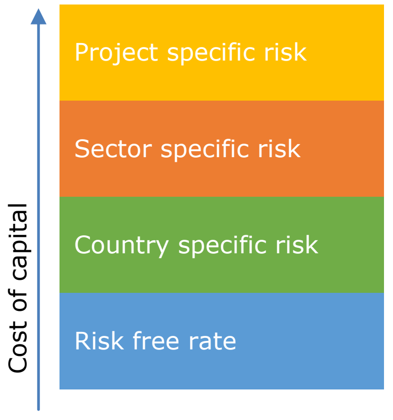


Figure 17 Cost of capital risk components

Every debt provider and equity provider examines these risks and assesses the interest rate (debt) or required return on investment (equity) on a combination of these risks. The different risk categories should be treated separately, since they can deviate quite far in different projects and countries. For an exact similar project in two different MS (which is only possible in theory), differences in the WACC would be completely based on country specific risks, such as policy design and general investment appetite. As no project is the same, this can however not be said for a total WACC as presented in the Dia-Core study. For example, the given WACC of 5,7% in France and 5,6% in Belgium for onshore wind projects indicate a similar perceived risk for investments in both countries. However, it cannot be extracted to which extend this risk is due to the country risk and to which extent due to sector or project specific risks. Moreover, other, more innovative or immature RES technologies such as geothermal projects require a different debt-equity structure than more mature technologies such as wind and solar projects, since debt providers have a smaller appetite for the first. In this hypothesis the WACC would turn out to differ significantly from the rates provided by the Dia-Core research.

These notes make the results from the Dia-Core research only suitable for a broad comparison of the WACC and associated perceived risk for RES projects between the MS.

The underlying cost of debt and cost of equity results of the WACC that are presented in the Dia-Core research give a general impression of the large differences throughout the EU Member States. In 2014 the cost of equity for onshore wind projects ranged from 6% in Germany up to 15% in the Baltic states, Romania, Greece and Slovenia. For the cost of debt a similar division was visible: From 1,8% in Germany to 12,6% in Greece. Other large differences were found in the general debt-equity structure for onshore wind farms of the different MS. Since generally debt financing requires a much lower return on investment than equity, this also has an impact on the differences seen in the WACC.

2.1.1.3 Country risk

The Dia-Core study did not only look into the WACC in different MS, it also studies the main drivers of risks behind the WACC in the different MS. The study identified nine risk categories specifically for RES investments. Relating these risks to the before-mentioned risk categories results in the following list (the size of the blocks are not meant to reflect the size of the risk):

Table 18 Relating the nine DiaCore risks to the four general cost of capital risks

Dia-Core risks		Cost of capital
Administrative risk Grid access risk	Financial risk	Project specific risk
Technical & management risk Social acceptance risk	Financial risk	Sector specific risk
Policy design risk Market design & regulatory risk Sudden policy change risk Country risk *(out of scope in Dia-Core study)*	Financial risk	Country specific risk
	Financial risk	Risk free rate

Based on expert interviews with financial specialists, a ranking of the top risks per MS has been generated. The following figure presents the top risk per MS as published by Dia-Core.

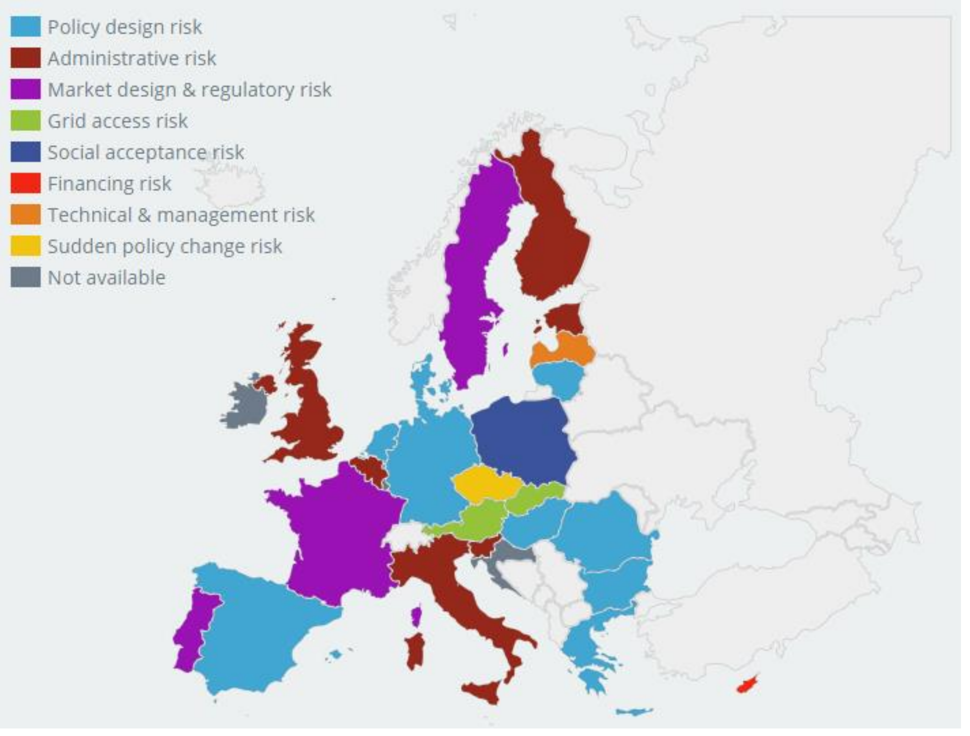


Figure 18 Top-ranked Risk by Member State as published by Dia-Core

The main finding of the study is that the risk induced by policy design (a country risk) is perceived as the most pressing as it determines the level of certainty provided to project developers. Policy schemes that are beneficial for investors are, for example, the use of feed-in tariff or quotas. At the same time, 'Financing Risk' (defined as the risks that arise from scarcity of available capital) is only ranked the primary risk in one country, namely Cyprus. Based on the findings of the Dia-core study it can thus be concluded that the general availability of capital is not the bottleneck.

From the Dia-Core study and the specification of risks associated with the WACC we can conclude that the costs of capital strongly differs per project, partially due to differences in country risk, such as policy design. These risks can greatly affect the cost of capital and thus the feasibility of a project. Countries with a national act and approved laws that enforce RES deployment, such as Germany, have a high credibility with regard to support structures for RES deployment and thus have a relatively low perceived risk compared to other MS. The countries that have yet to embed RES in laws and policies experience a higher cost of capital.

As illustrated in the text box below, RES policy design options result in specific risk profiles. The main policy designs, feed-in tariffs, feed-in premiums and quota obligations, are therefore perceived differently by potential investors in RE.

Investor perspective on policy design options

With regard to the instrument design of policies and support schemes it can be concluded that from an investors' point of view feed-in tariffs or premiums are more appealing than quota schemes: Quota schemes can only provide more revenue certainty on the volume, not the price. A feed-in tariff or premium also limits the price risk. However, they have proven to be a costly scheme, which bears the risk of premature abolishment of this policy in times of low economic prosperity. A feed-in premium on the other hand provides some exposure to market volatile if the premium is fixed at a certain price. A Contract for Difference (or sliding) premium is a scheme that combines the best of those two feed-in tariffs. The premium is a function of the wholesale electricity price and varies accordingly while guaranteeing a certain tariff to the producer. By reducing exposure to market price risk, this provides the revenue certainty needed for investors. The burden can be lowered even more when the Contract for Difference is granted in a tender or auction process.

Uncertainty about the time frame of support schemes and especially the risk of sudden or drastic changes to the RES support scheme also makes investors reluctant to consider RES projects. Thus, clarity on the policy period and the possible future caps to a program are essential.

Another bottleneck concerning policy design is the difference in instruments per MS. Financiers have investment teams, who specialize in specific sectors. The RES market is a complex market with (from most investors' perspective) small projects and extensive regulation and incentive schemes, requiring an extensive knowledge base in order to be able to invest. Regardless of the (political) feasibility, from the perspective of a commercial financial institution, incentive schemes across the EU should be harmonized.

Not only the type of measure, but also the stability of policies strongly adds to the risk perceived by investors. A poll by Bloomberg[84] showed that political movements on RES policies were unsettling the financial community and potentially pushing up the cost of capital. New policies create additional complexity to new investments. However, the largest risk for investors lies in changing policy for existing projects. Investors make their investment decisions based on a cost and revenue forecast.

The cost of capital reflects the risks investors foresee in this future revenue stream. A FiT or FiP creates certainty for investors especially for relatively mature technologies (mainly onshore wind). Investors will therefore provide capital with relatively low costs. Especially banks or other debt providers can – considering the currently low general interest rates (see paragraph 1.1.2.1)– provide debt at low cost. Cost of capital for the nearly-mature technologies in countries with a sufficing scheme is thus already low.

However, in those countries without FiT, FiP or quota obligations, or in case of retrofitting this certainty drops, which creates again a higher WACC. Since in general RES projects have limited returns and thus cannot be feasible when confronted with high WACCs, this policy uncertainty can add significant boundaries to the feasibility of RES projects. For example, the elimination of existing policy schemes in Spain and Bulgaria (as illustrated in paragraph 1.1.2.1) caused a lack of confidence by investors in the RES policy in these MS. This is also illustrated by the Bulgaria case study.

The picture below shows the results of these differences: about 40% in 2014 and more than half in 2015 of the investments in new RES capacity where done in two MS. The investments in other countries is significantly smaller to negligible.

[84] Bloomberg New Energy Finance (2013). How to attract new sources of capital to EU renewables. UNEP (2013). Green energy 2013 – Key Findings.

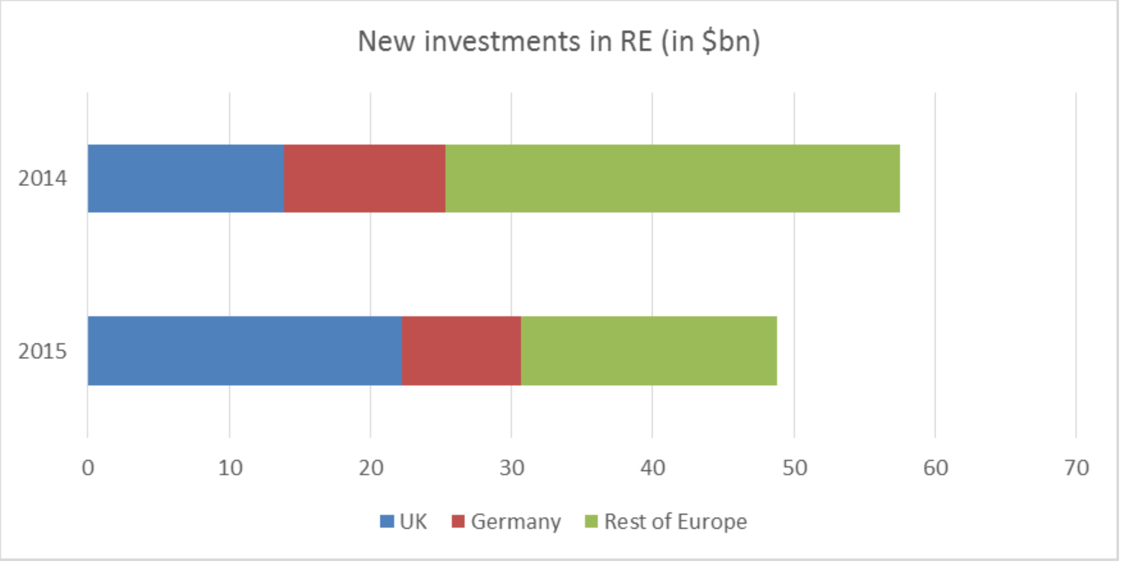


Figure 19 New investments in renewable energy capacity in 2014 and 2015. Bloomberg New Energy Finance (2015 and 2016)

2.1.1.4 Sector risks

The sector risks could be approximated to the RES sector as a whole and, in more detail, to the different RES technologies specific. The underlying risks that are associated with, and expressed in, the sector risks in the Dia-Core research are the technological and management risks and the social acceptance risk.

Although some studies approach the RES sector as a whole to determine a sector specific risk rate, a more accurate rendition of the risks is provided when a distinction is made between different RES technologies. This provides more information on the underlying differences and therefore gives a more detailed sector risk rate. Additionally it provides an insight in the complexity of the sector risk rate related to RES technologies. Regarding the timeframe of the RES sector risks a subdivision can be made in the (pre-)development phase and the operational phase. A further elaboration on this subdivision in phases and the corresponding risks per phase can be found in paragraph 2.1.1.6.

Scoping top-down and considering the energy sector - and RES sector more specific- as a whole, one of the biggest sector risks are the declining energy prices (as mentioned in paragraph 1.1.2.1). This risk has an enormous impact on the revenues of RES projects and could destabilize investments in the RES sector, since RES projects generally thrive with high energy prices. Only in those countries where the price risk is fully covered by the incentive scheme (feed in tariff schemes), the low energy prices will not have an impact.

In figure 5 (found in paragraph 1.1.2.1) the maturity curve for different RES technologies is shown. In general, the sector specific risk declines with the maturity of a technology. Hydro and onshore wind are relatively mature technologies, where the technological challenges are known and the long term revenues secure. These technologies are therefore not too risky investments. The risk premium based on these technologies is therefore limited. Unproven/demonstration technologies such as tidal energy are however still extremely risky: technology is not yet fully developed, therefore the technological challenges are still partially unknown. Also whether the current installations will be able to provide long term revenues is not yet known. The risk premium based on technology maturity is thus mainly driven by the lower and more predictable costs per energy unit produced, the certainty on long term revenue, and the industry knowledge (e.g. proven track record) which is related to the large-scale deployment.

Another sector risk of RES projects is the weather-related volume risk. This specifically is of influence on (offshore) wind projects and solar PV projects. But also for some hydropower projects (mainly reservoir and free-flow hydropower projects) the weather-related volume risk is of importance. The risk mainly incorporates the lack of revenues due to unexpected weather conditions. The weather-related volume risk is amongst others also dependent on the geographical location of the RES project. However, it is not incorporated in the country specific risk, since it is not influenced by country specific policies or markets changes.

Since the RES sector as a whole is quite young, the sector specific risk-management resources (including industry expertise, operating data and specialized risk transfer) remain limited in some cases.[85] This especially applies to more innovative and new deployed technologies, such as geothermal energy. The two biggest obstacles to more effective risk-management are the opacity regarding the risks in the RES sector as a whole, and the restricted availability of industry data.

The last large RES sector specific risk is common to be the environmental risk. This is mainly the risk of incurring fees, fines or withdrawal of license resulting from environmental failures or disasters. Again, also this risk is assessed per RES technology since it differs significant between different technologies. The RES technologies with a potentially large environmental impact are mainly offshore wind and geothermal energy and experience a higher rate than less environmental impactful technologies like solar PV energy.

A smaller sector specific risk for RES projects occurs before the operational phase starts: The social acceptance risk. This risk relates to the social acceptance of a RES project, and the possibility of lawsuits and/or unexpected interruptions during the development and construction phase. The social acceptance risk correlates strongly with the type of RES technology and the geographical location of the project. In general, wind energy has a relatively high social acceptance risk due to the perceived discomfort that wind turbines cause near populated and/or recreational areas (e.g. noise disturbance and visual amenity). Also hydropower energy (mainly due to downstream irrigation concerns) and geothermal energy (mainly due to fear of it enhancing earthquakes) have in general a high social acceptance risk.

As for the mitigation of these sector specific risks, the current most powerful used “tools” are driven by a diversification in geographies and technologies. This is

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85 The Economist Intelligence Unit Limited (2011); Available at: http://www.economistinsights.com/sites/default/files/downloads/EIU-SwissRe_ManagingRiskRenewableEnergy_Web_2.pdf

however only applicable to the developers and utilities that are of a big enough scale to diversify their investments. Additionally, this diversification is experienced from a portfolio perspective and has no influence on the WACC of the different projects. Tools that do lower the sector specific risk per project, and therefore also the WACC, are insurances. However, not for all the risks incorporated in the sector specific risk factor an insurance is available and therefore it remains in RES projects a driver of for a higher WACC.

2.1.1.5 Project risks

The Dia-Core project concludes that the project risks are perceived to be limited. However these conclusions are based on the onshore wind market, which is one of the most mature of all RES technologies. And even within the onshore wind market, project risks can strongly differ as the case study in paragraph 2.1.1.1 shows (WACC differences of two onshore wind farms based on their location relative to a dike). The project risk can therefore strongly differ due to e.g. location and shareholders.

Project risks are strongly related to the (technical) specificities of the project. Think of for instance the supplier of the assets and corresponding technological characteristics. As well influencing the project risk is the location of the project. Basically all RES technologies are strongly dependent on the location. In case of solar energy, the solar radiation and shade strongly influences the revenue of the project, the same accounts for wind speed for wind power and source temperature for geothermal.

As well of influence to the risks perceived by investors are contracts in place with subcontractors and buyers. PPA's, operation & maintenance contracts and insurances can, if negotiated and drafted well, provide a security to investors.

Another project characteristics of interest to investors is the size of a project. Large scale projects can be financed through project finance. The securities provided by the project cash flow (in case of a relatively mature technology) as well as assets attract private investors with a low risk profile such as institutional investors. These investors with their low cost of capital suit the RES business cases well. However, small scale projects have to be financed on the balance sheet of existing companies. The companies themselves providing equity and attracting finance from banks. Utilities are currently the largest players in the energy market and therefore the largest investors in generation capacity, most are however struggling with the current market developments (as described in paragraph 1.1.1.2) and not always able to invest to a large extent. New, smaller players, like cooperatives, in general have limited funding available to invest in RES. These parties can make use of crowd funding which, however growing, is still limited in total size and impact (see paragraph 1.1.2.3).

Related to this, but also of strong influence to the risks perceived by investors is the shareholder structure. In most large scale investments, there will be a number of financiers. To a highly rated equity provider financiers will be more willing to co-invest than to for instance a cooperative. Furthermore different arrangements can be made to different providers of capital. Debt providers often request for a minimum share of equity, as this secures the repayment and interest payments.

In addition, one debt trench can be subordinate to another. The total financing structure of a project can therefore have a strong influence on the willingness to invest as well as the resulting cost of capital.

Considering these project-specific dependencies, it is only natural for a financier to assess the project-specific risks. As many RES projects are of a relatively limited size, this assessment can be very time consuming. Small scale projects are therefore not always able to attract funding, unless they are developed by a larger company providing equity and drawing debt for a portfolio of projects.

2.1.1.6 Risk differentiation in project phases

The risks of projects change during the project lifetime. Projects go through several phases, which are relevant for a financier, since each phase is associated with a different risk profile.

1) The first phase is the development phase. This phase is extremely risky, considering for instance the lack of a power purchase agreements and permits, and uncertainties about costs, prices and technologies.

2) The next step –the construction phase - is ushered by a 'financial close'. At the financial close the financing structure is set. In order to reach a financial close permits have to be granted and commitments with suppliers, power purchase agreements and financiers have to be set. The subsequent phase is the construction phase. As now the assets are actually built, most of the financial resources are required for this phase. The risks of this phase are lower than the development phase, but still relatively high, considering construction (e.g. budget) and technical (e.g. functioning according to specifications) risks.

3) The final phase (at least from a finance perspective) is the operational phase. Most RE-projects have a very long time span with limited operational cost and relatively stable revenues. The main risk remaining is associated with the electricity price developments. A feed-in tariff evens out this risk by offering a fixed price for renewable electricity, creating a very low risk operational phase. Other incentive schemes such as feed-in premiums and quota obligations leave sector pricing risks open to the market.

Per technology (depending on the technological maturity and technology specific risks), a different risk profile applies. For instance onshore wind projects are relatively mature and the risks during construction are well known and can thus be mitigated as much as possible. However, the deployment of a geothermal project is more risky, as the technology is less known and location specific risks apply (e.g. the intensity of the geothermal source).

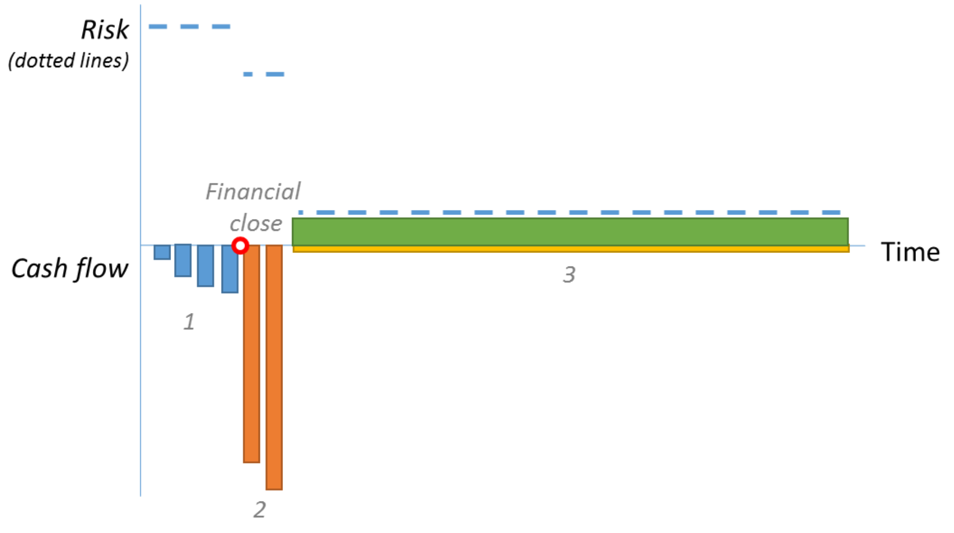

Figure 20 Top-ranked Risk by Member State as published by Dia-Core

Different risk profiles correspond with different cost of capital and different investor types. Long-term debt requires a certain, guaranteed cash flow and is therefore unlikely in the high risk development phase, but is very likely to play a role in the operational and (under circumstances) construction phase. This debt will always be combined with a small share of equity, or mezzanine finance (see text box). A high share of equity is needed to fit the high risk profile of the development phase. These equity providers (Venture Capital) will not only request a high yield to cover the risks, they also want a clear exit strategy and high liquidity of their assets. In the middle of these two is the construction phase, in which as well equity as (short term) debt can play a role, although both could require certainty on the possibility of refinancing in a later phase. A quite common option for large-scale projects is to refinance the project by (for instance) institutional investors after the more risky phases have passed and the project is in its operational phase. In this example, the high risks activities have taken place, VC or public guarantees can be removed (and start new projects), and institutional investors can enter for their required long-term steady returns.

Mezzanine capital

The Dia-Core study concludes that availability of finance is not a bottleneck for RE projects. Even though finance in general is available, projects might not be able to reach financial close. This case will be explained by means of a fictive example:

The example concerns a 100 MW onshore wind park following the technology assumptions given by the EC and the financial assumptions as presented by Spanish experts in interviews given in the Dia-Core study. This means a gearing of 70%, a cost of debt of 8,5% and a cost of equity of 13%. The LCOE of this case (excluding costs for grid connection), calculated using a financial model developed by Rebel, is 72 EUR/MWh. Assume the electricity price this project can get in a PPA in Spain is 70 EUR/MWh. Therefore, this project could be financed (i.e. capital is available), but is not financeable, since the resulting LCOE does not show an economic feasible business case.

However, the provision of mezzanine capital (also often called subordinate debt) could provide a solution to this. Mezzanine capital is a financial instrument that operates in between debt and equity. It can have many forms, but in general has interest and repayments, although with less securities than normal (senior) debt. In some cases interest payment can be related to the profitability of the project. The financing structure provides more securities on the repayment than equity but it is still subordinate to the senior debt. The latter causes the senior debt provider to acknowledge it as risk capital similar to equity, while the risk premium is lower than for equity (but higher than senior debt). This way, mezzanine finance can thus lower the total the cost of capital / WACC and therefore improve the economic feasibility of a RE project.

To illustrate the working of mezzanine finance, a 10% subordinate loan with an interest rate of 9,5% is introduced in the fictional onshore wind energy case in Spain: This way, the LCOE of the project results in 70 EUR/MWh, which means that the business case is economic feasible and the project is financeable.

Note: Due to the mezzanine capital the WACC lowered 35 basis points, from 8,36% to 8,01%.

By looking at the different development phases from a perspective of EU mechanisms a more precise insight in the bottlenecks is visible. Typically the financial bottleneck in the development phase is the limited availability and/or high returns expected for equity (e.g. Venture Capital): The risks in this phase do not match with the expected (modest) returns in exploitation, even with support from a feed in tariff. Therefore, in this phase, a public guarantee for revenues during the upcoming operational phase will not provide a big enough incentive. However, on the other hand, the construction phase can be financed on the basis of guaranteed cash flows during the operational life time of a project: The incentive schemes during the operational phase allows private capital to limit the risks associated with the sector/ MS in question.

2.1.1.7 *Conclusions on bottlenecks from cost of capital perspective*

The risk of a project is reflected in the cost of capital (WACC). As RES projects are very capital intensive and require long payback periods, the WACC can have a significant impact on a project business case.

In order to look into the bottlenecks to financing RE, we looked into three main components of the risks:

- country risks, related to general investment risks and country specific RES policies
- sector risks, related to specific RES technologies
- project risks, related to project specifications such as location, shareholders, contracts etc.

Based on the analysis of these risk categories, we derived the following bottlenecks:

- Member states' RES policy, specifically the stability of policy and incentive schemes, are perceived to have a large impact on the cost of capital.
- General availability of capital is not the problem in financing RE. Mature technologies (under the condition of a stable incentive scheme) have access to private funding. The cost of capital of this funding is even relatively low, as macro-economic developments have led to low general interest rates. However, more risky projects do not always have access to finance. Riskier projects (whether due to the deployment of immature RES technologies or due to instable RES policies) experience, amongst others, a barrier in the cost of capital to deploy on large scale.
- When a (mature technology and large-scale) project reaches the operational phase, the risks are limited and banks and institutional investors are eager to step into refinancing opportunities. However, in the first stage of a project, especially the development phase, project developers seem to have limited access to funding, which thereby creates a barrier for the realization of projects.

2.1.2 Categories of measures to reduce bottlenecks

This paragraph will look into four categories of measures to overcome the aforementioned bottlenecks.

As described in paragraph 1.1.1.4 European institutions (EC, EIB and EBRD) already have a number of measures based on different financing instruments in place to support RE. Potential new measures should not 'compete' with these existing ones. In fact, they should be additional and fill in the gap (if existing) for solving the bottlenecks to financing RE. Moreover, new measures might not be required if improvements to existing measures could as well solve the problem.

This paragraph will therefore look into existing measures and instruments in each category and describe whether these new instruments are required or existing instruments can be improved. Note that this report will not provide full evaluation or gap analysis as this is outside the scope of this project.

2.1.2.1 Subsidies and grants

In order to achieve the 2030 target, the investment need accounts for 40 billion euro annually until 2030, according to the European Commission[86]. RES needs to become competitive to non-RES alternatives and not only dependent on governmental subsidy schemes. However, considering the current low electricity prices and low carbon prices in ETS, RES projects are not yet economically viable without subsidies (see paragraph 1.1.2.2). Feed in tariffs, feed in premiums and quota obligations are therefore currently still a precondition to a viable and financeable RES project in Europe. As described in paragraph 1.1.2.2, some MS stopped or changed their RES support schemes for all new projects, as well as some did for existing projects. This changing policy is one of the main bottlenecks in financing RES as it influences the predictability of the revenue cash flow and thereby increases the risks.

The support schemes are currently a national affair. However, in case RES actually lags the 2030 target, the EC could consider intervening in these national schemes as well. One can think of multiple options to do so:

- The most rigorous option would be the introduction of a common European support scheme, such as FiT, FiP or quota obligation. This option is deemed politically very challenging, as most MS have one or more schemes in place and will not easily change those schemes. In addition, MS would have to contribute to RES investments performed in other MS.

- The EU could subsidize projects in MS that cannot apply to subsidies in the MS, or where the schemes do not sufficiently stimulate RES investments. Thereby the EU would only compensate for MS without a RES scheme. This could however provide perverse incentives to MS not to invest themselves in RES and therefore would have to be combined with an incentive for the MS to introduce a stable RES policy.

- A less rigorous option would be to give an official status to the National Renewable Energy Action Plans (NREAP) that the MS have to submit. Currently MS are merely required to submit the plans, there is no real check on, for instance, consistency or plausibility (i.e. whether it is reasonable that the proposed measures lead to the proposed target). Through this check, the EU does not directly impose measures on the MS, but it can however be a soft incentive to MS to improve their policy. Moreover, it does create transparent and plausible plans and objectives. This transparency on measures and the certainty of those measures are essential to investors to assess the stability of RE policy in MS. The check on the plans can also form

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[86] European Commission (2016). 2030 Climate & Energy Framework. http://ec.europa.eu/clima/policies/strategies/2030/index_en.htm

a condition for providing any of the other instruments that the EU provides (grants as well as guarantees or financing instruments) to projects.

Innovation subsidies

Regardless of the uncertainty on support schemes in some MS, projects need to have a certain level of maturity and quality to even apply to the FIT, FIP and quota obligations incentive schemes as mentioned above. More innovative, less market-ready technologies, such as tidal energy, still are dependent of additional up-front subsidies.

On an EU level, several subsidy programmes are in place, including programmes for innovative projects. Horizon2020[87] covers research and innovation projects of industries and the academic world. It offers technical assistance to local and regional authorities to develop energy efficiency or renewable energy projects. NER300[88] supported demonstration projects, but the budget is now exhausted. Other grant programmes (such as Cohesion Fund and European Regional Development Fund) support RES from a perspective of regional development and decreasing social and economic differences between MS.

Combined, the different programmes cover all aspects of early innovation stages: from research and development to first demonstration projects. From a project perspective the grants are, however, not always easy to obtain as the subsidization landscape for RES seems to be scattered in various programs and comes with substantial administrative requirements. The administrative requirements create a threshold for projects to apply to EU funding, as the transaction costs (e.g. the time it takes to submit a proposal with administrative requirements) are high. Projects thus have to be of a certain scale and the organisation of a certain professionalism in order to successfully apply for these European grants.

In addition, grants are often made available based on open tenders with a broad scope. In that case the results in e.g. types of technologies, or potential RES capacity installed are completely up to the market. The grant provider is, in a sense, reactive to the market.

Grant tenders can also be more proactive. Two examples illustrate this:

- Fuel Cell Hydrogen Joint Undertaking (FCH-JU)[89] is part of Horizon2020 (used to be part of FP6 and FP7). The FCH-JU puts out calls for specific hydrogen transport subsections (e.g. hydrogen busses or cars). A tenderer can subscribe to a call in a region. The winning consortium is granted an investment subsidy. The tender thereby actively invites public-private consortia to subscribe for the grant.
- In the Netherlands offshore wind is tendered (as well described in paragraph 1.1.1.3.1). Consortia can subscribe to an offshore area and the winning consortium is granted with the concession of the area (including permit) as well as a feed-in premium subsidy. The tender prepares some first steps for

[87] European Commission (2016). 2030 climate & energy framework. https://ec.europa.eu/programmes/horizon2020/

[88] FCH-JU (2016). Who we are. http://ec.europa.eu/clima/policies/lowcarbon/ner300/index_en.htm

[89] European Commission (2016). NER 300 programme. http://www.fch.europa.eu/page/who-we-are

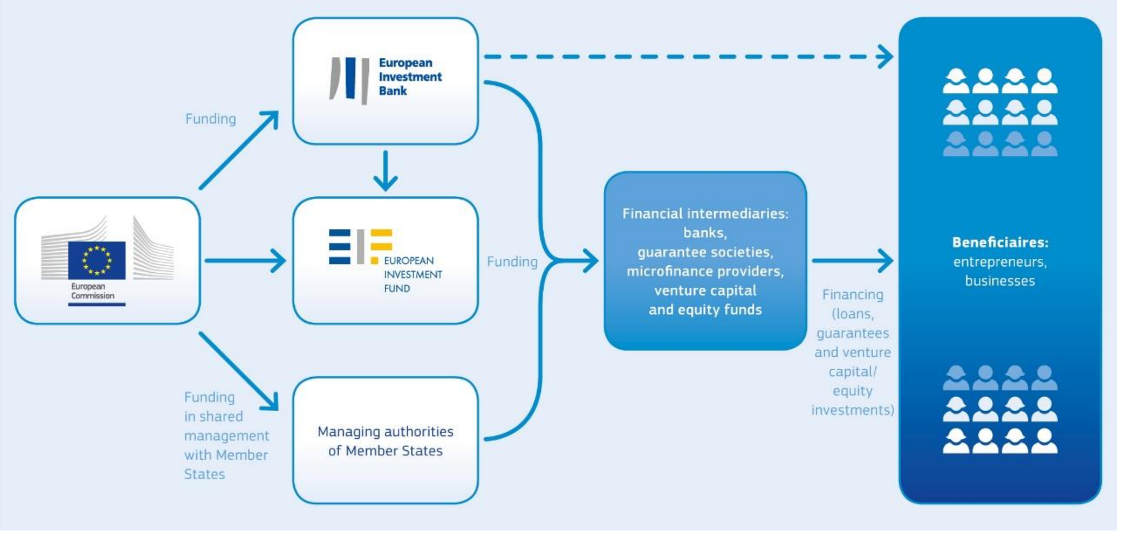
the realization of the wind farms and thereby mitigates some of the risks (e.g. permit related risks).

A 'reactive' grant has the advantage of technology neutrality, in which market developments are left up to the market. At the same time, these tenders require expertise on a broad scope of technologies in order to assess the viability of projects. Subscribers are now asked to write very extensive proposals to apply to subsidies, with many administrative requirements, partially in order to provide as much information on the project as possible. Additionally, the means to steer and speed up the market are limited.

By proactively tendering grants, the EC can invite consortia more actively to subscribe to some priority areas. Expertise within the program can be focused on these priority areas as well. Potentially, by requesting for specific projects, which are well known by the people setting the requirements and assessing the proposals, the administrative requirements for these projects could also go down. In order to limit transaction costs and make grants better accessible for companies with less time or means to submit extensive paperwork, a lowering of the administrative requirements should be aimed. Furthermore a proactive grant program can lower some of the risks associated to early stage project development. For instance, when the company or consortium is granted a concession on a certain location this would limit the risks of the developer to find a suitable location.

2.1.2.2 Financing instruments (guarantees, debt and equity)

There is a broad range of financing instruments from European institutions, as the picture below illustrates.



Source: http://europa.eu/youreurope/business/funding-grants/access-to-finance/

Figure 2 Sources and intermediaries for financing instruments (not specifically renewable energy).

The EIB is currently involved in large scale RES projects as one of the main climate finance providers worldwide. As mentioned in paragraph 1.1.1.4, the EIB provides project loans, intermediate loans, venture capital, microfinance and equity and fund investments. Several blended instruments are managed by the

EIB and EIF, such as EFSI, InnovFin and the project bond initiative. For many financing instruments, local banks or funds act as intermediaries to companies or projects.

Role of EIB

By financing RES projects, the EIB directly increases the availability of finance, since the EIB is able to finance below the common market rates. Moreover, by financing projects, the EIB also increases the availability of private finance, as it has a signal function for other financiers to enter the market. The EIB not only provides direct project finance, it also finances local funds (fund to fund), thereby enabling financial resources for smaller projects or specific sectors.

From project experiences we perceived for the EIB to actually enter into deal making, similar or even more stringent conditions –depending on the project – are applied compared to private sector financing. From these experiences we know that the EIB is able to provide a loan 50-100 basis points below the commercial rate, due to favourable lending conditions and a lower margin. This makes a difference in total cost of capital, but other conditions (DSCR, Gearing, national insurance guarantees) are often stronger than the conditions inflicted by the market. In the end the EIB fund managers are also expected to behave in a risk adverse way to maintain the AAA rating. In their Energy Lending Criteria, the EIB also states that renewable energy will only be financed if the technology is competitive, or will become competitive within a reasonable time frame.[90]

The text box below gives an example of the effect that EIB financing could have on the feasibility of an RES project. In this example, the conditions (DSCR, Gearing etc.) are assumed to represent the market conditions in order to provide an insight in the potential of this EIB financing tool.

[90] EIB (2013). EIB Energy Lending Criteria. Available at: http://www.eib.org/attachments/strategies/eib_energy_lending_criteria_en.pdf (p26)

Lowering WACC through EIB financing

In this example, the same fictional RE project is used as in the mezzanine capital example text box (paragraph 2.1.1.6). This is deliberately chosen in order to provide an insight in the different results of both measures on the economic feasibility of the business case of RE projects.

So again, as base case we consider a 100 MW onshore wind park in Spain with a gearing of 70%, a cost of debt of 8,5% and cost of equity of 13%, which results in a LCOE of 72 EUR/MWh.

In this case we introduce debt financing by the EIB in the form of a project loan. Assuming that the gearing will remain similar this will result in a total loan of 125 Million euro (based on the technology cost estimations of the EC). Earlier project experience indicates that the cost of debt could decrease with 100 basis points to 7,5%. With this lower interest rate incorporated in calculation model developed by Rebel, the LCOE of the project results in 69 EUR/MWh, which is a reduction of -4.15% compared to the base case LCOE.

*Note: Due to this implementation of an EIB project loan the WACC lowered 52 basis points, from 8,36% to 7,84%.

For mature technologies in MS with stable incentive schemes (FiT, FiP or quota obligation), this financing by the EIB enables access to financial sources with a low cost of debt. However also many private financial institutions appear to be interested in these stable projects. The offshore wind tender case in the Netherlands (as described in paragraph 1.1.1.3.2) illustrates that in case of a stable incentive scheme, market developments do take place and many parties were interested to invest. As well a development in the market can be perceived towards lower technology prices. So even though the WACC does have an experience on the LCOE and thus the project viability, the certainty on incentive schemes appear to have a much bigger impact on the market than the WACC on its own.

Furthermore, the question rises whether EIB is actually making a difference in increasing private finance or if it is *competing* with private financial institutions over the same type of projects. Moreover the conditions limit the possibilities to address the WACC efficiently in those MS and for those technologies that would actually require a more stringent intervention.

<u>Programmes and funds</u>

<u>EFSI</u> is managed by the EIB and meant to uptake higher than market risks in order to mobilize private finance for strategic investments in multiple sectors, including energy. EFSI can therefore provide low interest rates and a lower cost of capital. However, EFSI funding is only available for projects with very low risk profiles as the EIB conditions as summarized above (DSCR, gearing etc.) apply to EFSI funding as well. Higher risk projects or projects in MS with less profitable incentive schemes are thus excluded from access to this fund.

EFSI targets to create a leverage of 15, meaning that the funding provided by EFSI will create a fifteen times large investment by other public and private investors. On the one hand this target is valid, as this would mean that the funding on European level can be minimised while investments from other sources can be triggered. On the other hand however, focussing on creating such a large leverage will rise the question whether EFSI is actually funding those projects or funds that would otherwise not take place, or if it is funding those projects that could as well apply to private or regular EIB funding.

In other words would the investment also have taken place if EFSI would not have provided 1/15th of the total investment?

In 2014 the EIB and the European Investment Fund (EIF), together with the European Commission, introduced InnovFin under the Horizon2020 program. The objective of the InnovFin guarantee is to enable finance for research and innovation activities. InnovFin is a blended instrument that provides a broad set of financing instruments. Moreover, the Horizon2020 budget allows for higher risk profiles.[91]

For debt financing, one of the main priorities of InnovFin is to finance Energy Demo Projects. The EIB provides loans for innovative renewable energy projects between 7,5 million and 75 million euro. Objective of these loans is to overcome the "valley of death from demonstration to commercialisation"[92]. There is no specific budget for RES projects within InnovFin, Energy is one of the eight different priority sectors. InnovFin does provide an advisory service to assist in improving projects to increase their opportunities for long-term finance.

Another facility is called COSME. This facility provides guarantees and equity to financial intermediaries (e.g. banks, leasing companies), aimed for small and medium size enterprises (SMEs). The guarantee is free of charge and allows the financial intermediaries to take additional risk in financing new (risky) products of a SME. The guarantee is caped to the expected loss on the investment. The Equity Facility for Growth (EFG) – also part of the COSME program – supports research and innovation by SMEs and can therefore also be applicable to RES innovation. The EFG is also managed by the EIF[93]. Financial intermediaries can receive funding under the COSME EFG facility, thereby investing risk capital - including venture capital and mezzanine finance - to SMEs.

Financial intermediaries

Despite extensive research, the budget of the InnovFin and COSME guarantees aimed for RES investments were not found. Furthermore, both guarantees are provided through financial intermediaries. A sample of the InnovFin intermediaries showed that not all

91 Source: InnovFin SME Guarantee & COSME Loan Guarantee. Workshop Warsaw, 6 November 2014. Available at: http://www.eib.org/attachments/general/events/20141106_innovfin_warsaw_kozlowski_en.pdf

92 EIB (2015). InnovFin Energy Demo Projects. Available at: http://www.eib.org/attachments/documents/innovfin_energy_demo_projects_flysheet_en.pdf

93 http://ec.europa.eu/growth/access-to-finance/cosme-financial-instruments/index_en.htm

intermediaries even make notion of a financial product supported by InnovFin[94].

It is thus not transparent whether the products offered by these intermediaries are actually used or provided at all and even more so specifically for RES investments.

At this stage it is unclear whether existing guarantee instruments have an effect on RES investments. Before introducing potential new instruments it could be worthwhile to thoroughly evaluate whether existing instruments actually reach the RES market and enhance investments.

Besides these programs managed through the EIB or EIF, there are also funds indirectly supported by European institutions. For instance the KIC InnoEnergy, which is part of the European Institute of Innovation and Technology (EIT), funded by the EIF. The fund provides risky capital to innovative projects as well as support through a platform of knowledge institutes. The fund supports eight thematic fields. The exact budget for RES is not specified in KIC InnoEnnergy.

The broad spectrum of financing instruments covers early innovation stages (InnovFin and KIC InnoEnergy), as well as operational finance (EIB and EFSI). Debt (EIB, EFSI, InnovFin) and equity (EFG, KIC InnoEnergy) provision appears to be covered as well. None of these instruments however have "ring fenced" or even specified budgets for RE, making it difficult to monitor how much financial resources are directed to RES projects.

Furthermore, due to the large number of instruments (from a project developer perspective) it will not always be clear which instrument can be used for which case. The instruments listed above are for instance all found on different websites, and there is no clear overview given of which instrument applies to which type of project, investor, or development stage. The instruments are structured based on financial logic. Different instruments (e.g. debt or equity) have different objectives and require different know-how and are therefore placed in a different structure or fund. Furthermore, every new instrument has a new target group, identity and communication strategy in order to attract proposals for funding. However valid these arguments, a project developer might not see the forest to its trees.

An overview and assistance could help project developers in which instrument to apply to. An overview could as well be valuable to the EU institutions to assess whether or not the financial sources are aimed at the existing financing gaps.

2.1.2.3 Conclusions based on categories of and existing measures

The description of the categories of measures show a broad spectrum of measures and instruments already in place. From grants and subsidies at EU and MS level to (near) market financing instruments.

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[94] Popolare Bari Italy: mentions InnovFin product on website; Belfius Belgium: no mentioning of InnovFin on website; Santander UK: no mentioning of products on website; ING Luxembourg: mentioning of products on website; Sace Italy: general mentioning on website; IdeaBank Poland: mentioning of products on website. Noorlandsfonden Sweden: no mentioning on website. Bank of Ireland: no mentioning on website.
Based on InnovFin list of selected Financial Intermediaries for SME Guarantees. Available at: http://www.eif.org/what_we_do/guarantees/single_eu_debt_instrument/innovfin-guarantee-facility/innovfin-smeg_signatures.pdf

Subsidies and grants:

- Subsidies such as FiT, FiP or quota obligations are still required to make RES projects viable. As these schemes are currently a national affair with many different approaches, it is not deemed viable to replace the MS schemes by one EU scheme.
- MS could be incentivized to introduce and/or maintain an RES scheme. At minimum by giving an official status to the NREAP and check the consistency and plausibility of measures and objectives. Thereby creating transparency on the investment climate to potential financiers or project developers. This check can also be made a precondition to access other instruments provided by the EIB and EIF (e.g. grants, guarantees or financing instruments).
- Innovation subsidies on EU level in general cover all innovation stages, from 'research and innovation' to 'demonstration'. Also more mature technologies can apply for financing instruments. Subsidies do however have extensive administrative requirements. The transaction costs associated to submitting a proposal for funding can therefore become a barrier to parties with limited time and means, as well as access and experience with European funding.
- Most grants have a reactive character, meaning that the scope is quite broad and the realization of projects is dependent on the projects applying. Grant programs can also be more focused and proactive, thereby limiting barriers to subscribers (e.g. being granted a concession for a certain location).

Guarantees:

- Guarantees exist under the InnovFin and COSME programme. These guarantees are provided through intermediaries. There is very limited transparency on these instruments and to which extent they are used for RE.

Financing instruments:

- The EIB directly (and through EFSI) plays a leading role in financing RES by offering debt at below market interest rates. These low interest rates decrease the WACC of a project and can thereby make more projects viable and bankable to other financiers. However, both the EIB as EFSI apply strict (more stringent than market) conditions to their funding (e.g. in the DSCR and gearing). The question therefore rises whether the EIB funding is additional to private financial sources or if EIB is competing with private institutions over already viable RES projects.
- A number of instruments exist that support more innovative projects. Specifically InnovFin has a special priority window for renewable energy demonstration projects. Particularly equity is lacking whereas there is substantial senior debt available in the market.
- Combined, the instruments cover a broad spectrum of types of projects and investors. The instruments however do not have ring fenced budgets or even indicative budgets for RES investments. It is therefore not transparent how much financial resources are directed to RE.
- From a project developers' perspective the most feasible instrument for a specific project is not easily identified. A clear overview of the different EU level financing instruments is lacking and there appears to be limited coherence between the offered instruments.

- Many instruments are accessed through financial intermediaries, which are not always transparent on the financial products they provide with EU support. In addition, not all MS have a financial intermediary, thereby limiting the access to funding of specific MS.

When looking at the categories of instruments and the project types or phases they are targeting, the existing instruments combined are aimed to cover all innovation stages. However early project stages are covered to a limited extent. When considering the availability of private financial resources, those are also mainly found in the lower right corner (institutional investors, banks and utilities) and to some extent in the middle (utilities) and upper left corner (Venture Capital).

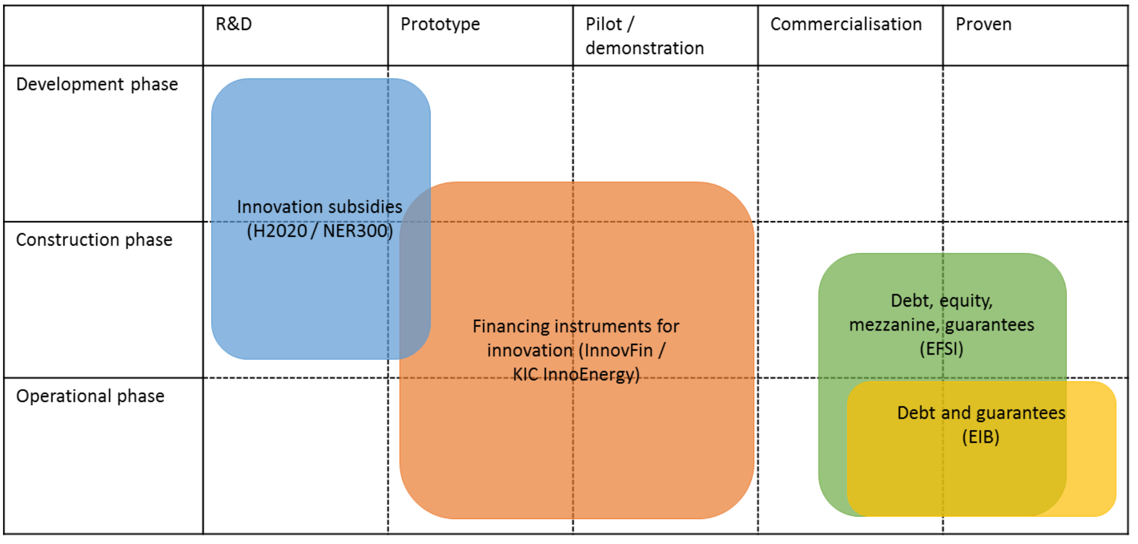

Figure 3 Mapping of EU level instruments on project phase and innovation stage

Note that in this figure the size of the shapes do not represent the size of the instrument, but merely the coverage of different stages. As well note that this figure only represents two dimensions for the coverage of instruments. Coverage for project size and member states are not included.

2.1.3 Proposed solutions to bottlenecks

Even though different bottlenecks where identified in financing RE, a quick scan of the existing instruments showed that a broad spectrum of these instruments can potentially cover all innovation stages and project phases, but by doing so creating a complex combination of different finance options for RES projects.

Solutions to deal with the bottlenecks should therefore not be focused on designing a new instrument, but rather focus on making sure existing instruments and measures work effectively and create impact. New instruments would come into play in case all existing measures work effectively but still a gap remains.

Based on the analysis in the previous paragraphs, we propose the following measures:

1. Create a single entrance 'portal' for RES finance applications

2. Focus existing financial resources to those areas where private finance is lacking

3. Incentivize MS to introduce or maintain a long term incentive RES policy

On a first note, it is important to understand that the existing instruments and proposed improvements on these have the potential to lower bottlenecks but none will be the silver bullet to unlock private financing by itself. Moreover, under present market conditions (staggering energy consumption, no real decrease of fossil generation) there is little reason to believe that a single instrument addressing e.g. the WACC will be sufficient without an additional instrument that ensures a certain amount of revenues (FIT/FIP) from the project on a MS level. On the longer term it might be possible to phase-out current incentive schemes gradually (for new projects), depending on energy pricing, carbon pricing, tax schemes and technological innovation. In that sense, the combination between MS their FIT/FIP/Quota schemes and an (EU-) instrument for financing needs can be very efficient. Additionally, this can gradually limit the RES projects' current dependency on subsidies.

2.1.3.1 RES finance portal

This study provided a quick scan of the existing instruments for RE. This quick scan showed a broad spectrum of instruments with different objectives and target groups.

Currently all European level instruments have a broad scope, including for example energy infrastructure, sustainable mobility and/or in some cases non-energy related sectors. All funds have their own target and objective as well as different administrative requirements. The first insight from the quick scan is that it is not easy to get a full overview of the current possibilities to attract European financial support for a RES project. It can be imagined that this would be the case for a potential RES project applicant as well.

Large scale RES projects of relative mature technologies know how to access specific funding, for instance directly through the EIB. But the application often requires extensive documentation. Therefore, project developers are likely to be assisted by consultants that are specialized in funding or other financial institutions. However, for projects of smaller size or in early development stages financial resources are harder to attract, as there is no clear overview of the funds and instruments and which types of projects they are targeting. Additionally, the available instruments are often provided through different institutions and different contact persons, which decreases the ease of access even more.

Bundling ring fenced budgets

The instruments provided are currently structured according to their financing objectives, and not according to the applicants' perspectives. We therefore propose to create specific RES budgets and bundle the different instruments as one market proposition.

The bundling of financial resources could be structured in an additional fund, however this would not be necessarily be the case.Advantages of a single fund would be that the resources can be optimally bundled towards the targeted projects. In addition, economies of scale could be achieved in the fund management.

However different instruments require different types of fund managers with different know-how and different objectives. For instance venture capital requires entrepreneurial type investors with a high risk profile, while a debt provider would be risk averse. Furthermore, existing funds have multiple and differentiating objectives (for instance regional development) and are mostly strongly driven by political affiliations.

Key in our proposal is however not a new instrument as such, but the fact that access to sources of RES financing is transparent and coherent from the perspective of the developer. The resources can therefore still originate from multiple funds in case one dedicated fund is deemed unviable (e.g. due to political affiliations). Therefore these funds would have to work closely together and introduce an advisory desk as the first portal to European funding and finance. The figure below illustrates how this would work.

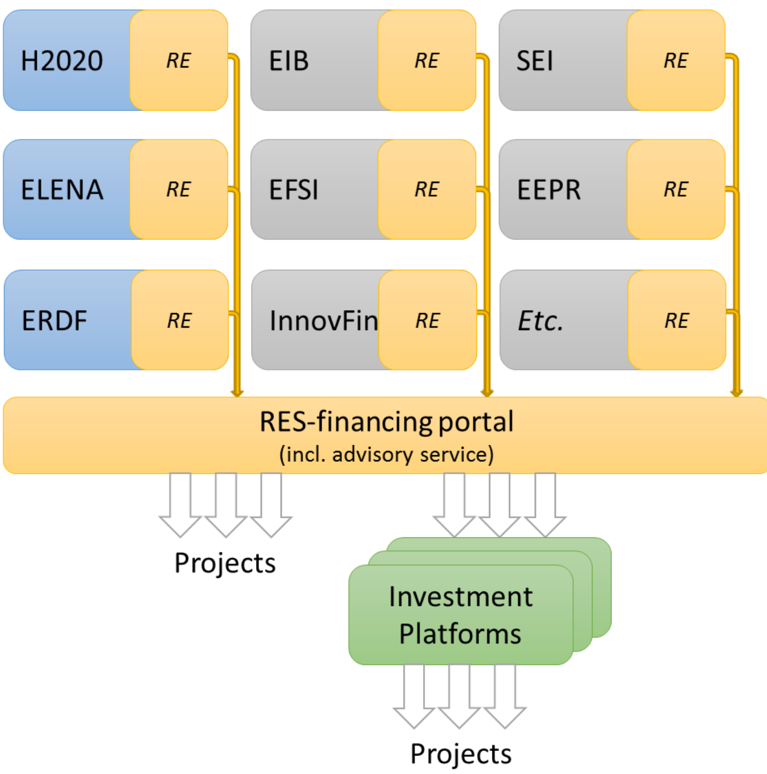

Figure 21 Illustration of RES finance portal

To create transparency and coherence, we propose that first entrance for an applicant to finance is through one 'portal', e.g. call it the *RES-finance portal*. The RES-finance portal can act as an advisor to help an applicant with the best fitting financing and funding structure from European resources. These structures can include:

- European grants or subsidies
- Guarantees, debt or equity from EIB, EFSI, InnovFin, or other sources

After assisting in the financing structure, the portal can support in the further application to EIB, EIF, EC or financial intermediaries.

Funding projects and platforms

Currently both projects as local financing platforms (being for instance local or regional funds) can apply to finance and funding from different instruments. For instance EFSI has an investment strategy for Investment Platforms[95]. We propose to also open the RES-finance portal for these platforms as this enables financing towards smaller scale projects without having to assist every small scale project on an EU level. The Investment Platforms can on the other hand benefit from the advisory service, as often they make use of multiple European Sources (for instance EFSI and ERDF or ESIF funding).

We thus propose not to create a completely new instrument, but to ring fence RE-budgets in existing instruments. In practice ring fencing comes down to a target share of the total investment for each of the instruments. As current instruments have no specifically assigned budget for RES projects and do not (uniformly) communicate on their investments in RE, it is unclear what the current resources are and how much of the current funding can realistically be ring fenced. In order to set specific RES targets, the current budgets and future potential budgets require further evaluation.

To give a rough estimation of the total size of the ring fenced budget, we will reason from the total investment requirement. As stated in paragraph 1.1.2.1, the annual investment need (based on existing research) is estimated between EUR 50-80 billion per year and the total investment gap between current and required investment levels for RES could be up to EUR 28 billion per year (as well a rough estimation).

The resources of the European Commission would not have to fill this entire gap, but can as well unlock additional funding by providing securities for other investors or close a funding gap in a business case and thereby create leverage for other investors. The leverage potential strongly differs per EU instrument. For instance direct EIB project finance can go up to 50% of total debt provision, thereby creating a relatively limited leverage of 2-3 (depending on the gearing). At the same time EFSI intends a leverage of 15 on their investments. However, as stated in paragraph 2.1.2.2, the question rises whether an instrument with this leverage funds the projects that otherwise would not have been funded. Assuming a conservative average leverage of 3, the reasoning would be that the total required ring fenced budget of all resources combined would be EUR 9 billion per year to cover the maximum gap.

The required ring-fenced RES target can strongly differ per instrument. For instance, the EIB lending (including EFSI) announced that the future climate finance activities will account for 25% of the total lending program96. The

95 European Commission (2015). European Fund for Strategic Investments. Rules applicable to operations with investment platforms and national promotional banks or institutions. Available at: http://www.eib.org/attachments/general/efsi_rules_applicable_to_operations.pdf

96 EIB (2015). External Lending Mandate Climate Strategy. Available at: http://www.eib.org/attachments/thematic/elm_climate_strategy_en.pdf

Structural and Investment funds have already ring-fenced a minimum of 5% (EUR 23 billion between 2014-2020 out of EUR 454 billion) for low-carbon economy investments. Both programmes have different objectives and the differences can be justified through these objectives. The set of specific targets per instrument should thus be based on a more detailed evaluation of the current instruments and their potential, instead of a standardized amount per instrument, to create a maximum impact in the RES market.

Although ring fencing basically comes down to setting targets, specifically for some instruments merely defining targets might not suffice. In the next paragraph we will describe why and how this would work.

Role of portal

It is proposed that the RES budgets should all be allocated through the RES Finance Portal. The role of the portal manager comes down to advisory services, communication, monitoring and acting as an intermediary between existing instrument managers (EIB, EIF and EC) and applicants.

On EU level several advisory services already exist. For example, the European Investment Advisory Hub (EIAH) is a combined initiative by the EIB and European Commission as part of the Investment Plan for Europe (as well the driver behind EFSI). This hub provides a wide range of advisory services for different types of projects and aims to bundle different existing services.

The different advisory services of the EIAH are built around existing financial instruments. E.g. InnovFin provides an advisory service to projects with a minimum of EUR 15 million investment in research and innovation. This service is however linked to InnovFin (although the service is not per definition linked to EU funding) and not to a market sector. Therefore, currently a project developer has to know the specific instrument to be able to find the advisory service.

A more customer based approach, focused on finding the right financing structure for a project dependent on the project phase or innovation stage, will increase the accessibility of funding, especially for the projects which are currently unable to. The customer based portal should focus on the RES market. Not only does this enable better support for the applicant of finance / funding (because the market is well known), but it also allows for a much more targeted marketing approach. The project as central point of attention rather than the financial instrument. This may also lead to innovative solutions such as a smart mix of equity and debt.

We propose to align the communication strategies of all financial resources to the advisory service and to not use different communication channels on RES through any of the other institutions. A clear portal is also more easily communicated and targeted towards market parties.

The advisory service can also act proactively in the market by actively tendering specific priority area's or linking companies to improve innovative processes, thereby acting as a "deal maker".

The portal assists projects through finance application processes and can act as a deal maker for new projects. A significant role for existing instrument- and fund managers (EIB, EIF and EC) still remains in the tasks of budget allocation and (risk) assessment of projects based on a pre-set list of criteria. There is however a role for the portal manager in the latter as well as also the administrative requirements could be aligned. If a project applies to one instrument and submits all necessary administration, application to another instrument can be simplified as information on the project and applicant is already submitted. This case would occur for a project that is being rejected for one instrument and applies to another instrument, as well as for a project going through multiple development phases which each require a different type of funding. The latter would for instance occur if an applicant gained support from InnovFin for a first demonstration project and after a successful demonstration requests additional funding of EFSI for upscaling. Naturally the new project characteristics, market developments, lessons learned and proposed financing structure would have to be assessed. However the administrative requirements on technology and the applicant can be limited in case they are aligned for all instruments in the back-office of the RES-finance portal.

On the other hand, before facilitating the access of projects of smaller size to EIB funding a decision has to be made whether or not funds by the EIB should also be made accessible for such small projects. For the time being, projects smaller than EUR 120 million EUR usually have access through national intermediaries only. As energy transition is a lot about decentralized, local project, this is a substantial sum. The relation between EIB funds and national intermediaries for smaller projects is not always that clear from the perspective of project developers.

Steps

Implementation of the RES finance portal requires the following steps:

1. *Evaluation of impact of existing instruments for RES development*
   The first step is to thoroughly evaluate the entire spectrum of instruments, specifically from a RES project perspective or from the wider scope of the COP21 deal impact (hence including climate actions)

   The objective of the evaluation is:

   - To provide a full overview of existing instruments, including potential gaps and overlaps.
   - To gain insight and provide transparency on the resources currently allocated towards RES (/climate/COP21).
   - To gain insight in which funds should provide a ring fenced budget for RES and which have very limited contribution to RES projects, differentiated by large and smaller projects.
   - To justify the size of the ring fenced RES budgets (for each instrument).
   - To gain insight in the best practices of different funds in e.g. investment criteria and communication strategies.

   The evaluation subjects would include:

   a) Whether current instruments actually cover all project types and phases, including the following dimensions:
      - Project phase (development, construction, operational).
      - Technology type and related innovation stage (R&D, prototype, pilot/demonstration, commercialization, proven).
      - Project size (smaller and larger than for instance 15 million).
      - Member states (covering all MS, or a selection -and whether or not this is done deliberately-).

b) How much of the instruments' resources is allocated towards RES in the period of 2010-2016?
c) What are the criteria or administrative requirements and how do these translate in transaction costs for both the applicant as the financial institution providing the resources?
d) How do the interest rates and financing conditions correspond to market rates and conditions?
e) Specifically in case of financial intermediaries: How transparent are intermediaries on their products and how do the products which are supported by the EU compare to regular products of these intermediaries?
f) Is there a strategic interest in financing smaller projects?

An evaluation is suggested for the following instruments:

- EFSI and other financing by the EIB
- Horizon2020 and InnovFin
- ELENA
- COSME
- Cohesion Fund
- European Regional Development Fund
- Structured Finance Facility
- ESIF Financial Instruments
- Sustainable Energy Initiative (SEI) by EBRD
- European Programme for Recovery (EEPR)
- KIC InnoEnergy

2. Ring fencing of existing budgets

The above mentioned instruments mostly have a broad scope. These broad scopes make it difficult on the one hand to monitor the financial resources allocated to RES (see paragraph 1.1.2.1) and on the other hand to proactively target RES investments. We propose the ring fenced budgets in order to focus resources on finding suitable RES projects which are required to meet the total RES targets.

The next step is therefore to assign budgets within the existing instruments towards RES investments. Based on the long list of instruments, the evaluation in step 1 will result in a shortlist of existing funds and instruments to which the ring fencing of RES budget would apply.

3. Implementing the common portal

The advisory service should make use of the extensive knowledge base of the European institutions, especially of the EIB on financing RES projects. It should however not only include the risk averse perspective of debt financing, but also the perspective of InnovFin in finding financing solutions for innovative, more risky projects.

The European Investment Advisory Hub can form the basis of the finance portal as it already combines several instruments and services into one hub. We do however propose to use a specific RES window within the EIAH to 1) specifically target this market, 2) bundle the already existing knowledge and resources of the sector and 3) allow for other instruments (non-EFSI/EIB) to be offered through the hub as well.

Key in the success of the portal is a clear and common communication strategy and a customer focused financial advisory service. The financing for the projects can come from different sources, like funds or even intermediaries reallocating funds. However, this complexity should not be shown to the applicant as this complexity can become a barrier into finding the right sources of finance. It is expressively the task of the portal to help the applicant in its search for European finance / funding. Additionally, a specific RES target can also enable a stronger marketing message than the current marketing of the EIAH (which is for instance not easily found on the EIB website, as it is not found under 'Advising').

4. *Monitor RES investments*

By ring fencing the budget for RES projects, the EC can make a clear statement on the priority of RES in the total investment portfolio. Moreover, a common portal to all RES financing instruments allows for monitoring of total RES investments in the MS. The bundling of resources and a clear communication on the investment portfolio would also fit the ambition of the EU to create an Energy Union.

Timeline

The first step – the evaluation – is estimated to require 6 months. The political discussion on RES budget targets is estimated to take as well 6 months. Implementation of the portal is as well estimated to take 6 months. However, as these steps can partly be taken in parallel, we estimate a total timeline of approximately 1 year.

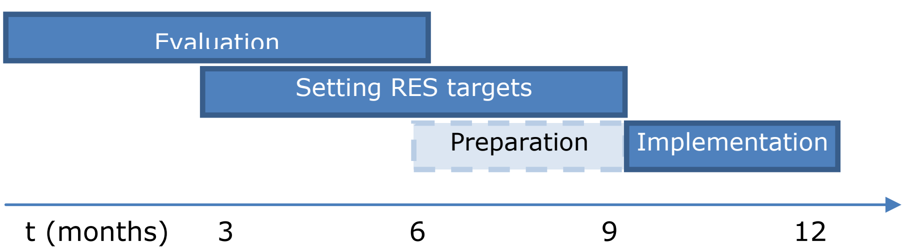

Figure 22 Timeline RES finance portal

Budgetary appropriations

The measure merely includes the bundling of resources and would therefore not have significant budgetary consequences. It is therefore expected that the extra necessary budget is limited to the costs of an evaluative analysis of the current instruments (e.g. EUR 500k-750k). The other main costs will be the organization of the RES finance portal (including advisory activities). As currently the EIAH already has an advisory service in place and the RES finance portal would merely be an additional window within this portal part of the activities and resources of the EIAH can be reallocated to the RES finance portal. Additionally, experts from the EIB, EIF and EC could also be reallocated to the portal, which will further limit the additional management costs. The other expenses that are expected are mainly for marketing and profiling sources, but these can be limited as well.

2.1.3.2 Focus existing financial resources on creating impact

The hazard in general instruments with open scope is – as we are now witnessing - that support is provided to mature technologies in countries with sufficient support schemes. However, as stated in paragraph 2.1.1.7 the general availability of capital is not the problem in financing those RES projects. Mature technologies - under the condition of a stable incentive scheme and once in operational phase - have access to private funding. This capital is currently even at low costs, due to the generally low interest rates. On the other hand, riskier projects cannot always access capital markets. Also, access to financial sources is limited for small-scale projects.

We therefore propose to concentrate on projects that need the additional "push" rather than financing projects that would otherwise be financed by the private sector. This would mean that the focus of existing financial resources should be on those areas where private finance is lacking, e.g. more risky capital (mezzanine, equity) for construction and operational phases, and development stage funding & finance (Venture Capital or innovation grants). When implementing the proposed measure, it has to be ensured though, that financing from private sector will not be crowded out.

Higher risk profile

EFSI has a strong potential to fill this financing gap as it is meant to uptake higher projects risk than the EIB. Of the total lending budget of EUR 63 billion, EUR 16 billion is guaranteed by the EC. EUR 8 billion of the guarantee is completely drawn from the EU budget. EFSI is however not a fund on its own, but managed by the EIB and subject to the same due diligence and approval criteria as regular EIB funding.

As the textbox below shows, the projects and national/regional funds financed by EFSI focus on offshore wind, onshore wind and solar projects in relatively secure North- and Western EU countries. National and regional funds are as well only co-financed in case of strong securities or guarantees by local governments. Also for funds, EFSI requests for a low risk portfolio for instance including relatively mature technologies (wind, solar), or high rated applicants (governmental clients).

EFSI renewable energy portfolio[97]

Project/fund	**Country**	**Scope**
Rentel	Belgium	Offshore wind
Susi Renewable Energy Fund II		Fund focussed on small-mid size projects in mainly PV and onshore wind
Energiepark Bruck	Austria	Onshore wind

[97] European Commission (2016). The Investment Plan for Europe – State of Play 13 January 2016. Available at: http://ec.europa.eu/priorities/sites/beta-political/files/sector-factsheet-energy_en.pdf

Odewald Infrastructure Fund I	EU	Fund focussed on small-mid size projects in mainly onshore wind, PV and small hydro
Ico Infrastructure risk sharing loan	Spain	RE
Envo Biogas Tonder	Denmark	Biogas plant
Mirova Eurofideme 3	Sweden	Onshore wind
Beatrice Offshore	United Kingdom	Offshore wind
Renewable income Europe	Ireland	Fund focussed on solar, onshore, offshore wind
Galloper offshore wind	United Kingdom	Offshore wind
Nobelwind	Belgium	Offshore wind
Saarlb – RES project finance guarantee	Germany France	RE
Impax New Energy Investors III	EU	Fund for onshore, solar, hydro
Capenergie 3 Fund	France	RE
Copenhagen Infrastructure II	Denmark	Fund for offshore wind, biomass (and electricity transmission).

Thus in practice the risk profile of the projects appears to be closer to regular EIB projects than on paper proposed. This is not necessarily due to the products the EFSI offers, but also due to the due diligence process and stringent criteria of the EIB.

We would therefore suggest to allocate the ring fenced EFSI budget to the RES investments that are struggling to gain funding, not merely from the EIB or other European institutions, but who as well face a financing gap from the market:

- Not yet mature technologies (like geothermal, wave energy, innovative solar technologies) in countries where private financial institutions already invest.
- All RES in countries with limited financial market confidence.
- Early project phase finance (e.g. Venture Capital).

The EFSI portfolio will bear the consequences of the additional risk appetite of the fund, as the cost of capital is a reflection of the risks. However a high cost of capital will make most RES projects unviable. Therefore the fund will need to have an adjusted policy with respect to the return expected: chances are that the EC guarantee reserve (for EFSI in total EUR 8 billion, for RES to be decided) will be largely depleted by the end of the financing period. This guarantee works thus in practice as a subsidy to the EFSI budget. As the EIB would want to have a buffer in order to secure the AAA-rating, this could mean that an additional guarantee would be needed on top of the initial guarantee (see below the budgetary appropriations).

This means that the ring fenced budget for EFSI would be a stricter ring fence than for the other instruments (as discussed in the previous paragraph). Therefore, the ring-fenced EFSI budget would have to be set aside in an earmarked fund structure in such a way that the additional guarantee does not influence the rating of the EIB, and monitoring and evaluation of actual investments dedicated to renewables is possible. It is not required to setup a separate entity for this earmarked fund.

Example fund - depletion of guarantee reserve

This example will show the concept of the depletion of the fund.

Please note that due to insufficient information on the current and potential future portfolio, this model does not include actual portfolio projects, but merely a fictional and simplified case on financing characteristics to show the concept.

In this example, we assume that EUR 10 bln of the EFSI budget is ring fenced and that of this budget EUR 4 bln is guaranteed (subsidised) by the EC.

The suggestion above is to accept higher risk within the EFSI portfolio, thereby accepting the depletion of the EC guarantee budget. At the end of the financing period - assumed to be 14 years (until 2030) - the budget could thus be at minimum EUR 6 bln instead of EUR 10 bln.

Similar structures are applied for EFRO co-financed innovation funds with a revolving structure[98]. The default anticipated for the early stage investments allows the fund to allow for a higher risk acceptance.

To show the difference of allowing for the EUR 4 bln lower fund exit, the table below shows two financing instruments with similar characteristics. Here a simplified proxy for the risk taken by these instruments is a percentage of default of payments. In one scenario the fund will have a break even result: the money coming out of the fund is equal to the money going in (corrected for the time value of money). In the second scenario, the value of the fund is depleted with the amount of the guarantee. The scenario's show differences in IRR and interest the fund could offer to projects. Both scenario's assume a 40-60 distribution of equity-debt provision.

	1. Break even result	**2. Depleting fund size**
Fund exit value (NPV)	EUR 10 bln	EUR 6 bln
Equity	IRR 11% Redemption 5 yrs Default 30%	IRR 7.5% Redemption 5 yrs Default 30%
Debt	Interest 4% Repayment period 15 yrs Default 15%	Interest 2% Repayment period 15 yrs Default 15%

Please note that multiple scenario's would show the same result. For instance different default payments or other ratios debt equity rations will lead to different interests and IRR.

98 See for instance http://www.doefondsfryslan.nl

Not only will these financial resources be made available to more difficult markets by accepting higher risks on portfolio basis, but also by bundling EFSI funding with other instruments (measure 1) the focus of these markets can be enlarged:

- Through the RES-finance portal the EFSI finance can be bundled with innovation subsidies, thereby enabling financial resources for relatively innovative technologies. This is merely necessary for projects with a nearly – but not yet – viable business case, such as geothermal.

- Through bundling with funding for regional development funds (like ERDF or Cohesion Fund), funding can be made available to those MS who currently do not have access to RES finance. This funding would not have to cover for ill-designed or instable policy schemes, but can form a condition to certain minimal MS policies (see measure 3).

This way, projects would be allowed to reach financial close, that would otherwise have to wait for higher ETS prices, lower country risks or a more favorable subsidy scheme. A different risk appetite would be possible and the fund would help projects that currently struggle to gain funding.

To retain the freedom of the fund manager while at the same time directing funding to priority areas and minimizing administrative requirements for project developers, we propose to not set strict criteria on a project level, but to set criteria on a portfolio level. These criteria would for instance include:

- The *total investments in RES*. The level would have to be based on the evaluation of the existing instruments (see measure 1).
- The *GHG-emissions* reduced directly through the projects supported by the RES finance portal. The RES finance portal will enable a clear overview of the realized projects, from which this figure can be derived. One should keep in mind that an absolute focus on GHG might limit attention for investments in small scale or early phase innovations. We therefore propose to also look into innovative projects that will enable further GHG emission reduction in the future. This objective is however merely qualitatively measured.
- The diversity of technologies (the so called *dynamic efficiency*). The effect of the adjusted EFSI portfolio would be underlined with the objective not only to support technologies at a later stage (e.g. on shore wind farms) but also technologies that will be important in the energy mix of 2030 or beyond.
- The *geographical distribution* of RES, meaning that RES development will not only take place in the low-risk countries, but also in countries where currently RES-deployment is lacking. This objective can be measured by 1) the number of different countries in which the portal invests in and 2) the differences in investments per country. The fund manager should strive for full coverage of the MS and should provide elucidation if any MS are not covered. This latter would provide valuable input on the general access to finance in those specific MS which in turn could lead to potential improvements of the risk profile.
- The *additionality* of investments compared to market financial resources and historic investments by European institutions. This objective is the most difficult one to measure. The evaluation in step 1 of implementing the

RES Finance Portal (measure 1) will result in a.o. specific financing gaps. The additionality of the new investments can be estimated from this gap and the total financial resources provided to these gap areas.

We note that the discussion around additionality should be organised with great care. It may depend on very project and country specific aspects, besides private sector has an own interest to reason that 'crowding out' takes place.

Development stage funding and finance

Currently most funding and financing instruments (like InnovFin or ELENA) are 'responsive', meaning that companies or governments (in case of ELENA) can apply to the instrument based on a specific finance or funding need within a pre-set list of criteria. These applications are then assessed based on specific instrument criteria. The instruments are however not actively requesting proposals on specific projects/technologies or geographical areas and the funding or financing merely includes the financial resources. This is on the one hand valuable as it allows the instruments to respond to actual questions and demands from the market. However, for some specific priority areas it can as well be valuable to proactively tender grants or VC (as described in paragraph 2.1.2.1) combined with for instance local subsidies, permits or specific locations, in order to fill the noticed market gaps.

In the development phase of a project the risk of failure is very high, as it is uncertain whether the project will be able to attract funding, find a suitable location, will get the required permits, agree on suitable contracts etcetera. If, trough for example proactive tendering including permits or including sites, a (small) part of this development is already prepared, this risk is also to a (small) extent reduced. The Dutch offshore wind tender (see paragraph 1.1.1.3.2) showed that the risk reduction in the development phase, combined with the effect of competition, resulted in unexpectedly low prices for offshore wind farms.

The RES Finance Portal could actively tender part of its financial resources, combined with project specificities. By doing so, the EC can focus the available funding for innovation on specific priority areas and provide as well a focus for developers for their development process. Moreover, the approach might also result in a more efficient funding mechanism, as market parties will not want to bid competitively. A proactive tender to support the development phase of RES projects would involve:

- The specific location for the development of the plant
- A fastened permit procedure by the MS government
- An investment grant covering for the first stage investments

Proactive tendering on priority areas allows the EC to take a first step and actively invite the market to participate on those projects that are deemed important by MS, for instance regional, cross border projects.

Another benefit is the focus of expertise that can be gained in certain sectors at EU level. The grant provider (e.g. EC or EIF) can build internal knowledge on the specific priority area for assessing the applications.

This proactive approach is not necessarily only suitable for grants, but can also be applied to Venture Capital (VC) investment. As VC investors require specific knowledge of the sector risks and opportunities in order to assess whether an investment is an actual opportunity, the bundling of this knowledge to a limited number of priority areas can be beneficial to VC investments.

This internal knowledge base can also be beneficial to the applicants. We propose to set specific frameworks for proposals and limit the information required for application, as the internal knowledge will enable the grant provider to assess the project's feasibility based on fewer information by the applicant. By limiting the administrative requirements, transaction costs for application can be limited and make grants better accessible for companies with less time or means to submit extensive paperwork.

As it is as well valuable to have an open application to funding, in order to respond to market developments, we propose to not allocate all funding in this manner, but rather base a part of the available budgets on specific priority areas. Open and proactive tenders can therefore exist parallel and within the same instrument (for instance InnovFin).

The following steps are proposed to introduce focused proactive innovation grants and VC:

1. Specify priority areas based on the NREAP process (see measure 3, step 2). These areas should include both technologies as geographical regions. Through these assigned priority areas based on the NREAP, the MS are incentivized to propose ambitious innovation projects. It could be valuable to especially focus on cross border projects, as this is one of the focus points to achieve the Energy Union.

   In addition, by basing the subsidies or VC investments on the priority areas as assigned by MS, the EC will ensure cooperation with the MS involved in the specific area, as this is needed to help the projects in the first phases (for instance regarding location and permits).

2. Involve sector specialists and conduct market studies on the priority areas in order to build a knowledge base on opportunities and risks in those areas.

3. Tender the development of (innovative) technologies in the priority areas. The tender includes a concession for development in a designated location. Combined to the tender is a development grant or VC investment (depending per priority area on the market study). The tender is marketed and allocated through the RES Finance Portal.

4. The proposals are assessed based on the quality of their business plan and business case. An ex-ante analysis on market failure(as is done in for instance ERDF)is not required as this information is known by the grant or VC provider.

Timeline

<u>Higher risk under EFSI</u>

A specific RES window for RES in EFSI will largely be a political decision, with a time frame of multiple months (the figure below sketches an indicative duration). Furthermore, the set-up of a separate structure for full ring-fencing and an additional guarantee would take at least another 6 months.

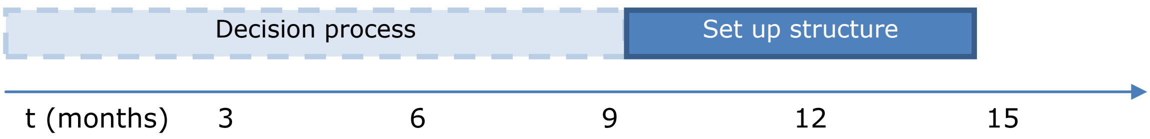

Figure 23 Timeline measure higher risk under EFSI

<u>Development stage funding and financing</u>

The timeline of proactively tendering grants and VC is highly dependent on when the priority areas can be set, which will be further discussed in the next paragraph. After the priority areas are set, the tender preparation will take about a year (to specify the project and agree with the MS on permit procedures). The tender procedure itself will take about 6 months, including the evaluation of the bids.

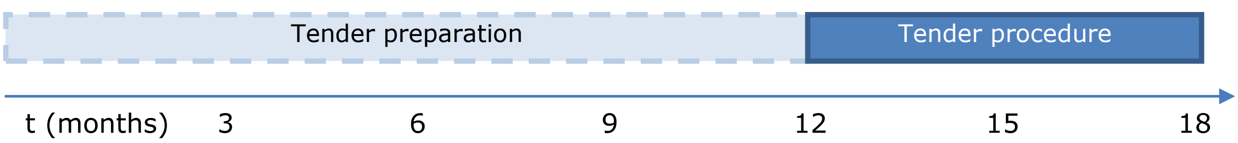

Figure 24 Timeline development stage funding and financing

Budgetary appropriations

<u>Higher risk under EFSI</u>

Allowing for a higher risk profile of projects funded by EFSI will have some budgetary consequences. The EIB will not be able to deal with the additional risks under the principle of maintaining their AAA rating. The additional risk will thus have to be based on a contribution by the EC. Currently, EFSI is already guaranteed by the EC for up to EUR 16 billion, of which EUR 8 billion is already drawn from the EU budget. As aforementioned, to allow for actual depletion of the total budget, an additional guarantee might be required for the EIB. As it is unclear at this stage what the exact portfolio of projects, as well as the ring-fenced budget would be, we can only provide a rough estimation, based on the current situation. Thus in case of a EUR 10 billion ring-fenced RES budget, the structure would look as follows:

	Total EFSI (current)	**Ring fenced RE**
Total EFSI budget	63 bln	10 bln
EC guarantee drawn from EU budget	8 bln	2,5 bln (1,25 from current guarantee and 1,25 additional)
Additional EC guarantee	8 bln	2,5 bln (1,25 from current guarantee and 1,25 additional)

Figure 25 EFSI guarantee structure estimation

In case of a ring-fenced budget of EUR 10 billion, the additional budgetary appropriation would thus be EUR 1,25 billion. Subsequently the additional guarantee would as well account for EUR 1,25 billion. These guarantee structures would however need to be clarified with the EIB.

Development stage funding and financing

The budgetary consequences for applying a proactive investment approach for grants and venture capital would be negligible. The instruments can utilize the resources of the RES finance portal, as well as the existing instruments. We believe as well that the concept of NER300 (using ETS revenues for innovation) could be the future origin of the funding, as it is announced that there might be an expanded NER300 programme in the future[99]. As expertise is currently anticipated to only a limited number of priority areas, the extra efforts for assessing applications might even be limited to a certain extent.

2.1.3.3 Incentivize MS to introduce or maintain a long term RES policy

Feed in tariffs, feed in premiums and quota obligations are currently still a precondition to a viable and financeable project in Europe. The largest risk perceived by investors in RES is the (stability of) these policies in the MS. In addition the complexity of all different measures in the MS creates a threshold for investors to finance RES projects. Investment teams require specific knowledge on incentive schemes in MS, thereby creating a bias to certain MS with a clear and stable policy.

A measure to limit the policy risk and complexity, is to provide a status and check to the National Renewable Energy Action Plans. The check would result in an 'investment ready' label of the plan, which is then a precondition to the access of existing or newly devised financial instruments. A check on the impact of plans on investments would thereby act as an incentive for MS to improve their policy. Moreover, it creates transparent and plausible plans and corresponding objectives. Such a measure has to be with a mechanisms that restricts the use of EU funds for instable projects, or it has to offer an additional guarantee for the EIB.

The transparency on measures like subsidy schemes, and the long-term security of those measures, are essential to investors to assess the stability of RES policy in the MS. This can to some extent lower the complexity of the measures as well.

Also due to the condition of funding, the EIB/EC/EIF can pressure MS to stick to national plans on the long term. Changing policy will be discouraged as MS have to justify to the EC when they do so and the access to financial instruments can be withdrawn. This withdrawal would however only apply to new projects as for existing projects the consistency of instruments is essential for investors' confidence in the market.

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99 European Commission (2014). A Policy Framework for Climate and Energy in the period from 2020 to 2030.

In the "policy framework for climate and energy in the period from 2020 to 2030"[100] report, the EC sets the framework for the national energy plans. The implementation of the plans is envisaged in three steps. A more detailed substantiation of those steps is given below[101].

1. *Detailed guidance by the Commission on the operation of a new governance process and content of national plans*

   Specifically for RE, every MS should include the following elements in the NREAP:
   a. Quantified policy ambitions for RES deployment in 2030;
   b. Support measures and associated budget reservations; clarification of financial instruments applied;
   c. Assessment of the effectiveness of the current incentive measures;
   d. Perspective on the gradual abolishment of disincentives for energy saving and RES production, particularly as part of the taxing system;
   e. Vision on cost effectiveness and innovation;
   f. Regular assessment of the 'RES investment climate' among the country's green banks and investors.

2. *MS prepare plans through iterative and interactive process*

   This step provides interaction between the MS to enhance cross-border projects. It can however also assist in learning best practices from other MS and to coordinate projects. The main elements of this step are:

   a. Learn best practices on effectiveness of incentive schemes;
   b. Learn best practices on the investment climate among financiers and identify potential investment gaps to be filled by the EIB or other funds (see as well measure 2).
   c. Coordination of innovation projects and efforts. Coordination between MS on innovation schemes can help to better focus innovation processes (e.g. to not start the same demonstration project in different MS) and can thereby help the existing subsidy schemes to increase focus in innovation projects. The result of this coordination should be the identification of priority investment areas (relevant to measure 2).

3. *Assessment of MS' plans and commitments by the Commission*

   Plans are by the EC checked on the following questions:
   a. Are long term budget reservations for the support measures in place and/or is the RES support secured for a long term period through legislation (e.g. quota obligations)?

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[100] European Commission (2014). A Policy Framework for Climate and Energy in the period from 2020 to 2030. Available at: http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52014DC0015&from=EN

[101] Please note that the aspects mentioned below are merely focussed on increasing access to financial resources for RE. These plans will have a larger scope and should also include for instance specific plans on improving energy (transmission) networks, interconnectivity and energy efficiency. This is outside this project scope.

b. Is it plausible that the proposed support measures and budget reservations will lead to achieving the 2030 target ambitions?
c. What guarantees are provided towards RES developers to ensure revenues and avoid dependencies on changing policy conditions?

In case the NREAP includes all of these aspects, it will be labelled 'investment ready'. This label will be a condition for providing any of the other instruments to projects in MS. This would mean that grants as well as guarantees or financing instruments are only accessible for new projects in MS with an approved (on consistency and plausibility) NREAP. This labelling provides an incentive for MS to improve the consistency or plausibility of their plans, for instance by adjusting targets, increasing budget or changing legislation.

The legal basis for refusal of EU funding would then lie in the financial conditions that would have to be agreed with the EU/EIB/EIF (the fund manager) and the developer. The existence of an approved NREAP is simply part of the eligibility criteria of the earmarked fund. Therefore, a project developed in a MS that does not possess an approved NREAP is not eligible for funding. It would also allow to convince pledging Member States that additional resources are not transferred to Member States and projects that are themselves responsible (retrofit, denial of climate change) for a poor investment climate.

The most important aspect is however the signal that goes out to the MS, i.e. to have a NREAP that presents investor certainty for both RES developers as the European Funds. The 'investment ready' label could as well lower some of the policy risks for other investors in the project.

To actually reduce complexity and reduce policy risks on a structural basis, in the long term the EC should strive for one European RES program in the long term. ETS can play a key role in this by creating a level playing field for RES throughout Europe. Moreover ETS can enhance the competitiveness of RES compared to conventional energy production and thereby reduce the dependency on national incentive schemes.

Timeline

The timeline of this approach would follow the general approach of the implementation of the NREAPs. The timeline for this process is not stated by the Commission, although it is said that the NREAPs should be operational long before 2020. We advise a more stringent deadline in this, in order ensure the operational effectiveness on short notice. Additionally, some extra time is anticipated in the possibly iterative evaluation process of the NREAPs following the aforementioned steps.

Budgetary appropriations

The budgetary consequences of this measure are very limited to only some additional work to assess and approve the NREAPs.

2.1.3.4 Conclusion and considerations on proposed solutions

In this paragraph we proposed the following measures to unlock funding and financing for RES projects:

1. *Create a single entrance 'portal' for RES finance applications*, thereby focusing more on the perspective of the applicant than the perspective of the financing products. The RES financing portal would include an advisory service to assist in financing structures for RES projects which can build on the existing European Investment Advisory Hub. The portal would also enable the cutting of red tape for applications of financial instruments and grants.

2. *Focus existing financial resources to those areas where private finance is lacking*. Currently the majority of the European financing resources are focused on relatively mature technologies in stable RES policy MS. Some of these projects could however as well be financed by the market, thereby leaving a gap for less conventional technologies or MS. EFSI resources should therefore accept a higher project risk profile, partially by a larger EC guarantee, partially by co-financing with other budgets. In addition, grant and VC resources should be proactively tendered in combination with other secondary advantages such as a location or permit, in order to –to some extent– limit the development risks and focus the available budgets to priority areas.

3. *Incentivize MS to introduce or maintain a long term incentive RES policy* by giving an official status to the National Renewable Energy Action Plans. These plans would be a precondition to financial instruments by the RES finance portal, thereby create transparency on the status in the MS, as well as provide an incentive for MS to introduce a stable and sound RES scheme.

The measures above are meant to reduce the bottlenecks in funding RE. However none of these measures will be the silver bullet to enable RES deployment and achieve the 2030 target. As long as energy prices are low, fiscal incentive schemes to conventional generation is in place, and the ETS system is not sufficiently reflecting the external effects of fossil fuel energy generation, renewable energy cannot compete with conventional energy sources. National FiT, FiP and Quota schemes are thus still essential to enable RES development. At the same time one should also accept that there are issues that cannot be changed by merely spending money at it (e.g. local politics and permit requirements, other priorities, lack of sense of urgency, etc.).

However the measures proposed above will enable a more efficient use of the available funding. Moreover we do advise to as well do an in depth evaluation of the existing instruments currently supporting RES in order to gain a clear overview on the available funding and possibilities to increase impact.

2.1.4 Indicators for impact assessment of financing instruments

In the context of the impact assessment for the new Renewable Energy Directive this memo provides a set of possible indicators in order to clarify the impact of the measures proposed. There are three dimensions relevant to measure the impact: economic, social and environmental impact. On these dimensions we propose several objectives the instruments should contribute to. These objectives are then translated into indicators. Please note that the list of indicators is merely a first draft and requires further completion depending on the precise choice of measures.

Although several instruments or institutions claim to have contributed significantly to RES financing this has proven to be hard to verify in the end. Funds or instruments themselves cover a wide range of investments (infrastructure, health care etc.) thereby impeding the monitoring of actual investments in renewables. The same accounts for funding categories in the energy sector, including e.g. conventional energy investment or climate mitigation measures, that have no impact on RES financing. Furthermore if a financial instrument is used for deals that would also be realized with 100% private funds, the added value of public intervention is limited. Therefore, in addition to measuring economic, social and environmental impact we propose to tune in on 'additionality' as well.

2.1.4.1 Additionality

In our report we propose several measures designed to achieve the same main objective; to unlock long term funding for RES. The measures are all targeting the efficient and effective use of European budget and efforts and are strongly interlinked. Counting all of the effects per measure would possibly result in 'double counting' of effects. We therefore propose to measure the effects of the measures integrally, through data collected by the RES finance portal. The RES-finance portal will enable better monitoring of projects supported by EU-institutions. Due to the portal there is a complete overview of projects which are supported by financial resources (EIB, EFSI), grants (H2020) or advisory services. The other measures support the resources provided by the portal, so these effects will also be visible in the results.

Even though the RES finance portal provides data on the effects of the financial resources by European institutions, the effects can not only be attributed to the measures proposed but are mainly an effect of the financial resources itself. In order to gain insight in the additional effect of the specific proposed measures, we propose to use a proxy for the increase of financial resources due to the measures. This proxy is based on the ratio of the financial resources (financing instruments and grants) targeted to RES projects before, and after the measures are implemented:

$$Proxy\ investment\ ratio = \frac{\sum EU\ financial\ resources\ before\ (bn\ EUR)}{\sum EU\ financial\ resources\ after\ (bn\ EUR)}$$

Most of the indicators below thus have to be multiplied by this proxy in order to see the actual impact of the measures (they are indicated by a '*'). This would however mean that the measures have to be implemented *ceteris paribus* (all other things equal), so we propose to limit other changes regarding RES financing through European institutions as much as possible.

2.1.4.2 Indicators based on dimensions

The economic dimension

On the economic dimension, objectives could cover on the one hand to *increase the total investments in RES*. This objective can be achieved by the investments by the portal itself, but as well by creating leverage of market parties. The leverage should however not be a target to strive for, as a high leverage (like in EFSI) can also lower the actual additionality of the instrument.

Besides the total investments in RES, as well as a *lower cost of energy* could be an objective for the impact assessment. The cost of energy (through the levelized cost of electricity) will show the impact of reduced financing costs for a project.

On the long term, in order to increase the large scale deployment of RES, the objective should be to *lower the dependency on public resources*. However, as indicated in our report, currently public support for RES is a precondition to access private financial resources. Due to this timewise split objective, simply measuring the public resources would not be the right indicator for success. We therefore propose to merely judge this objective qualitatively based on the national energy action plans.

The (static) *efficiency* of the measures describes the costs made to implement, thus the budgetary appropriations of the measures. Indication of these costs are relevant to ensure that the costs of operation do not exceed the benefits and to compare these measures to others. The estimated budgetary appropriations are already described in paragraph 2.1.3 of the report.

Another aspect of efficiency is the efficiency of the measures is the *transaction costs* for market parties, meaning the effort and costs they have to take in order to apply for EU financial resources. These transaction costs will be difficult to determine, as they are often intangible (time spend) and not available to the RES finance portal. We therefore propose a qualitative indicator describing the administrative requirements for applications.

In order to make the RES-market innovative and future prove, it is important to support a *diversity of technologies* (the so called dynamic efficiency). The additionality of public intervention would be underlined with the objective not only to support technologies at a later stage (on shore wind farms) but also technologies that will be important in the energy mix of 2030 or beyond. This objective can be measured by means of multiple indicators.

The social dimension

While sustainability is a very important objective to strive for, it is as well relevant to keep track of the *affordability of the energy supply*. From social perspective it is thus relevant to look into the consumer costs of energy related to the projects financed through the portal. When this cannot directly be derived for those projects, one should alternatively again look into the LCOE of the projects and translate those to consumer costs by adjusting for taxes etc..

As well relevant from this perspective is the *social acceptance* of the RES projects realized through the measures. Social acceptance is not easily measured. We therefore propose to make use of existing survey results to see whether a trend in social acceptance over the years is visible.

Another indicator for a success from a social perspective is the *geographical distribution* of RES, meaning that RES development will not only take place in the low-risk countries, but as well in countries where currently RES-deployment is lacking behind. This objective can be measured by 1) the number of different countries in which the portal invested and 2) the differences in investments per countries. The latter involves the standard deviation of the investment per MS, divided by the total energy use in the country (to correct for different sizes of energy demand). The indicators should however always be viewed in combination as the size of investment is not all-saying but can also depend on for instance one large project vs. several small projects.

Environmental dimension

Environmental impact of the proposed measures can be measured by the *GHG-emissions* reduced directly through the projects supported by the RES finance portal. The RES finance portal will enable a clear overview of the realized projects, from which this figure can be derived.

One should keep in mind that an absolute focus on GHG might limit attention for investments in small scale or early phase innovations. We therefore propose to also look into innovative projects that will enable further GHG emission reduction in the future. This objective is however merely qualitatively measured.

Overview of objectives and indicators

The table below provides an overview of the dimensions, objectives and indicators:

Dimension	Objective	Indicators specifically for instruments
Economic	Increase the total investments in RES	• EUR invested in RES through RES finance portal* • # of RES projects supported through RES finance portal* • Investments by private parties due to investments of RES finance portal (advisory as well as leverage)*
	Lower the costs of RES	• Levelized Cost of Electricity (LCOE) of projects financed through portal*
	Lower the dependency on public resources on long term	• *Visions of EU and MS on reducing dependency on grants and subsidies*
	Efficient use of EU resources	• Budgetary appropriations of measures: employment costs for portal and checks on NCEAPs, costs for evaluation of existing instruments
	Lower transaction costs for market parties	• *Administrative requirements for applying for EU-financial resources through the RES finance portal*
	Increase diversity of RES-technologies to increase RES-investment in the long term (dynamic efficiency)	• # of different technologies supported through finance portal* • Difference in investment through RES finance portal per technology (standard deviation in EUR/GJ per MS)*

		• # of innovation projects supported*
Social	Affordability of energy supply	• Average consumer price (€/GJ) of projects financed through portal*
	Geographic distribution of RES deployment	• # of countries in which invested through portal* • Difference in investment through portal per MS (standard deviation in EUR/GJ corrected for total GJ per MS)
	Increase social acceptance	• *Support by residents for RES (mainly wind energy) – e.g. by assessing existing surveys*
Environmental	Reduce GHG-emissions	• % GHG emission reduction of projects financed through RES finance portal (compared to 1990)* • *Innovative projects to enable future GHG emission reduction*

* corrected by proxy | *italic* in case of qualitative indicator

2.2 RES Transport

2.2.1 Introduction

This section focuses on

- Assessing EU-wide measures and policies for increased uptake of renewable energy in transport, and
- (Further) analyse whether some of these measures can also be applied as a gap filler.

2.2.2 Problem definition

The '2030 Climate and Energy Policy Framework' introduces a binding target of a 40% reduction of greenhouse gas (GHG) emissions until 2030 compared to 1990 and an EU-wide binding target for renewable energy of at least 27%. One major difference, compared to the 2020 frameworks, is that the 2030 framework does not include any RES targets for transportation for the period beyond 2020. This poses a significant uncertainty and risk to RES development in transport sector and reducing the GHG emissions.

The transport sector is, however, responsible for around a quarter of the EU's GHG emissions, making it the second-biggest emitting sector after energy[102]. As such, it has a key contribution to make to decarbonise the European economy.

Decarbonising transport sector requires improving vehicle efficiency, electrification of transport sector, managing transport demand and switching towards carbon free or less carbon intensive fuels. RES fuels are an essential decarbonisation option requiring a clear and stable EU policy framework. This is especially the case for advanced biofuels, where incentives are very much needed over the next two

[102] According to a recent publication from the EEA (EEA, 2015) transport is the only sector where emissions increased compared to 1990 levels.

decades. In response to these challenges, an EU-Wide Quota Obligation (QO) for energy suppliers/distributors could be considered. This option will provide investor confidence and a stable growth of renewable fuel deployment in the post-2020 period. At the same time, targeting the fuel suppliers and distributers can help to achieve Energy and Climate objectives in transport.

Obligation systems are, in general, considered as cost-efficient measures to ensure a certain amount of RES on the market. They can encourage cost reduction and competition. An obligation system will generally stimulate the lowest cost and least risky renewable technologies, thereby allowing a set target to be met in an efficient way. Moreover, the total costs of an obligation system can be capped by the size of the quota and the level of the penalty. For governments it is a policy measure with low direct budgetary impact, which ensures the desired amount of RES to reach the market, as long as the fine or buy-out price is sufficiently high. However, several issues remain to be researched, such as:

- how the design elements of an EU-wide QO could be set so that it ensures a stable investment climate for RES-T development.
- how a QO could be shaped so that it sufficiently supports biofuels that have high GHG emission reduction potentials, i.e. advanced biofuels.
- what supporting policy instruments are needed that help overcoming other main barriers to the development of advanced biofuels

This study looks into the design details of a possible future QO instrument, and supporting policy instruments for RES-T.

2.2.3 Approach

During the kick off meeting and in further contacts with the client the study focus is determined as:

- a system with a (quota) obligation will be the prime policy instrument to be analysed. Supportive measures that can compensate for the weaknesses of a quota system will also be explored.
- the focus of the analysis will be given to fuels but it will be briefly assessed whether it would be possible allow suppliers to fulfil the obligation supplying renewable electricity. Electrification of transport systems and the role of renewable electricity will be excluded from this study as this topic may not necessarily fall under the new Renewable Energy Directive as it does not lead to an increased production of renewable energy(REDII).
- as the focus is on fuels, we will also explore the possible inclusion of other end use sectors that consume fuels, such as decentral heating.

Thus, different design elements of a possible Quota Obligation will be analysed with the aim to ensure a high degree of investors certainty. Different options will be compared among each other, their strengths and weaknesses will be identified.

The study will be executed in the following steps:

1. *Longlisting:* We will introduce a long list of policy characteristics that are relevant for renewable fuels. This list consists of two parts:

   a. Detailed characteristics of an obligation system and related measures (for a first list see Section 3), and possible options for setting these characteristics;
   b. Possible supportive instruments not related to the obligation system and rollout, but reducing other barriers for further development of renewable fuels (for a first list see Section 4).
2. *Quick scan/short list:* We will define pros and cons of all above policy characteristics to eliminate options for which we can directly find a compelling reason why they should not be selected, e.g. because it is conflicting with the underlying objectives of the RED, or creates unacceptable administrative burden. On this basis, and after reflection by the client on the list, we will develop a shortlist of key characteristics of the obligation and their possible settings, and the supportive measures, for more detailed analysis.
3. *Criteria setup & elaboration:* We will develop an analytical framework for evaluating the characteristics and instruments listed in step 2 (short list):
   a. Selection of the most important criteria for assessing the options, i.e. efficiency and effectiveness. Compatibility with EU/national legislation is also covered in a separate memo.
   b. A comparison of the supportive measures with the barriers they should be solving, and a reflection of their effectiveness in doing so.
4. *Reporting:* The outcomes of the assessment of the shortlist options, and the background longlist information will be reported.

2.2.4 Quota Obligation-1st screening of design elements

2.2.4.1 Intro to long list of design elements

Characteristic	Possible options
1. Which sectors and fuels should the measure cover?	a. Liquid and gaseous fuels in road transport b. Liquid and gaseous fuels in all transport, so including aviation and maritime c. Liquid and gaseous fuels delivered to all end users, so including use in decentral heating, cooling and power, and as industrial energy source/ feedstock, but excluding use in centralised power and district heating d. Liquid and gaseous fuels delivered to all sectors e. Liquid, gaseous and solid fuels delivered to all sectors
2. Sub-targets for (sub)sectors?	a. No b. Yes, for road transport, aviation and maritime separately (see 1b) c. Yes, for all end user sectors (see 1c) d. Yes, for all sectors (see 1d/e)
3. Sub-targets for specific fuels?	a. No b. Yes, for gaseous and liquid fuels (and solid if relevant, see 1e) c. Yes, for gaseous and liquid fuels and for various types of liquid fuel substitutes, such as for gasoline, diesel, kerosene, etc.)
4. What types of renewable fuels should be covered?	a. Advanced renewable fuels only b. Advanced renewable fuels and conventional fuels not based on food crops c. All renewable fuels, but with a cap on fuels based on food crops
5. Which part of	a. Suppliers that bring oil/gaseous products on the EU market for

	the supply chain?	the first time b. Suppliers as defined by the FQD: party passing fuel through an excise duty point or other relevant fiscal entity
6.	**Obligation applies to whom?**	a. Fuel suppliers, EU-wide b. Fuel suppliers, with same obligation for each MS c. Fuel suppliers, with flexibility for MS in some respects d. Fuel suppliers, with the option to offset by additional realisations in RES-E
7.	**What penalty system in case of non-compliance?**	a. Financial penalty higher than the tradable certificate price b. (to be further elaborated, examples found in current practice)
8.	**Which unit to use for the obligation?**	a. In energy terms (PJ, toe, etc.) b. In GHG terms (ton CO_2) c. In volume terms (l, m^3)
9.	**Absolute or relative target? And Which denominator (in case of a share)?**	a. Absolute number (see 5) b. Relative share of total consumption or emission
10.	**How to deal with RES of non-organic origin (e.g. P2G)?**	a. According to current RED: RES share is either EU or MS average b. According to current RED, but with 100% RES share when prices are very low c. Use GoO system for accounting fuels produced from renewable electricity d. Use GoO system and separate non-organic fuels from biofuels

2.2.4.2 Which sectors and fuels should the measure cover?

Options:

- Road transport only or all transport modes in Europe, including aviation and shipping
- Transport fuels only or all end use sectors consuming gaseous and liquid fuels
- Liquid and gaseous fuels only or also solid fuels.

The FQD (Directive 98/70/EC) relates to the quality of petrol and diesel fuels and establishes minimum specifications for petrol and diesel fuels for use in road and non-road mobile applications for health and environmental reasons.

Within the RED (2009/28/EC) the 10% renewable fuel target applies to "road transport" only. Any quantity of renewable fuels used for aviation would count towards the 10% renewable fuels target but the total fuels used in these sectors are not included in the denominator. Aviation fuel and fuel used in shipping is taken into account when calculating Member States' overall energy use, important for calculating the 20% 'renewable energy' target. The amount of aviation fuel considered is 'capped', which means that for states with a high aviation volume, the full aviation fuel isn't taken into account in the denominator for 20% RES calculation.

The transposition of the RES Directive differs per Member State, depending on the Member State translation of the RED in their legislation. Member States are not obliged to directly translate the RED in their national legislation. Even though the RED specifies that Member States should count renewable fuels used in non-road modes towards the 2020 target, most of the current biofuels policies of the Member States are still limited to biofuels use in road transport.

A similar approach is followed in the US. The Renewable Fuels Standards (RFS) program is a national policy that requires a certain volume of renewable fuel to replace or reduce the quantity of petroleum-based transportation fuel, heating oil or jet fuel. While the fuels that are subject to the percentage standards[103] are currently only non-renewable gasoline and diesel[104], renewable fuels that are valid for compliance with the standards include those used as transportation fuel, heating oil, or jet fuel.

Since 2012 emissions from all flights from, to and within the European Economic Area(EEA) are included in the EU Emission Trading System (EU ETS). The EU ETS requirements were, however, suspended for flights in 2012 to and from non-EU countries. For the period 2013-2016 the legislation has also been amended so that only emissions from flights within the EEA fall under the EU ETS (EC, 2016). In the EU ETS biofuels are counted as climate-neutral (in line with biomass use for power production, for example) and do not require any CO_2 emission allowances. However, biofuels costs are much higher than the current price of the emission allowances, even with the zero-counting, so that the ETS is not likely to provide an effective incentive for sustainable biofuels use in the coming years (Kampman et al., 2013).

According to a study conducted by DG CLIMA, some transport modes, namely long distance heavy duty vehicles, aviation and shipping, have only few options to reduce the GHG intensity of their fuels. In a future low-carbon economy, all trains, passenger cars and vans and part of the heavy-duty vehicles[105] are expected to drive mainly on renewable electricity, and possibly on hydrogen produced from renewable energy sources. Battery electric drive trains are, however, not expected to be suitable for aviation and shipping and heavy duty vehicles, these sectors will thus be dependent on biofuels and energy efficiency improvements to reduce their GHG footprint.

Table 19 Coverage of transport modes and travel range by the main alternative fuels (EC, 2013)

Fuel	**Mode**	**Road-passenger**			**Road-freight**			**Air**	**Rail**	**Water**		
	Range	short	medium	long	short	medium	long			inland	Short-sea	maritime
LPG												
Natural Gas	**LNG**											

[103] The renewable fuels standards are expressed as a volume percentage of gasoline sold un the US.
[104] Convectional diesel used in ocean vessels are excluded from percentage standards.
[105] Up to 100 km range electricity, 100- 400 km hydrogen considered as future alternative options for heavy duty vehicles.

	CVG											
Electricity												
Biofuels (liquid)												
Hydrogen												

It is advisable to provide an incentive for sustainable biofuel use in the non-road sectors. A QO to fuel suppliers, including aviation and marine transport (intra-EU) could provide fuel suppliers the opportunity to use the biofuel blending potential in these sectors (See ANNEX F for some more details on alternative fuels for shipping and aviation).

- *Include end use sectors consuming liquid and gaseous fuels*

Liquid and gaseous biofuels could also be considered for household/building heating since this sector is not covered in the EU ETS. For instance, biodiesel is suitable as an additive or replacement fuel in a standard oil-fired furnace or boiler, and bio-methane can replace fossil natural gas in heating boilers in homes and offices.

In the US, the Renewable Fuel Standard (RFS) has been expanded to renewable fuels used for heating buildings to be counted towards the RFS2 mandates[106]. In 2013, Environmental Protection Agency(EPA) amended the definition of "heating oil" in the regulations for the RFS programme. This amendment expands the scope of renewable fuels that can be used to show compliance with the RFS renewable fuel volume obligations by adding additional category of compliant renewable fuel referred to as "fuel oils", produced from qualifying renewable biomass and used to generate heat to warm buildings or other facilities where people live, work, recreate, or conduct other activities. Producers or importers of fuel oil that meets the amended definition of heating oil will be allowed to generate Renewable Identification Numbers (RINs), provided that the fuel oil meets all other requirements specified in the RFS regulations. Fuel

> The existing definition of heating oil at 40 CFR 80.2(ccc) is ''any #1, #2, or nonpetroleum diesel blend that is sold for use in furnaces, boilers, and similar applications and which is commonly or commercially known or sold as heating oil, fuel oil, or similar trade names, and that is not jet fuel, kerosene, or MVNRLM [Motor Vehicle, Non-Road, Locomotive and Marine] diesel fuel.''
>
> The existing definition of nonpetroleum diesel at 40 CFR 80.2(sss) is ''a diesel fuel that contains at least 80 percent mono-alkyl esters of long chain fatty acids derived from vegetable oils or animal fats.' Limiting ''home heating oil'' to the fuel types defined in 40 CFR 80.2(ccc) disqualifies certain types of renewable fuel oils that could be used for home heating.

[106] EPA, 40 C.F.R. Part 80, "Regulation of Fuels and Fuel Additives: Changes to Renewable Fuel Standard Program, Final Rule," Feb. 3, 2010.

oils used to generate process heat, power, or other functions are not included in this additional category of heating oil. All fuels previously included in the definition of heating oil continue to be included as heating oil for purposes of the RFS program. (EPA, 2013a,b).

Expanding the QO to other sectors (i.e. heating and cooling) could provide flexibility in fulfilling the Quota and at the same time increase the liquidity of the market in case the certificates are tradable. Thus, this option could allow for optimisation between mobile and stationary end use and contribute to cost-efficiency.

- *Liquid and gaseous fuels only or also solid fuels*

Within the existing RED, RES-T fuels include liquid and gaseous biofuels and excludes solid biomass as a fuel (not as a feedstock). In case of expanding RES-T obligation, for instance, to heating and cooling could justify inclusion of solid biomass to the QO. However, this would likely undermine key objectives of the instrument e.g. promote the development and deployment of advanced renewable fuels. Next to that, the possible conflicts between an EU-wide QO and the national support schemes targeted to solid biomass applications may result in difficulties that increase the administrative costs and decrease the political acceptance.

Thus, for further analysis we propose to eliminate:

- the expansion to solid biomass,
- limiting the sector to road transport only, and
- the option to expend the QO to all sectors (including large scale H&C and power production).

While expanding the QO to decentralised heating& cooling, power and industrial use appears to be quite complex, we decide to keep this option and further analyse the possibilities in close cooperation

Table 20 Pros and cons of a QO that covers different sectors and fuels

Characteristic	Possible options	Pro's	Cons
Which sectors and fuels does the measure cover?	a. Liquid and gaseous fuels in road transport	• Road transport accounts for more than two-third of EU transport related GHG emissions • All most all biofuels produced is currently consumed in road transport, thus, the sector is more mature when compared with other sectors in transport (See section 3.1, Annex F for further details).	• May not be the most cost-efficient approach if renewable fuels in other sectors are cheaper • Not technology neutral /discrimination in comparison to other transport modes • A limited market application • No incentive to the other transport sectors, for which biofuels will become more relevant and important
	b. Liquid and gaseous fuels in all transport, so including aviation and maritime	• Broader scope covering most types of fuels • Addresses sector that is most difficult to decarbonise • Equal treatment of all sectors • Larger market in case of certificate trading	• Costs only on transport, may exclude cost efficient renewables in other sectors • Aviation is already included in the EU ETS
	c. Liquid and gaseous fuels delivered to all end users, so including use in decentral heating, cooling and power and as industrial energy source/ feedstock, but excluding use in centralised power and district heating	• The measure could capture a larger part of the energy sector • Optimisation between mobile and stationary end use, contributing to cost-efficiency • Increases flexibility • Limits cost of system if renewable liquid fuels prove to be much more expensive than gaseous fuels	• Need to avoid double counting for fuels used for power generation. • High administrative costs(expand to suppliers also for small scale E&H) (for transport the number of producers and distributors may be manageable, what about for decentral heating& cooling and power??) • Definition between central and decentral (non ETS covering sectors?) • Conflicts with existing MS feed-in premiums particularly for liquid and gaseous fuels, • May dilute/decrease the ambitions in transport sector as applications in heating and cooling may turn out more cost efficient

Characteristic	Possible options	Pro's	Cons
			• As costs for RES are generally lower in other sectors, probably less RES renewable fuels will be realised. • Increased complexity • Likely to reduce investment security to producers of renewable transport fuels if not very well specified
	d. Liquid and gaseous fuels delivered to all sectors	• A sector neutral Quota obligation would ensure the highest level of cost-efficiency	• A high risk to biofuel use in transport (in case use of biofuels in other sectors become more profitable) • High administrative costs (due to complexity of administering many various suppliers) • Conflicts with existing MS feed-in premiums particularly for liquid and gaseous fuels,
	e. Liquid, gaseous and solid fuels delivered to all sectors	• A sector neutral Quota obligation would ensure the highest level of cost-efficiency • A feedstock neutral application could ensure the an even higher level of cost-efficiency	• Heavy burden on administration costs • Conflicts with existing MS feed-in premiums particularly for liquid and gaseous fuels, • Sold biomass cheaper than liquid res fuels. A high risk to biofuel use in transport (in case use of biofuels in other sectors become more profitable)

2.2.4.3 Sub-targets for (sub)sectors

Options to focus

- No sub-targets
- Sub-targets for road transport, aviation and maritime
- Sub-targets for all end user sectors
- Sub-targets for all sectors

The previous question and the initial discussions indicate a preference for inclusion of all transport sectors and the possibility to expand the QO to the heating sector. In this sub-section, we discusses whether sub-targets need to be set to different sectors (including all transport modes and targets for H&C and power etc.). Having no sub-target among the sectors will, on the one hand, ensure flexibility in fulfilling the quota in a cost efficient way. On the other hand, this option may result in less biofuels in the transport sector but more in other sectors depending on the cost-competiveness and the reference fuel prices. Including sub-targets to each sector can motivate more innovative technologies and push for biofuel use in other sectors than road transport. Third option, having sub-targets to all sectors (including large scale heating and cooling and power) is excluded for further analysis as in the previous question we decide to exclude this option.

Table 21 introduces pros and cons of sub-targets for different sectors.

Within option one 'no sub-targets' there is also the possibility to include other types of incentives such as multiple counting to encourage biofuel use in sectors that don't have other alternative fuel options such as long-distance heavy-duty vehicles, aviation and maritime.

Table 21 Pros and cons of including sector specific sub-targets

Characteristic	Possible options	Pro's	Cons
Whether there should be sub-targets or not?	No	• Increases the flexibility, total system optimisation-cost-efficient , • In line with the existing RED	• Transport sector may suffer(i.e. if green gas becomes more cost-competitive in comparison to reference fuel)
	Yes, for all (sub) sectors	• Will motivate more innovative technologies (i.e biofuels for aviation) • No lock in effect-all sectors need to act	• Reduces the flexibility-higher costs • Market will be smaller, leading to higher costs[107] • Burden sharing problem • More difficulty to define sub-targets (particularly for small scale heating and cooling)
	Yes, for all sectors (see 1d/e)		• Reduces the flexibility-higher costs • Market will be smaller, leading to higher costs[108] • Burden sharing problem • Difficulty to define sub-targets (particularly for heating and cooling and power sector) • Conflicts can occur with the existing feed-in premiums • Higher administrative costs

[107] In case the Quota scheme is not designed properly.
[108] In case the Quota scheme is not designed properly.

2.2.4.4 Sub-targets for specific fuels

This question relates to whether to have sub-targets for liquid and gaseous fuels and for various types of liquid fuels substitutes, such as for gasoline, diesel and kerosene. Table 22 introduces the pros and cons of the options:

- *No*
- *Yes, for gaseous and liquid fuels (and solid if relevant, see 1e)*
- *Yes, for gaseous and liquid fuels and for various types of liquid fuel substitutes, such as for gasoline, diesel, kerosene, etc.)*

Table 22 Pros and cons of sub-targets for specific fuels

Characteristic	Possible options	Pro's	Cons
Sub-targets for specific fuels?	a. No	• Cost-efficient (static) • Flexibility, system optimisation • Don't bump into blending issues(blending wall issues can be managed more easily by opting for other sectors)	
	b. Yes, for gaseous and liquid fuels	• More investor certainty • A clear incentive for gaseous fuels (i.e. for biomethane)	• Introduces another uncertainty related to fuel demand in sectoral demand developments • Increase in administrative costs
	c. Yes, for gaseous and liquid fuels and for various types of liquid fuel substitutes, such as for gasoline, diesel, kerosene, etc.)	• Miss match between demand and supply can be addressed • opportunity to create a better match with supply mix of European bio-refineries (with a cost)	• Higher administrative costs with respect to defining and monitoring all different targets

2.2.4.5 What types of renewable fuels to cover

This sub-section addresses whether an EU-wide policy should focus on specific fuels and foster innovation or ensure efficiency, i.e. dynamic vs. static efficiency.

Defining the terminology for biofuels

A wide range of terms are used to refer to biofuels and there have been no universally agreed definition of biofuels. The classifications (1st generation, 2nd generation, 3rd generation, next generation, sustainable, renewable, advanced, etc. are based on the type of feedstock, conversion technology applied, and the properties of the fuel molecules produced. In the recent legislative act (Directive 2015/1513), so called the iLUC directive, essentially three categories of biofuels are identified:

- Crop-based biofuels, for which a cap of 7% towards 2020 applies
- Advanced biofuels that count twice towards the 10% target and for which an indicative 0,5% sub-target applies (further specified in annex IX part A): mainly biofuels from residues, wastes, and lignocellulosic materials. Part A. includes feedstocks and fuels that are double counted (a wide range of non- food crop based biofuels (no differentiation between lignocellulosic biofuels and biofuels produced from non-crop based feedstocks with conventional technologies like Anaerobic Digestion (AD)
- Biofuels that count twice towards the 10% target but not towards the 0,5% sub-target (further specified in annex IX part B: biofuels from used cooking oil and certain animal fats (see Annex F).

In this project we propose to use the terminology as below.

Table 23 Terminology used for biofuels in this study

Terminology	Type of biofuels
Food crop-based conventional biofuels	Produced from food crops (sugar, starch, oil)
Biofuels from waste oils and fats	Trans-Esterification of waste grease, such as category 1 & 2 animal fats, grease trap waste, flotation fat (FAME) or used cooking oil (UCO) (ILUC directive Annex IX B)
Advanced biofuels and non-organic fuels/fuel components	Produced from lignocellulosic feedstocks (i.e. agricultural and forestry residues, e.g. wheat straw/corn stover/bagasse, wood based biomass), hemicellulose crops (i.e. grasses,(ILUC directive Annex IX A) miscanthus, other wastes and residues (for AD), algae and products derived from renewable electricity.
Advanced technologies	Part A list of the iLUC Directive does not differentiate between commercial (i.e. AD) and non-commercial technologies (mainly based on lignocellulosic feedstocks). This group refers to biofuels produced from technologies that are at TRL6 and 7 Level. Some technologies related to products derived from renewable electricity are also still in this category.

An obligation can be designed to cover different types of fuels and/or give priority to some of them depending at the ultimate goal of the obligation. The obligation could cover different options, such as:

- Only advanced technologies
- Advanced biofuels and biofuels from waste oil and fats
- All renewable fuels, but with a cap on fuels based on food crops
- All renewable fuels but with caps for food crop based and biofuels based on oils and fats.

The first option focuses mainly on technologies that are at the R&D and demo scale. A sole focus on these biofuels is, on the one hand, a way to indicate the importance of fostering innovation in biofuel production. On the other hand, this would leave existing biofuels production capacity without any policy support after 2020, which means most of it would be phased out rapidly. As this conflicts with key values like investor's security, we propose to eliminate this option. The other options will be discussed in details in further analysis.

Table 24 Pros and Cons of defining type of biofuels in the QO

Characteristic	Options	Pro's	Cons
Which types of fuels can the QO cover?	a. only advanced technologies (TRL6-7)	• Increased investors security to invest in advanced techn.	• Very costly, will require high penalties for non-compliance • Difficult to define the level of obligation • No level playing field for non-food based 1st generation biofuels (such as UCO, HVO) • Risk for the continuity of existing installations
	b. Advanced biofuels and biofuels from waste oil and fats	• Increased investors security to invest in advanced techn. • Promoting non-food based biofuels	• Risk that the QO may be filled in with conventional non-food based biofuels • Risk for the continuity of existing installations as the conventional biofuels are not yet competitive • Measures for food crop biofuels remain purely national
	c. All renewable fuels, but with a cap on fuels based on food crops	• In line with the recent iLUC Directive • Continuity of existing installations	
	d. All renewable fuels but with caps for food crop based and biofuels based on oils and fats	• Continuity of existing installations • Investment risk to advanced techn. are reduced	

2.2.4.6 *Which part of the supply chain*

A Quota Obligation can apply to various parties in the supply chain, essentially the:

- Party that first brings the fuel on the EU market, either by producing it in the EU or by importing it;
- Party passing the fuel through an excise duty point or other fiscal entity
- End user.

The third option clearly appears to be unfeasible because of administrative efforts. The first option may lead to complications as fuels can also be exported again, such trade flow should also be taken into account. For practical reasons it seems most feasible to stick to the second option, which was also applied in the FQD.

Table 25 pros and cons of a QO applied in different parts of the supply chain

Characteristic	Options	Pros	Cons
Which part of the supply chain?	a. Suppliers that bring oil/gaseous products to the EU market	• All oil products would be targeted independently from their end use; beneficial if option 1d or 1e is chosen, but complicating if 1a or 1b or 1c is preferred.	• Suppliers may supply various types of products which might partially be difficult to replace with renewable fuels
	b. Suppliers as defined by the FQD: party passing fuel through an excise duty point or other relevant fiscal entity	• Well defined concept that is easy to implement • Differences among MS are taken into account • Makes use of current administration for REDI/FQD	• No complete harmonisation • If obligation is to be expanded to other end use sectors (1c), comparable systems need to be established for e.g. suppliers of fuels to the built environment.
	c. End user		• Given the enormous amount of end users, this option would be difficult to manage

2.2.4.7 Obligation applies to whom

In this sub-section, we address on which spatial level the obligation should be laid, and correspondingly who would be the key implementing body and on what scale certificate trade should be organised. Options are:

- An EU-wide obligation on all suppliers
- An obligation in which all suppliers need to meet the same obligation in each Member State
- An obligation to fuel suppliers in each Member State, with national freedom to set specific sub-targets, e.g. on advanced biofuels.

The first option speaks for itself as a simple obligation for all fuel suppliers in the entire EU. Transport fuels suppliers would be obliged to ensure that a certain share (or amount) of the liquid and gaseous transport fuels they sell in the EU are of renewable origin. Such an obligation can be designed in different forms such as:

- A dedicated target to advanced biofuels and biofuels from waste oil and fats (as suggested in Table 7, option b). In this option measures for food

crop biofuels remain purely national. Thus the EU-wide obligation is applicable to only advanced biofuels and biofuels from waste oil and fats.
- A renewable fuels quota obligation including a cap on food crop-based biofuels (similar to the iLUC Directive) and a cap on biofuels from waste oil and fats. Thus, introducing indirectly a sub target for advanced 9more innovative) biofuel options.

In this option the administrative requirements can be built up on the existing MS administrative structures. The MS could record the amount of fuels replaced on the markets and report the figures to the Commission as part of the governance framework. In this option the level of penalty could be harmonised across the EU and each MS could be responsible to impose penalties in case of non-compliance (penalty issue is addressed further in sub-section 2.8).

The second option merely comes down to a national QO comparable to what is currently in place. The third option provides more room for diversification between Member States: it allows for specific sub-targets that are in line with the decarbonisation of the transport strategies of each MS. all three options are included in further analysis.

Table 26 also indicates which implementing body or bodies would need to be involved to administer the QO. Furthermore, we assume that in all proposed options the obligation(s) will be tradable, i.e. that parties under the obligation will be allowed to exchange proofs of contributions towards the target through a system of tradable certificates[109]. The scope of the obligation also has implications for the scope of the related certificates: they need to be aligned. Therefore, we include the scope of the tradable certificates in the various options in the table below.

[109] Generally, making an obligation tradable improves liquidity in the market meeting the obligation.

Table 26 Pros and cons of applying an obligation at different levels (EU vs. MS), related implementing body and certificate trade scope

Characteristic	Option	Implementing body	Scope of tradable certificates	Pro's	Cons
Obligation applies to whom?	a. Fuel suppliers, EU-wide	European Commission	EU-wide	• More flexibility for fuel suppliers to fulfil the mandate and reap specific regional or national opportunities for biofuels. • More cost efficient	• Administrate burden would need to be understood for the Commission, may be more complex to administer • The Commission could still make use of the existing national registration systems, only an additional EU collecting point would be needed.
	b. Fuel suppliers, with same obligation for each MS	MS	National	• Implementation could be based on existing administrative structures. • Lower administrative burden for the Commission.	• Lower degree of harmonisation, no essential difference with current national targets. • Possibly more costly
	c. Fuel suppliers, with flexibility for MS in some respects, e.g. in the height of sub-targets for crop-based or advanced biofuels	MS, both for 'general' obligation and sub-targets	National	• Higher ambition levels for e.g. advanced biofuels possible • MS specific target could reflect domestic challenges • Implementation could be based on existing administrative structures. • Lower administrative burden for Commission.	• Lower degree of harmonisation. Possibly more costly • Risk of lower renewable fuel ambitions.

2.2.4.8 What penalty system in case of non-compliance

The financial penalty needs to be defined at a level that it is effective, meaning that it provides an incentive to fulfil the quota obligation. If the level is set too low it can result in policy failure to deliver renewable fuels. If it is set too high it can result in unnecessary high costs to consumers.

The penalty for non-compliance could be set as:

- An fixed amount, significantly higher than the estimated marginal generation costs required to meet the target.
- A floating amount for example linked to the actual certificate price (i.e. as 150% of certificate price).

Table 27: Pros and cons of a fixed versus a flexible penalty level.

Characteristic	Option	pros	cons
How to set the penalty level?	A fixed price penalty	• Penalty level is known upfront, provides more certainty on it • Penalty also provides a 'safety valve': if marginal costs appear substantially higher than originally expected, the penalty will be paid	• 'Safety valve' mechanism reduces certainty of obligation target being met
	A floating price penalty	• More certainty of obligation target being met	• Risk of high societal costs if marginal costs appear to be higher than originally expected

The key difference between the approaches is in the appreciation of two potentially undesired effects, viz. the introduction of unexpectedly high societal costs for meeting the target versus the non-delivery of the targeted volume of renewable fuels. The fixed price penalty creates a safety valve for non-delivery in case of unexpectedly high costs for meeting the target, also maximising societal costs, while the floating price penalty creates a stronger safeguard for meeting the target.

In the practice of national obligations, both approaches can be observed. For example, the penalty in the RTFO system for biofuels in the UK is a floating price penalty, while in the German biofuels obligation (now based on CO_2 performance) has a fixed penalty of 470 €/ton CO_2. Another example is the premium for excess CO_2 emissions from new passenger cars. According to Commission decision of 17 February 2012, when a manufacturer fails to comply with the emission targets of Regulation (EC) No 443/2009 they shall pay excess emissions premiums. The premium is a fixed amount, calculated according to a formulae laid down in Article 9 of the Regulation. At this stage, there is no decisive reason why either of the two should be preferred and both options should be taken further for detailed consideration.

2.2.4.9 Which unit to use for the obligation

Options:

- *In energy terms (PJ, toe, etc.)*
- *In GHG terms (ton CO_2)*
- *In volume terms (l, m^3)*

When the obligation is "volume" based, obliged fuel suppliers can prefer sourcing the cheapest fuel by volume. This may, for instance, favour the use of imported cheaper bioethanol over biodiesel. Next to that, there is a significant difference in the energy equivalence of these fuels, with the calorific value of biomethane almost twice as high as that of ethanol and around 35% higher than biodiesel[110,111]. A volume based quota will disregard this difference. Finally, this option is not in line with the overall target of 27% RES that is based on energy content. The advantage of volumetric mandates is that they are certain regardless of oil and crop prices. They do not depend on the price or demand fluctuations.

The other possible way is to apply the "energy" based obligation that is also in line with the way the REDI target is defined. This type of obligation indirectly favours the supply of higher energy density fuels (like biodiesel).

The third option, obligation based on the GHG emissions, is very much reflecting the climate mitigation objective of biofuel use in transport sector. The level of the quota can be defined in a way that it promotes biofuels that are more effective in achieving higher GHG savings. Since 2015, the energy based quota for biofuels has been changed in Germany to a stepwise increasing GHG reduction commitment. One of the observed results of the conversion from an energy-based biofuel quota to the respective GHG quota in Germany is that the biofuel share in fossil fuels has decreased. The legal requirement could be met with a smaller amount of biofuel as the GHG balance of biodiesel and bioethanol has improved significantly over the recent years.

The energy and GHG emission saving based quota obligation are selected for further analysis.

[110] The calorific value of biomethane is around 50 MJ/kg, compared to 37 MJ/kg for biodiesel and 27 MJ/kg for bioethanol.

[111] A possible way forward would be separate obligation that create more level playing field and provide a more certain market for producers. Separate obligations for bioethanol and biodiesel are a feature of the systems in the US and some European Member States (including Germany, Austria and Spain).

Table 28 Pros and cons of setting different units

Char-acteristic	Options	Pro's	Cons
	In energy terms	• In line with the REDI, • Promotes high energy density biofuels over low density • Minimum GHG savings can be ensured by sustainability criteria	• Prioritises energy production on GHG emission avoidance • No incentive to increased GHG emission avoidance
	In GHG terms	• Can result in lower use of biofuels	• Comprehensive reporting requirements • Difficult to monitor and calculate GHG emissions (marginal vs-average approach; indirect effects such as ILUC) • Increased administrative costs • Can result in lower biofuel consumption, thus, less fossil fuel can be replaced • Could lead to virtual savings e.g. in case of food based biofuels incentives are provided to use feedstock from areas with low level of cultivation emissions. Feedstock from areas with high cultivation emission goes to other markets. • No direct incentive to advanced biofuels. Incentivizes the cheapest biofuels with a good GHG performance such as waste-based ones
	In volume terms	• It would tie in most closely with the information that companies report to duty points and be the simplest to administrate.	• Favours cheaper biofuels that can have lower energy density, as a consequence • can require higher amounts of biofuels

2.2.4.10 Absolute or relative target and which denominator in case it is relative

The targets for an obligation can be based on either absolute numbers (in PJs, toe or otherwise) or relative terms (e.g. x% of transport fuels, total fuels or otherwise).

The choice between absolute and relative amounts is a trade-off. An absolute target creates maximum market size certainty for investors in renewable fuels, a certainty that reduces their risk. A relative share creates less of that certainty. On the other hand, setting a target in terms of percentages can reflect the demand supply dynamics better, i.e. energy efficiency efforts can lead to lower final demand and less renewable fuel is then needed to be supplied by fuel suppliers. Besides, a relative target responds to other-than-expected developments in fuel demand, e.g. when economic growth is different than originally thought. In that sense, a relative obligation can be better maintained in times of economic insecurity.

These considerations have been summarised in Table 29. As there is no compelling argument in favour or against either of the options, both options can be taken for further analysis.

Table 29 Pros and cons of an absolute or relative target.

Characteristic	Options	Pros	Cons
Absolute or relative target?	Absolute amount	• Reduced risks related to i.e. fluctuations in the oil and crop prices	• Doesn't incentivise any future EE gains • Difficult to fix as EE gains will have to be taken into account somehow!
	Relative share	• Comparable to overall target setting • Takes into account EE improvements	• More risk to biofuel producers

2.2.4.11 How to deal with RES of non-organic origin (e.g. PtG)

As the scope of this study excludes the direct use of electricity in transport, and focusses on fuels, this question basically relates to the use of energy from RES-electricity for the production of transport fuels. This does include the use of hydrogen which is produced by means of electrolysis of water using RES-electricity (Power-to-Hydrogen, or PtH2). This hydrogen can subsequently be used for the production of methane (PtG) and other gaseous and liquid fuels through combination with CO_2 and CO of biomass or fossil origin in various processes.

Based on the literature survey below summary points are extracted (the background info can be found in Annex F):

- Even under optimistic assumptions with regard to the techno-economic parameters of the electrolyser, electrolytic hydrogen remains considerably more expensive than hydrogen from natural gas reforming, unless very low cost renewable electricity is available and carbon or natural gas prices are high.
- However, looking purely at hydrogen generation costs is not enough. Costs for hydrogen transport & distribution (T&D) and the availability of cars that can run on hydrogen need to be taken into account to evaluate the success of renewable hydrogen.
- The individual country ambitions and plans add up to around 350000 fuel cell electric vehicles (FCEVs) on the road by 2020. However, there are high uncertainties in respect to whether these numbers can be produced by the industry.
- There are large uncertainties in the role of H2 in transport sector in the future.
    - Two recent studies OECD/IEA (2015) and CERTIFY (2015) state the hydrogen use in transport as around 15 TWh and 26 TWh, respectively in 2030. While the first study focuses on 4 MS (France, Italy, Germany and the United Kingdom) and assumes more than 60% to be derived from natural gas the second study covers EU28 and considers around 75% of the hydrogen to be green.

Fundamental issues in non-direct use of RES-E for the purpose of RES-T fuels is how to avoid policy redundancy (to avoid unwanted issues such as double counting of RES use, and/or potential overstimulation through use of tradable certificates in combination with incentives for several process steps, e.g.

incentives for production of RES-electricity and incentives for subsequent production of RES-T fuels using this electricity), and how to keep track of and regulate the RES-share of the final fuel. Both issues, however, are not restricted specifically to the use of RES from non-organic nature, but also play a role in use of RES from organic nature.

Four options are proposed for how to deal with RES of non-organic nature. The options are:

- According to the current REDI rules: the RES share is either the EU or MS average
- According to the current REDI rules, but with a 100% RES share when (electricity) prices are very low
- Use of the RES-electricity GoO system for accounting of fuels that are produced using RES-electricity
- Use of the RES-electricity GoO system, and separate non-organic fuels from biofuels

According to the current REDI rules: the RES share is either the EU or MS average

The advantage of this solution is that it is a continuation of the current practice stakeholders are familiar with; it uses existing requirements. However, this way of dealing with RES of non-organic origin does not reflect the actual situation in practice as there is room for strategic optimization of the RES-T share by using either the EU or MS RES-electricity share, whichever leads to the most optimal result. Furthermore, it does not reward fuel producers that use more than the average RES-electricity share as this would not generate additional certificates. The solution does not act as potential stimulus to invest in PtH2 technology (electrolysis) and further technologies for using this hydrogen in the production of RES-T fuels; options that are very promising for the future as they provide a route to integrate abundantly available solar and wind energy into RES-T fuels. This solution does not provide a mechanism to optimally cover the initial financial gap for these technologies with revenues from RES-T fuel certificates and would thus require higher support for investments to take place.

According to the current REDI rules, but with a 100% RES share when (electricity) prices are very low

This option has the same pros and cons as the previous option, but it adds complexity because of the additional requirements, and additional arbitrariness because it needs answering the question 'what is very low', or 'below what prices can we be sure that the electricity produced is basically 100% RES'. Furthermore, it is expected that the additional accounting rule does not provide a significant additional stimulus to invest in PtH2. Low prices as a result of abundant electricity production from PV-cells and wind turbines will only exist for a limited period of time throughout the year. Once it becomes available in large amounts there will be competition between various options to absorb the energy into the energy systems. Multiple end-users will be interested in low-price electricity. Alternative options are expansion of the grid to transport the electricity to areas/markets where there is no excess of RES-electricity, demand response schemes (shifting demand in time in accordance with fluctuating supply), and storage. All these options will have a stabilizing effect on the electricity price as they contribute to balancing demand with supply.

Use of the RES-electricity GoO system for accounting of fuels that are produced using RES-electricity

Within the EU the amount of RES electricity produced in principle matches the amount of RES-electricity GoOs. If this GoO system is used for accounting of fuels that are produced using RES-electricity, it allow for the separated trade of the produced electricity and its renewable attribute, allowing hydrogen producers to consumers-E more widely. This would be an issue if there are individual MS-targets for RES-T fuels, but since there is only an overall EU-target it does not present a real concern.

Critical point here is that the current regulations on GoOs for electricity and heat in the REDI explicitly state that these GoOs should only be used for consumer disclosure, not for any kind of accounting towards renewable energy policy targets. That is quite understandable as RES GoOs generally do not create new RES production (no additionality): they merely redistribute the RES attributes of current electricity production over its consumers. This also brings a risk of overstimulation if RES-E production is allowed to receive both a production subsidy *and* a GoO that can be used in a RES-T policy context.

Besides, electricity GoOs historically were prone to double counting in case of international trade, although this issue has been merely solved by now. Further attention should be paid to import of RES-electricity GoO from areas that are not subject to the overall EU target for RES-T fuels. If such GoOs (e.g. hydro from Norway) are used then the result of the accounting will neither reflect the actual RES-T fuel situation, nor the RES-share as a whole.

Generally, GoOs could play a role in dealing with RES from non-organic origin, but only if their additionality is safeguarded, and overstimulation and double counting are fully prevented. That would require some essential (but not impossible) adaptations to current GoO systems.

Use of the RES-electricity GoO system, and separate non-organic fuels from biofuels

This potential way forward has the same pros and cons as the previous option. We fail to see potential added value in separating non-organic fuels from biofuels. By adding additional requirements, it may add complexity to the accounting system although we expect that, as far as we can see, this is not prohibitive.

For further analysis we will focus on option a, b and option c. The advantage of option a is its relative straightforwardness, even though this option does not incentives P2G technologies, relates to its ease of implementation. Existing studies (i.e. Joode, 2014) show that P2G is hard to realise in the short to medium term (2030) due to the capital intensity of P2G and its inherent efficiency losses[112]. A

[112] Deployment of P2G for the sake of providing electricity system flexibility alone is not sufficient for a positive business case. Even the low – or possibly even negative – electricity prices that may arise

simple, straightforward option may in this respect be considered more suitable. Options b and c are more complex but might have added value by the time transport fuels of non-organic origin become closer to the market.

Table 30 Pros and cons of different approaches for dealing with RES of non-organic fraction(PtG)

Character-istic	Options	Pros	Cons
How to deal with RES of non-organic origin (e.g. PtG)?	a. According to current REDI: RES share is either EU or MS average	• Uses existing requirements • Easy to implement • Minimum administrative cost • As the electrolysis can be expected to run 24/7 applying the average RES share can be considered to reflect the real generation pattern	• Does not reflect real time situation • Little incentive to invest in such technologies unless support is very high • Development of technology that potentially could be very promising in the future is hampered
	b. According to current REDI, but with 100% RES share when prices are very low	• Based on existing requirements • Avoids risks of double counting • Provides further incentive to produce at times when electricity is abundant and where a high share of RES is likely	• Does not reflect real time situation • Approach mixes different concepts • It adds complexity
	c. Use GoO system for accounting fuels produced from renewable electricity	• Higher incentive to invest in such technologies	• Some essential changes in current GoO schemes required to safeguard additionality and prevent double counting and overstimulation • In certain situations the carbon balance would be very poor (negative)[113]
	d. Use GoO system and separate non-organic fuels from biofuels	• Avoids risks of double counting • Higher incentive to invest in such technologies • Avoids the risk that the increased incentive for res fuels of non-organic origin crowds out advanced biofuels completely	• Some essential changes in current GoO schemes required to safeguard additionality and prevent double counting and overstimulation • In certain situations the carbon balance would be very poor • Support scheme gets more complex

for short time periods as a result of an imbalance in the electricity market, caused by an abundant supply of electricity from intermittent sustainable sources, are insufficient to compensate for the relatively high capital cost per produced unit of hydrogen or synthetic methane

[113] It would be possible at times when the real time share of RES is very low, fuels produced with electric energy could be counted easily to be 100% renewable although in practise they are based on electricity generated e.g. by coal power plants. In such cases the carbon balance would most likely be very poor (negative)

2.2.5 Detailed analysis of short list

Due to many interactions among different design elements we grouped the relevant ones accordingly for further detailed analysis and illustrated below.

Table 31 Short list for further analysis

Characteristic	Possible options
1. Which sectors and fuels does the measure cover?	Liquid and gaseous fuels in road transport
	Liquid and gaseous fuels in all transport, so including aviation and maritime
	Liquid and gaseous fuels delivered to all end users, so including use in decentral heating, cooling and power and as industrial energy source/ feedstock, but excluding use in centralised power and district heating
2. Whether there should be sub-targets or not? • **On subsectors** • **On specific fuel substitutes**	No
	Yes, for all (sub) sectors
	Yes, for gaseous and liquid fuels and for various types of liquid fuel substitutes, such as for gasoline, diesel, kerosene, etc.)
3. Which types of fuels can the QO cover?	Advanced biofuels and biofuels from waste oil and fats (possibility of a cap on waste based biofuels)
	All renewable fuels, but with a cap on fuels based on food crops
	All renewable fuels but with caps for food crop based and biofuels based on oils and fats
4. Geographical scope of the analysis. • **how the certificate trading can function?** • **how to define the penalty level?** • **Key implementation body**	Fuel supplier, EU-wide
	Fuel suppliers, with same obligation for each MS
	Fuel suppliers, with flexibility for MS in some respects, e.g. in the height of sub-targets for crop-based or advanced biofuels

The assessment is based on the criteria formulated in Table 32.

Table 32 Criteria applied in the detailed analysis.

Criterion	Sub-criterion	Explanation
Effectiveness	Increasing renewables in transport	Extent to which the option actually increases renewable transport fuels in particular in sectors where alternatives to fossil fuels are scarce
	Increasing renewable fuels	Extent to which the option actually increases renewables in transport (RES-T) and/or renewable fuels
	Advanced options	Extent to which the option actually promotes advanced renewable fuels and related technologies
	Internal market[114]	To which extend does the measure contribute towards the integration of the internal market

[114] This sub-criterion is relevant only for the section covering geographical scope

Efficiency	Static	Degree to which the instrument will reach the 2030 target of 27% renewables at lowest possible overall cost.
	Dynamic	Degree to which the instrument will trigger innovation, technology diversity and cost reductions over time, needed for an efficient realisation of long-term decarbonisation objectives,, i.e. by an increased deployment of advanced biofuels and related innovative technologies.
	Administrative	Degree to which the instrument avoids dead-weight implementation costs for both private stakeholders and public sector agents concerned, and the extent of (non-monetary) implementation readiness/bottlenecks.
Consistency	With the EU legislations	Degree to which the instrument (including its design features) is compatible with EU legislation and internal market principles
	With the national legislations	Where applicable, degree to the instrument to be consistent with decisions MS have taken in the past, i.e. might assume political acceptance for the newly proposed instrument as well.

Effectiveness has been defined as *'To what extent can the measure achieve its intended objectives, in relation either to outcomes (i.e. changes in the behaviour of socio-economic actors) and/or impacts (on the state of the bio-physical environment)?'*[115]*.* Thus, the effectiveness of each design option depends very much on the policy goals set for promoting the development and consumption of sustainable renewable fuels. The policy objectives of promoting the development and consumption of renewable fuels can be summarised as:

- Support decarbonisation of the transport sector replacing fossil fuels with advanced renewable fuels
- Reduction of the dependency on fuel imports and strengthening of the EU energy security
- Promote particularly advanced renewable fuels e.g. by reducing the risk for investments into advanced biofuels and other sustainable renewable fuels
- Contribute towards achieving the renewable energy target in 2030
- Integration of the EU market for renewable fuels
- Achievement of these objectives at least cost
- Growth and jobs in in rural communities where such opportunities a scarce
- Export opportunities for innovate technologies, products and services

We group these multiple objectives as follows to compare the effectiveness of each option:

- **Increase in RES-T**: that could help to decarbonise the transport sector and reduce dependency on fuel imports, particularly import of oil.
- **Increase in RES-Fuels**: that could contribute to least cost 2030 target achievement and growth and gobs in rural communities

[115] See 'Towards a new EU framework for reporting on environmental policies and measures (Reporting on environmental measures - 'REM')' at *www.eea.europa.eu/publications/rem/defining.pdf*

- **Increase in advanced fuels**: that reduce the risk for investments into advanced biofuels and increase export opportunities for innovative technologies.
- **Integration of the internal market**: To which extend does the measure contribute towards the integration of the internal market

Efficiency can be interpreted in at least three ways:

- Short-term static efficiency: is the 2030 target for renewable energy met at lowest possible cost?[116]
- Long-term dynamic efficiency: will the instrument be efficient for long-term developments, by triggering innovation, technology diversity and cost reductions over time, needed for an efficient realisation of long-term decarbonisation objectives,, i.e. by an increased deployment of advanced biofuels and related innovative technologies.
- Administrative efficiency: to what extent is the execution of the option efficient?
-

A colouring code is used in the summary tables next to pluses and minuses. The colours can be read as follows:

Colours	Representation
(green)	Scores very good
(orange)	Scores good
(red)	Scores bad
	Not relevant

2.2.5.1 Sectoral coverage of a possible future quota obligation

In the previous section we have selected three different options a quota obligation can cover for further analysis. These are:

1. Liquid and gaseous fuels in road transport
2. Liquid and gaseous fuels in all transport modes
3. Liquid and gaseous fuels in all sectors (including heating and cooling, power and industry)

A comparative analysis of these three options against a number of criteria (introduced above) requires a good understanding of the renewable fuels'

[116] Here we do not go into the question what the least-cost balance is between efforts in electricity, heat and transport, and only focus on transport/renewable fuels.

technology development, generation costs and the financial gap between the renewable fuels generation costs and the fossil fuel substitutes in the time frame 2020-2030. While a thorough techno-economic analysis of renewable fuel technologies in different sectors are beyond the scope of this study, a snapshot of the food crop-based biofuels for road transport, bio-jet fuel for aviation and renewable diesel for shipping and the biogas and biomethane for heating and cooling is briefly introduced in ANNEX G. This review indicates that:

- Conventional biofuels can be implemented more easily and cheaper in road transport, as the fuel quality requirements are very stringent in aviation
- There is no major difference between the costs of advanced biofuels in road transport and in aviation, although road transport can make use of a wider array of fuel options (including bio-ethanol that is relatively cheaper to produce);
- Currently, only two biofuel pathways, HEFA/HVO and FT, have been certified for use in aviation up to blends of 50%.
- Costs of biomethane, the most important gaseous biofuel relevant for other end use sectors, are relatively low compared to those of liquid biofuels, when biomethane is produced by anaerobic digestion from residues and wastes, but their potentials are relatively limited;
- Costs of advanced methane production technologies are in a comparable order of magnitude as advanced liquid biofuels, and uncertainties in both options are substantial.
- Biomethane use in transport sector depends on and is limited to the diffusion of the fleet that run on natural gas.
- LNG and methanol seem to be the most promising alternatives with good market supply infrastructure in place (JRC, 2016) [117]
    - Since biomethane is chemically identical to fossil LNG there is increasing interest to use it in the shipping sector, also because it can benefit from the growing LNG infrastructure(JRC, 2016)
    - Biomethanol is gaining interest in the marine industry. Conversions of marine vessels to methanol are significantly less costly than conversions to LNG because of the simplicity of the storage system for methanol. Although methanol itself is slightly more costly than LNG, the trade-off between methanol and LNG involves the complexity of the fuel system versus the cost of the fuel (McGill et al., 2013)[118].

2.2.5.1.1 *Effectiveness analysis*

Increase in RES-T

On this sub-criterion, the main differences between the options are as follows:

[117] See http://publications.jrc.ec.europa.eu/repository/bitstream/JRC100405/inland%20and%20marine%20waterways%20exploratory%20work%20on%20alternative%20fuels_kamaljit%20moirangthem_final.pdf

[118] See http://www.iea-amf.org/app/webroot/files/file/Annex%20Reports/AMF_Annex_41.pdf

- Essentially, there is no difference between options 1 and 2, as both focus on transport sector fuels. Only secondary consideration is that biofuels will be most relevant for aviation and shipping as well, so it would be fitting better in a long-term strategy if these sectors were also included in the obligation.
- Option 3 widens the scope of the obligation to other sectors and will therefore be less effective in increasing the share of renewables in transport only.

Increase in renewable fuels

On this sub-criterion, there are no essential differences between the options, as the obligations need to be fulfilled by renewable fuels. Only if renewable electricity is also counting towards the target (which is currently the case and is therefore also possible in options 1 and 2), options 3 will be more effective as it focuses on fuels only.

Besides, there may be a difference in the types of fuels that are produced to meet the target. As option 3 opens up the end use of gaseous fuels in other sectors, such as the built environment, there will be a stronger incentive for the production of biomethane, particularly in member states such as the UK, Germany and the Netherlands, in which this fuel plays an important role in heating buildings. With currently only 12 TWh of grid-quality biomethane produced (EBA, 2015), this sector could experience a strong incentive for further growth.

Increase in advanced fuels

On this sub-criterion, the main differences between the options are as follows:

- Neither of the options provide a clear incentive for advanced fuels; in this respect they are merely neutral.
- The inclusion of fuel use in other sectors (option 3) would require that the size of the market is taken into account when defining the obligation as share of the total market. It can also provide an incentive for advanced production routes for biomethane. This is a positive effect for these routes, but increases uncertainties for advanced liquid biofuel routes. However, if the quota level is set as an energetic volume the size of the targeted market would become irrelevant.

2.2.5.1.2 Efficiency analysis

Static efficiency

The main differences between the options are as follows:

- An expansion of the obligation to other end use sectors (option 3) can be considered as the most cost-efficient approach as this option expands the market, increases the liquidity and at the same time allows cheaper production pathways (i.e. biogas). The application of biomethane in the transport sector can be limited by the availability of transport infrastructure (i.e. number of fleet that run on biomethane) whereas biomethane can easily be injected into existing grid in countries that have one.

- The introduction of aviation, the sector in which biofuels are relatively costly, does not add to static efficiency (Maniatis, Weitz & Zschocke, 2013).

Dynamic efficiency

On this sub-criterion, the main differences between the options are as follows:

- In terms of dynamic efficiency, all options would have a relatively neutral effect as they do not provide specific incentives for the technologies and sectors in which biofuels will remain needed on the longer term.
- However, the inclusion of aviation next to road transport is an important signal that efforts will also be needed in this sector. And essentially this also holds for other end use sectors relying on liquid and gaseous fuels.

Administrative efficiency

On this sub-criterion, the main differences between the options are as follows:

- Administrative efficiency is likely to be the highest in option 1 (only road transport). This option has already been implemented in almost all MS due to the RED and the FQD. The administrative bodies that manage blending obligations have already been in place.
- Including aviation and shipping, will require some further administrative efforts as the sector has not been included in the exiting administrative structure of most MS. Next to that, the bio jet fuel supply chains are not yet handled through standard infrastructure because of the small volumes and the dedicated delivery to single airlines (Hamelinck et al,, 2013). The administrative procedures related to compliance with the sustainability criteria, the certification and the verification systems will need to be organised[119].
- Expanding the obligation to decentralised heating and cooling , power and industry will also require establishment of an administration system that can register, issue certificates and monitor the obligation achievement. Decentralised heating systems in many MS suffer from poor statistics, which will make the administration very challenging and costly.

[119] Under the RED, the requirement to demonstrate compliance with the sustainability criteria is placed at the fuel duty point (for road biofuel), as fuel volumes that cross this point are robustly monitored and recorded for tax purposes. International jet fuel is not subject to fuel duty and there is no established equivalent to the fuel duty point in jet fuel supply chains. A verification system will need to be designed, however, the bio jet fuel supply chains are not yet handled through standard infrastructure because of the small volumes and the dedicated delivery to single airlines (Ecofys, 2013).

Table 33 Summary table on design characteristic 1: Sectoral coverage of a possible future quota obligation.

	Criteria	Option 1	Option 2	Option 3	Evaluation
		road transport	all transport modes	all sectors (including heating & cooling and power	
Effectiveness	Increase in RES-T	+	++	-	Covering all transport modes will certainly be effective in increased RES deployment in transport sector. Option 2 also can help to pave the way to biofuels use in heavy duty vehicles, aviation and shipping, sectors that are less suited for electrification (an important route for light duty vehicles). However, expanding the QO to other sectors may dilute the consumption of biofuels in transport depending on the production costs versus fossil fuel prices. Decreasing oil prices will particularly push use of liquid and gaseous biofuels more in heating and cooling and power sector.
	Increase in RES-Fuels	+	+	++	In contrast to the previous one when the policy mainly aims at increased use of RES-fuels option 3 will be more effective.
	Increase in advanced fuels	0	0	-	A QO covering all transport modes will favour the least cost biofuel options in transport sector. These are the food crop-based biofuels as such effectiveness of option 1 and option 2 will be low unless there are sub sectoral targets and/or sub-targets for biofuels (which will be discussed in the following sections).
Efficiency	Static	+	+	++	While both options can ensure static efficiency when they are compared Option 3 can result in large deployment of biofuels with lower costs.
	Dynamic	0	+	+	Comparable to the effects of the two options on effectiveness related to advanced biofuels all options will not provide the right incentives to promote/mobilise advanced fuels unless there are sub sector and/or sub targets for biofuels.
	Administrative	++	-	--	A higher administrative burden can be expected due to expansion of biofuels to i.e. aviation or heating and cooling. The main reasons would be: • All reporting requirements under the REDI (articles XXX) will need to be expanded to heating and cooling and power applications. • For heating and cooling the sector will need a monitoring that distinguishes RES use solid and liquid & gaseous biofuel, next to other RES technologies.

			• In the case of tradeable green certificate (see section XX) application of penalty and related administrative burden will be much higher in option 3. • For aviation supply of bio jet fuels are not standardised and will require establishment of new administrations

Concluding

An expansion to gaseous and liquid fuels in other sector is mainly a choice for a renewable *fuels* obligation, not a transport obligation. This adds to static and dynamic efficiency as fuel using sectors other than transport will also need to move towards renewables. But it comes at the expense of increasing administrative burden and is less consistent with current legislation. The negative impact on the introduction of advanced biofuels of such extensions can be compensated by sub-targets (see section 3.2).

2.2.5.2 Impact of sub-targets for sub-sectors and fuel substitutes

This section looks into the impacts on specific sub-targets for different sectors (road transport, aviation, shipping, heating and cooling) and on fuel substitutes (gasoline and diesel substitutes) on policy effectiveness, efficiency and consistency. There is obviously a relation with the sectoral coverage characteristic of section 2.2.5.1.

2.2.5.2.1 Effectiveness analysis

Increase in RES-T

There is only an impact on this criterion if other end use sectors are also included. In that case, setting specific subsector targets increases the effectiveness of realising renewables in transport.

Increase in renewable fuels and advanced biofuels

- Sub-targets, in principle, increase the effectiveness in developing advanced biofuels (provided that the penalty levels are set accordingly).
- Success of the quota obligation, however, will depend on setting the obligation at levels that are achievable in each sub-sector(taking into consideration the technology developments in advanced biofuels, the specific safety requirements of the aviation sector etc.).

2.2.5.2.2 Efficiency analysis

Static efficiency

Setting no sub-target is consistent with a market driven obligation and will result in achieving the quota in the least cost manner. Setting sub-targets, on the other hand, is likely to be most costly and less statically efficient as it will require for instance bio jet fuels consumption for aviation or drop-in diesel for shipping that are much more costly than the conventional biofuels or even the other renewable biofuels produced from UCO and animal fats (See Annex F, generation cost figures).

Dynamic efficiency

On this sub-criterion, the main differences between the options are as follows:

- In contrast to the static efficiency sub-targets are likely to increase dynamic efficiency as certain sectors can satisfy the demand with drop-in biofuels and those biofuels require more innovative technologies. Subsector and fuel substitute sub-targets typically offer the opportunity to create incentives for sectors in which biofuels are currently less cost-efficient, but in which they will need to play an important role in the future.
- Defining sub-targets for road transport, for aviation and shipping can also avoid any lock-in effects and provide the right signals in terms of the long term decarbonisation of transport sector (i.e. more efforts needed to move biofuels to heavy duty vehicles, aviation and shipping) and ensure that the necessary efforts have been taken particularly in the aviation and shipping sector.
- As for sub-targets for gasoline and diesel substitutes: There has been a shift from gasoline to diesel in Europe that has led to excess of gasoline production capacity and a corresponding shortage of diesel production. The gasoline to diesel ration has been 20 years ago 2:1, but now 1:2 $^{1/2}$ and could potentially reach 1:3 by 2020. Currently, the majority of diesel and heating gasoil comes from Russia, while jet fuel is largely shipped from the Middle East. Most of the EU’s excess gasoline is absorbed by the US. It is hard to forecast the future demand for various oil products. Setting sub-targets for specific fuel substitutes (i.e. for gasoline, diesel, kerosene) can address any possible miss match between demand and supply in the future and enable opportunity to create a better match with supply mix of European bio-refineries.

Administrative efficiency

- Sub-targets will add administrative complexity in determining compliance with the obligations.

Table 34 Summary table related to sub-sector quotas

	Criteria	Option1	Option2	Evaluation
		No sub-sector targets	Yes sub-sector targets	
Effectiveness	Increase in RES-T	0/-	0/+-	Covering all transport modes will certainly be effective in increased RES deployment. However in the absence of sub-sector targets, the main effect is likely to be seen on road transport. When/if other sectors such as heating and cooling become cheaper (depending on fossil fuel prices) biofuels can be shifted more to these sectors than to transport fuels.
	Increase in RES-Fuels	0	0	
	Increase in advanced fuels	0	+	
Efficiency	Static	+	-	No sub-sector target will have a higher cost-efficiency whereas sub-sector targets will require more expensive advanced biofuels.
	Dynamic	-	++	Unless there are sub-targets the dynamic efficiency will be low. The technologies that are relevant for specific sectors but are less cost-efficient will not be triggered.
	Administrative	+	-	A higher administrative cost is expected due to expansion of biofuels to i.e. heating and cooling. This, will become more apparent if and when the trading option is considered

Concluding

A neutral QO will obviously result in cost-efficiency, however, in the absence of any dedicated design element to advanced biofuels this instrument would suffer from dynamic efficiency.

2.2.5.3 Sub-targets for specific type of biofuels in a quota obligation

Three options are analysed in this section. These are:

Option 1. Advanced biofuels and biofuels from waste oil and fats

Option 2. All renewable fuels, but with a cap on fuels based on food crops

Option 3. All renewable fuels but with cap for food crop-based biofuels and a cap for biofuels from UCO and animal fats

For analysing the option in detail, the current status and future outlooks for advanced biofuels is introduced in ANNEX H. This shows that:

- Most of the advanced technologies are still in demonstration or pre-commercial production stage and their contribution to the transport biofuel targets has been marginal[120]
- Although current production capacity of advanced biofuels is still limited, several studies indicate that they do belong to the most cost-efficient fuel mix to realise long-term renewables targets and corresponding greenhouse gas emission reduction goals.
- Current production costs however are inhibitive for their introduction without specific support, as conventional biofuels are currently more cost-efficient.
- Existing facilities and the industry investment plans for the near future(IEA, 2014[121]) give some indications that the technology development stage for cellulosic bioethanol appear more promising than the 2nd generation biodiesel technologies. The recent advanced biofuel production forecast from the IEA (2016), that is based on the projects operational, under construction and announced show a clear preference to advanced ethanol over 2nd generation biodiesel (excluding HVO). Additionally, majority of plants in operation or planned for the near future are either HVO or bioethanol. Only 2 FT Diesel is reported as planned (see Table 115 in Annex F).
- Biofuels from waste oils and fats use conventional technologies but are not susceptible to ILUC issues. Their potentials, however, are not expected to be substantially larger than their current level of application[122].
- Besides, further demand to these feedstocks may result in additional sustainability concerns.
- On food crop-based biofuels, the ILUC discussion has led to a 7% cap on their contribution to the 2020 objective.
- The role of biomethane in transport sector will mainly depend on the amount of transport fleet running on natural gas.

2.2.5.3.1 *Effectiveness analysis*

Increase in RES-T and renewable fuels in general

On this sub-criterion, the main differences between the options are as follows:

- Option 1, setting only a combined target for advanced biofuels and biofuels from waste oils and fats, does not provide an incentive for the current production of food crop-based biofuels.
- The other two options will be effective in raising renewables in transport, and renewable fuels in general.
- The setting of specific sub-targets has only marginal impact on the effectiveness of realising this. It can only be argued that a situation in

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[120] Advanced ethanol production in 2015 is reported as 8538 Mlitre, whereas advanced biodiesel was reported as 20 Mlitre in the same year, globally (UNCTAD, 2016).

[121] IEA, Market analysis. Overview on Advanced Biofuels Developments.

[122] The global HVO generation has been indicated as 4 billion liters in 2014, of which the EU 28 production was only 1.8 billion litres (mainly the NL) (Fritsche & Iriarte, 2016).

which a specific share needs to be realised by advanced biofuels has a higher risk of not reaching the target by non-delivery of advanced biofuels, which technologies are still under development.

Increase in advanced biofuels

On this sub-criterion, the main differences between the options are as follows:

- Most of the advanced technologies are still in demonstration or pre-commercial production stage and their contribution to the transport biofuel targets has been marginal. Thus, it can be concluded that setting a quota obligation on advanced biofuels that include biofuels from waste oils and animal fats (which is the case in options 1 and 2) will result in maximum efforts to produce biofuels from UCO and animal fats and biomethane from AD, and that it may lower the efforts towards advanced biofuel technologies.
- For advanced biofuels, option 3 is likely to have the strongest positive impact, as this options essentially leads to a specific sub-target for advanced biofuels (being the difference between the overall target and the specific sub-targets for crop-based biofuels and biofuels from waste oils and fats.
- Only difference between options 1 and 2 is that option 2 still contains a sub-target for crop-based biofuels. This sub-target would either be fixed to the total volume achieved in 2020 or would be considered as decreasing in option 1 conventional biofuels are not further incentivised. On this point, there may be two opposing spill-over impacts on advanced biofuels:
  - On the one hand, a crop-based biofuels sector in decay will not be beneficial for the general climate under which advanced biofuels will need to be developed and introduced.
  - On the other hand, the discontinuation of support for crop-based ethanol may provide a strong incentive to integrate existing ethanol capacity to advanced ethanol production. Several 2nd generation facilities (i.e. in Brazil, Finland, US) co-located[123] with 1st generation production facilities (Janssen et al, 2013) and increasing number of US 1st generation companies are exploring how to retrofit their processes to incorporate cellulosic feedstocks into their production lines (E2, 2014). Integrated strategies for second generation biodiesel routes are more challenging since fewer synergies might be creates in the process (IEA-RETD(2015)).

In balance, option 1 will probably be worse than option 2 for advanced diesel substitutes, but better than option 2 for advanced ethanol.

[123] Co-location involves installing a separate entity adjacent to an existing facility which uses part of the feedstock infrastructure and/or utilities of the existing facility.

2.2.5.3.2 Efficiency analysis

Static efficiency

The main differences between the options are as follows:

- As static efficiency focuses on reaching a certain consumption level of renewables on the short term, the option with inclusion of the most biofuels and the least sub-target is most efficient, viz. option 2.
- Option 1 is the least efficient as it lets go of the category of crop-based biofuels.
- Option 3 as an intermediary position as it includes crop-based biofuels but also contains two specific sub-targets.

Dynamic efficiency

On this sub-criterion, the main differences between the options are as follows:

- In respect to the instrument that will trigger innovation, technology diversity and cost reductions over time, option 3 is considered to have the highest efficiency as this option has clear attention on advanced biofuels, the types of fuels with the best perspectives for the longer term, but also maintains an incentive for current capacities of crop-based biofuels and biofuels based on waste oils and fats.
- In fact, a recent study indicates that the integration of advanced biofuel plants with conventional biofuel plants, especially for bioethanol plants, can lead to significant synergies and cost savings (RES - T - BIOPLANT, 2016).
- Dynamic efficiencies of option 1 and 2 are estimated on the same arguments as their evaluation on the impact on advanced biofuels.

Administrative efficiency

There are no major differences in administrative burden between the three options. For all, a registry for biofuels needs to be maintained, including a specification of the type of biofuels in order to link it to (potential) sub-targets.

Table 35 Summary of the analysis related to sub-targets for specific biofuels

Criteria	Sub-criteria	Option 1	Option 2	Option 3	Evaluation
		Advanced biofuels and biofuels from waste (both Annex A and B)	All renewable fuels with a cap on food crop-based biofuels	All renewable fuels with a cap on food crop-based biofuels and a cap on (UCO and animal fats	
Effectiveness	Increase in RES-T	-	++	+	Option 1 will based on HVO, biomethane and advanced biofuels based on innovative technologies. All there options have certain limitations (feedstock limitations, transport fleet compatibility and the

					technology risks). Effectiveness is higher in Option 2 and 3 as food-crop based biofuels are sufficiently available in the market.
	Increase in RES-Fuels	-	++	+	A higher Quota can be set in option 2, followed by option 3. Option 1 will be limited to the technology developments and the market roll out of the advanced technologies
	Increase in advanced fuels	-/+	0	++	Option 3 provides a clear sub-target for advanced biofuels and at the same time keeps the existing conventional fuel generation alive.
Efficiency	Static	0/-	++	+	Option 2 is likely to result in the least cost renewable fuel mix for transport
	Dynamic	0/+	0	++	
	Administrative	0	0	0	
Consistency	With the EU legislation	0	+	0	
	With the national legislations	0	+	0	Option 2 will be incorporated into the national legislations already in 2016.Option 3 is also to some extend covered by the existing legislation.

Concluding

Both option 2 and option 3 can increase effectiveness and efficiency in achieving the quota, mainly due to inclusion of conventional biofuels that are part of the least cost renewable fuel mix for transport sector. In respect to dynamic efficiency with a cap on HVO from UCO and animal fat a target is also set for innovative technologies.

2.2.5.4 Geographical scope of the analysis. How can the certificate trading function and how can the penalty level be defined? And by which key implementation body?

In the previous section, three different approaches have been selected for further analysis:

- Option 1. An EU-wide quota obligation for all fuel suppliers in the entire EU, for which the EC will be the main implementation body.

- Option 2. All fuel suppliers to comply with the same obligation in each MS.
- Option 3. A quota obligation to fuel suppliers, with flexibility for MS in some respects, e.g. in the height of sub-targets for crop-based or advanced biofuels. The main implementation body would be the MS.

2.2.5.4.1 Effectiveness analysis

Within this assessment we also include the effectiveness criteria related to the extend the measure contributes towards the integration of the internal market.

Increase in RES-T and Increase in RES-fuels

On this sub-criterion, the main differences between the options are as follows:

- In option 1 transport fuel suppliers would be required to ensure that a certain share of the liquid and gaseous transport fuels they sell in the EU is of renewable origin whereas in option 2 fuel suppliers in each MS would be obligated with the same obligation level in each MS. The main difference between the two options relate to the possibility for fuel suppliers to choose in which part of the EU they introduce renewable fuels in Option 1.
- Different than option 1and 2 option 3 leaves flexibility to MS in determining the level of ambitions
  - some MS would opt for increasing the competitiveness of the domestic industry and define ambituses targets for advanced biofuels (such as Finland, Sweden and Italy).
  - The 7% cap to food crop-based biofuels have been heavily debated in the past years and some MS reflected their wishes to decrease the role of food crop-based biofuels further (i.e. the Netherlands, Germany). In this option they can define the level of the cap.

While in all options the effectiveness can be comparable, the level of quota depends on the MS policy and the political process in option 3. Certain MS indicate relatively high ambitions for RES-T (i.e. Finland has set as 20% RES target in 2020 increasing to 40% in 2030). Other MS may have much lower ambitions. This could result in low levels of RES- T in EU as a whole. Option 1 and 2 have more certainty in this respect.

Increase in advanced fuels

On this criterion, key considerations are as follows.

- For the further development of advanced biofuels, a growing and predictable demand is essential. This would probably be arranged most effectively by and EU-wide sub-target for advanced biofuels, that is in the context of option 1 or option 2.
- In option 2, the suppliers in all MS will have to satisfy the same level of obligation on advanced biofuels, whereas in option 1 a certain share of total fuels sold in the EU market would have to come from advanced biofuels.
- In option 3, the size of this market will be less predictable. In several member states the development of advanced biofuels is considered an opportunity for further developing an innovative industry that reaps assets in terms of feedstocks and technology. Other member states may decarbonize their transport sector with more focus on electrification and

less on biofuels. In short, this desire for diversification would plea for national targets for advanced biofuels (possible in options 3).

Integration of the internal market.

- An EU-wide obligation would lead to an integration of the EU market for renewable fuels in transport (Option 1). Fuels are tradable commodities: they can be transported without major physical restrictions and can be easily stored.
- Quota obligation has been the common practice in the EU, which can ease of an EU-wide obligation
- Option 2 and 3 on the other hand, may result in fragmentation of the market. Option 2 would resemble the current 10% mandate.
- In Option 3 the level of ambitions would be different among the MS, so would be the national support schemes. This would be a barrier to trade them freely among MS.

2.2.5.4.2 Efficiency analysis

Static efficiency

- One main argument for an EU-wide quota obligation is the relatively large size, liquidity and cost efficiency of an EU-wide tradable renewable transport fuel certification.
- An EU-wide mechanism would result in an harmonised and integrated market for renewable fuels whereas option 2 would be the continuation of the existing fragmented markets and option 3 would even cause more fragmentation.

Dynamic efficiency

- In option 1 and 2 the EC can ensure the dynamic efficiency by setting a certain quota for advanced renewable fuels.
- Dynamic efficiency in option 3 will depend on the country circumstances (whether a country wishes to promote innovation versus opts for the static efficiency).
- All in all, dynamic efficiency will depend on the levels at which EU or national targets for advanced biofuels are set. In all three options, dynamic efficiency can be sufficient.

Administrative efficiency

- In respect to administrative efficiency option 2 and 3 are higher as they mainly depend on the existing administrative procedures.
- Option 1, an EU-wide quota obligation would require a different type of administration that provide the EU-wide picture. A data registry across the EU would be necessary to define whether each supplier in the EU meets its obligation. The existing MS level administration could be used to receive the data on the total fuel supply to the market and the biofuels supply, the names of the suppliers and other relevant information as the basis for an EU-wide registry. Setting up such a central administrative body would be challenging since
    - i) the current administrative registries in each MS are not aligned, thus different type and level of data might be collected at present, which makes aggregation difficult,

- ii) there is no data available at EU level on number of fuel suppliers and the amount and type of fuel they supply. In 2012, the Commission sent a question to collect key information on the sector. Extrapolation of the answers received from 12 MS was conducted to provide a representative baseline for the EU27. The number of suppliers calculated in this baseline was more than 800 suppliers (only 10% of this was considered as producers, more than 80% as traders). The FQD impact assessment further indicated that "*it was not possible to categorize EU suppliers according to their size in a comprehensive manner. In addition, subsequent attempts from the Commission to Member States and industry associations such as UPEI have failed to yield any useful information that could be used in providing a more disaggregated analysis of competitiveness impacts by company size accurately." (EC, 2014*[124]*)*. This effort can be considered as an indication of challenging to set up a central administrative body would be.

- However, in the mid to long term, once a central administrative body as in option 1 is created this will require less administrative costs in each MS and increase the efficiency.

Table 36 Summary of the analysis related to geographical scope of the QO

		Option 1	**Option 2**	**Option 3**	
Criteria	Sub-criteria	EU-wide obligation	Same obligation to MS	MS level quota setting	Evaluation
Effectiveness	increase in RES-T	++	++	+	Option 1 and 2 can ensure a certain level of quota for RES-T/renewable fuels
	Increase in RES-Fuels	++	++	+	
	Increase in advanced fuels	+	+	0	Effectiveness depends on the definition of sub-targets for advanced biofuels (see 2.2.5.3
	Integration of energy market	++	0	-	An EU-wide obligation would lead to an integration of EU market for renewable fuels
Efficiency	Static	++	+	-	
	Dynamic	0	0	0	Dynamic efficiency depends more on which targets and sub-targets are defined (see 2.2.5.3)
	Administrative	-	++	++	

124 http://ec.europa.eu/clima/policies/transport/fuel/docs/swd_2014_296_en.pdf

Concluding

Adoption of an EU-wide quota obligation would provide a stable policy framework for renewable fuels in transport. An EU-wide quota obligation will require harmonisation of certain design details. BOX 1 and BOX 2 provide some further details in this respect based on a review of existing practices in Europe and in the US. Further details of the US RFS can be found in Annex F.

BOX 1 Design elements of an EU-wide QO

Implications for administrative bodies, obligation level and penalties of an EU-wide quota obligation

Defining an EU-wide obligation to fuel suppliers will require certain design elements to be harmonised. Based on the review of the existing practices and the literature (i.e. the Sweden- Norwegian RES-E obligation with Tradable Green Certificates; the US RFS with tradable RINS; the Dutch and the UK schemes on transport fuels) below messages for a possible EU- wide fuel supplier obligation have been draw:

- An EU-wide approach (to some degree resembling the US approach) would require MS to turn over some authority to the centralized governance of the Commission, as was done with **the CAP and Regional Policy**.
- Implementation of the certificate with respect to issuing, trading and cancelation can be done at national level, at EU level, or at national level monitored by the EU. For instance
    - The administrative requirements can be built up on the existing MS administrative structures. The MS could report to the Commission the type of renewable fuels entered into the markets and the amounts of fuels substituted, etc. Up to 2020 this has been done through progress reports. Beyond 2020 such info can be integrated into the new governance framework.
    - Certificates can be traded bilaterally or at an exchange, or both[125]. An exchange may increase market transparency and the transactions can be managed centrally (i.e. EPA has developed a system called the EPA Moderated Transaction System (EMTS[126]) to manage RIN transactions, See Annex C).
    - Alternatively, a harmonised approach to administering and the application of a web-based data exchange software can simplify the process and increase the transparency of the data exchange and the trade[127].
- Defining **the obligation level** is of great importance for the advanced biofuels (particularly for cellulosic biofuels). A waiver provision would be recommended that can be activated (i) if it is technically unfeasible or economically not viable for the industry to provide it and (ii) if there is evidence that they have unintended societal consequences (i.e. resulting in indirect land use change affects and/or causing food price increase). Such a provision have been continuously used in the US in the last few years. The details of the waiver credit is introduced in Box 1.
- A harmonised **penalty setting** will be needed. As introduced in sub-section 2.2.4.8, the penalty for non-compliance can be set as a fixed amount significantly higher than the marginal generation costs or a floating amount linked to the certificate price with their pros and cons.
    - In Sweden the penalty level for non-compliance is set to 1.5 times the average certificate price for non-compliance in RES-E.

[125] Similar to the regular electricity market

[126] As of July 1, 2010, renewable fuel producers and importers, gasoline and diesel refiners, renewable fuel exporters, RIN owners, and any other RFS2 regulated party must use EMTS.

[127] For instance in the Sweden Norway case Swedish participants have electricity certificate accounts in Cesar, while Norwegian participants have accounts in NECS. When traded, electricity certificates are transferred from the seller's to the buyer's account.

BOX 2 The Waiver credit in the US

The waiver credit in the US[128]

If refiner fail to meet the RFS mandate, the industry has to purchase the so called waiver credits. The price of these credits is determined using a formula specified in the Clean Air Act (CAA). The cellulosic waiver credit price is the greater of $0.25 or $3.00 minus the wholesale price of gasoline, where both the $0.25 and $3.00 are adjusted for inflation.[129]

Thus, the renewable volume obligations combined with the Waiver Credits can operate as a floor and make the economics work better for producers of the cellulosic biofuels during Short Years because ultimately cellulosic biofuels must compete with gasoline on price.

At the same time, producers of cellulosic biofuels cannot charge exorbitant prices to Obligated Parties because the foregoing pricing structure will functionally operate as a cap on the amount that Obligated Parties would be willing to pay for a gallon of cellulosic biofuel.

The EPA has created a number of limitations on the use of Waiver Credits in order to prevent abuse of the Waiver Credits. Waiver Credits:

- will only be available for the compliance year for which the EPA has waived some portion of the cellulosic biofuel standard; - will only be available to Obligated Parties; - will be non-transferable and non-refundable;
- may only be purchased by Obligated Parties up to the level of their cellulosic biofuel renewable volume obligations, less the number of cellulosic biofuel RINs that they own;
- may not be used by Obligated Parties to meet a prior year deficit obligation;
- may not be carried over by Obligated Parties to the next calendar year;
- may only be used for an Obligated Party's compliance with its cellulosic biofuel renewable volume obligation and not the advanced biofuel or renewable biofuel standards; and
- may only be purchased by an Obligated Party to the extent it establishes with the EPA that it does not have sufficient cellulosic biofuel RINs to meet its cellulosic biofuel renewable volume obligation

2.2.6 Practical implementation options for the future policy design

This chapter discusses practical design futures of a future renewable fuel quota obligation. In order to facilitate the in-depth assessment we assume that the policy design will be as follows:

- The EU introduces an EU-wide obligation for fuel suppliers covering all transport modes.
- The obligation would cover all renewable fuels with a cap for food based biofuels and a cap for waste based conventional biofuels (The latter could

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128 https://www.andrewskurth.com/media/article/1536_An%20Introduction%20To%20Cellulosic%20Biofuel%20Waiver%20Credits.pdf

129 https://www.epa.gov/sites/production/files/2015-11/documents/420b15092.pdf

still replace food based biofuels). As a result, this leads to a specific target for advanced renewable fuels

- The obligation will be set in energy terms and
- There will be no sub targets for sectors.

2.2.6.1 Duration and percentage of the obligation & intermediate periods

An EU-wide quota obligation can run from 1 January 2020 to 31 December 2030. It can impose an increasing obligation level each year with an aim to achieve a certain share in 2030.

- For advanced renewable fuels the obligation level in 2020 can be 0.5% as set out in the new iLUC Directive increasing to i.e. 4% of transport fuel demand in 2030.
- For food crop-based biofuels two options can be followed.
  - o it can be kept in 2020 levels (i.e. 5.6%[130] of energy demand in road transport) up to 2030, or
  - o a gradual decrease can be considered after 2020
- For biofuels based on UCO and animal fats can be limited to 2020 level (i.e. 1.6%[131])

A sample illustration is presented in Table 37.

[130] These are illustrative assumptions. The real values will be known after 2020. A better prediction can be made i.e. in 2019 once the 2018 data are available.

[131] These are illustrative assumptions. The real values will be known after 2020. A better prediction can be made i.e. in 2019 once the 2018 data are available.

Table 37 Illustration of obligation percentages in the time frame 2020-2030 (focus on liquid and gaseous fuels, RES-E is not included)

Options	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Share of advanced biofuels	0.5%	0.9%	1.2%	1.6%	1.9%	2.3%	2.6%	3.0%	3.3%	3.7%	4%
Option1. Share of food crop-based biofuels	5.6%	5.6%	5.6%	5.6%	5.6%	5.6%	5.6%	5.6%	5.6%	5.6%	5.6%
Option 2. Share of food-crop based biofuels	5.6%	5.0%	4.5%	3.9%	3.4%	2.8%	2.2%	1.7%	1.1%	0.6%	0.0%
Share of UCO&AF	1.6%	1.6%	1.6%	1.6%	1.6%	1.6%	1.6%	1.6%	1.6%	1.6%	1.6%
Option 1.Share of total liquid and gaseous renewable fuels	7.7%	8.1%	8.4%	8.8%	9.1%	9.5%	9.8%	10.2 %	10.5 %	10.9 %	11.2 %
Option 2.Share of total liquid and gaseouse renewable fuels	7.7%	7.5%	7.3%	7.1%	6.9%	6.7%	6.4%	6.2%	6.0%	5.8%	5.6%

2.2.6.2 Suggested flexibility provisions

- *Deficit carry over*
  - Deficit carryovers can occur due to ''inability'' to supply or purchase sufficient credits. This can especially be useful for advanced biofuels.
  - a provision allowing an obligated party to carry a deficit forward from one year into the next if it cannot comply with its obligation can be considered provided that the deficit cannot be carried over two years in a row.
  - a maximum share for the deficit carryover can be introduced. E.g. maximally 20% of the quota obligation can be forwarded to next year, not the full obligation.
  - the deficit then can be added to the obligation for the next year.
  - There should be no provisions allowing for another year of carry over. If the obligated party does not meet its obligation for that year plus the deficit carryover from the previous year, it will be in noncompliance.
  - There could be some sort of criteria or condition that obligated parties must meet before they would be allowed to use the deficit carryover provision. This, however, would require a comprehensive investigation to define what inability means.

- *Flexibility in types of biofuels to achieve the obligation*
  - *An overall renewable fuel target that include a cap on food crops, a sub-target on advanced biofuels and a cap on UCO based biofuels can have above flexibilities*
  - advanced biofuels exceeding the obliged targets can be used to meet the overall renewable fuels obligation (i.e. replacing the crop-based biofuels or waste based biofuels).
  - UCO&AF biofuels can be used to meet the food crop-based biofuel obligation.

- *Flexibility in renewable fuel obligation (a waiver provision)*:
  - EC may waive the obligation in part or in whole upon a petition by MS with a demonstration that implementation of the renewable fuel requirements would severely harm the economy or environment of a country, a region, or the EU as a whole. It would, however, be difficult to define the term 'severely harm economy or environment'.
  - Similar to the US approach a cellulosic waiver provision may be necessary since the sector has not yet commercial and the projections defining the obligation level for advanced biofuels will include quite some uncertainty. In the US, for any calendar year for which the projected volume of cellulosic biofuel production is less than the minimum applicable volume estimated by EPA, the applicable volume of cellulosic biofuel shall be reduced to the projected volume available. Whenever the levels are reduced waiver credits will need to be made available. T
  - The EPA has created a number of limitations on the use of Waiver Credits in order to prevent abuse of the Waiver Credits. The Waiver Credits:
    - will only be available for the compliance year for which the EPA has waived some portion of the cellulosic biofuel standard;
    - will only be available to Obligated Parties;
    - will be non-transferable and non-refundable;
    - may only be purchased by Obligated Parties up to the level of their cellulosic biofuel renewable volume obligations, less the number of cellulosic biofuel RINs that they own;
    - may not be used by Obligated Parties to meet a prior year deficit obligation;
    - may not be carried over by Obligated Parties to the next calendar year;
    - may only be used for an Obligated Party's compliance with its cellulosic biofuel renewable volume obligation and not the advanced biofuel or renewable biofuel standards; and
    - may only be purchased by an Obligated Party to the extent it establishes with the EPA that it does not have sufficient cellulosic biofuel RINs to meet its cellulosic biofuel renewable volume obligation.

- Determining the right price of the CWC is very crucial. It should be calculated in a way that it doesn't reduces the impetus for investors to go for advanced biofuel production capacity. Thus, price of gasoline (or diesel)+ the price of cellulosic waiver credit ≥ price of cellulosic ethanol(or diesel).So that, the renewable fuel obligations combined with the waiver credit can operate as a floor.
- This waiver provision can be set for a limited period of time (i.e. up to 2025) and based on the previous experiences and the sector development can be abolished.

- *Flexibility in trade among the fuel suppliers*
  - An EU wide quota obligation accompanied with tradable certificates would give the flexibility to fulfil all or part of the obligation through certificates.
  - This will ensure the cost-efficient obligation fulfilment.

2.2.6.3 Who are effected

An EU-wide quota obligation is planned to be mandated to the transport fuel suppliers, hence, the fuel suppliers to the EU market will be obliged parties. Next to them, the Member States and consumers (i.e. through price impacts) in different ways will be effected.

Obliged parties

The fuel supply chain is quite complex and there are a number of parties involved that could potentially be the focus of an Obligation. The FQD defines a supplier as "the entity responsible for passing fuel or energy through an excise duty point or, if no excise is due, any other relevant entity designated by a Member State". This would mean that those paying duty on fossil fuels primarily intended for road transport would be one of the obligated companies. For other transport sectors, namely aviation and shipping other relevant entities will need to be designated as these fuels are in general tax exempt.

Unfortunately, there are no available datasets indicating the main transport fuel suppliers in Europe. However, as part of the review of the existing obligations and the reporting requirements some MS publish the names of the main suppliers in their territory.

- In the Netherlands a registry with a total of 60 parties passing fuels through an excise duty point were reported in 2012. Of these 60, 15 parties met their quota the obligation by physical blending and 45 of them fulfiled the obligation only administratively (through biotickets, the tradeable certificate by that time) (van Grinsven and Kampman, 2013).

- In the UK[132] typically around 20 mostly very large companies are indicated as obliged parties (RTFO, 2005). In Ireland the biofuel Obligation scheme 9BOS) puts an obligation on 13 oil companies (BOS, 2009)It is however, necessary to indicate that all these suppliers concern road transport fuel. For aviation and shipping next to main biorefineries who process feedstocks from within the EU or outside EU to produce fuels for the EU market other fuel traders that do not have EU based refining capacity but trade finished products will also be affected.

When the companies supplying transport fuel (and biofuels) to the UK and the NL markets are compared we see that 5 companies supply biofuels to both markets. An EU wide obligation would mean that these 5 suppliers are obliged to achieve X% of their transport fuels supply from renewable fuels regardless of which markets they supply. Thus, an EU-wide obligation would reduce the burden to suppliers compared to the current system with national support schemes and allow them to decide to which markets they want to supply RES fuels.

Aviation

Kerosene, one of the products of crude oil refining, is the premier fuel for aviation. The kerosene supply chain consists of two major links.

- The first is that the kerosene is processed from crude oil in oil refineries and distributed to the main kerosene terminals at airports.
- The second and more complex link is the distribution of kerosene from the kerosene terminals at the airport towards each individual aircraft.

Large international airports usually make use of pipeline infrastructure directly from refineries to the airports. This is motivated by the very highly centralized location of the fuel demand, the large volumes which are necessary and also to the importance of a reliable supply of the kerosene (IATA Fuel, 2014). At the airport, kerosene is usually distributed from the kerosene terminals to the aircraft via an underground pipeline system. This is especially true for the larger international airports. At smaller airports (and isolated terminals at international airports) kerosene is usually supplied to the aircraft via fuel trucks. Bio jet fuel supply chains are not yet handled through the standard infrastructure because of the small volumes and the dedicated delivery to single airlines. Next to this, at present the biokerosene used cannot be mixed with regular kerosene fuel supply due to different certification requirements (SkyNRG, 2014). After production, the biojet fuel quality is tested according to the ASTM D7566 specification and a Certificate of analysis issued by the testing company. The certified biofuel is then blended with fossil ASTM D1655 certified JetA1 fuel. This blending can be done at any point in the supply chain, at the biojetfuel refinery, a petroleum refinery or at a separate facility. The blending point is considered to be the point of manufacture

[132] Any fuel supplier supplying more than 450,000 litres of biofuel for use in road transport in the UK were required to submit verified reports on the sustainability of their biofuels

of final jet fuel. The obliged party could be considered as the biojet fuel suppliers that are certified as ASTM D1655 Jet A1 fuel.

Shipping

Marine fuels in general are free from excise duty. On international ships (the majority of the ship activities) no excises are in place. Fuel blending could occur at the refinery, at the storage (into a pre-blend), on the bunker ship, and on board of the receiving ship. Blending marine fuels with biofuels on the bunker storage or bunker ship level is indicated as a preferred option in a study conducted by Ecofys (2012[133]). It indicates that it will reduce the need for dedicated biofuel-tanks on-board, which would lead to extra management costs, and possibly new hardware costs. Blending at bunker station still enables the benefit of low infrastructural changes, as long as blending can be done as close to the refinery as possible. This way the fuel infrastructure does not change, and the blended biofuels can be used in all ships, without the introduction of an alternative fuel infrastructure or dedicated engines.

Many parties are involved in the bunkering process, with large amount of bunker parties (in Rotterdam only already 80 bunker fuel suppliers) and many small ship owners (there are only a few large ship owners).

Member States

In enforcing an EU-wide quota obligation Member States will mostly rely on their existing infrastructure. They will record the amount of fuel placed on the market and report the figures to the Commission. The penalties can be set at EU-level and the Member States would impose these penalties in case of non-compliance. Extra administrative requirements will relate to:

- inclusion of aviation and shipping sectors
- harmonising administrative procedures among the MS to enable smooth data collection and transfer to a central data centre (possibly at the EC level)
- Enforce policies on data collection and timely input into data centre

Consumers

All costs (such as the additional cost of biofuel relative to fossil fuels, the infrastructure costs, biofuel blending costs, fuel supplier administration costs etc.) borne by fuel suppliers obligated under the obligation are assumed to be passed through to fuel consumers through higher pump prices.

[133] http://www.ecofys.com/files/files/ecofys_2012_potential_of_biofuels_in_shipping_02.pdf

2.2.6.4 Possible exemptions from the obligation

Member States can be allowed not to impose the obligation on small fuel suppliers to avoid disproportionate administrative burdens. The Commission can set out principles that should be taken into account by Member States. For instance a de-minimis supply threshold could be considered.

Great care would be needed in defining the threshold to avoid any unintended effects (i.e. a loophole whereby companies restructure to avoid their obligation). MS can determine the level of threshold depending on the country circumstances and the EC can provide the harmonised approach in determining.

- In the UK, suppliers of road and NRMM fuel supplying petrol, diesel, gas oil or renewable fuel totalling 450,000 litres or more in an obligation period have an obligation under the Order.
- In the NL, companies with annual market volume more than 5,000 litres of road transport fuels have an obligation
- In the US, an exemption from the RFS standard for small refineries during the first five year of the programme is defined. The US Clean Air Act[134] defines small refineries as ''a refinery for which the average aggregate daily crude oil throughput for a calendar year (as determined by dividing the aggregate throughput for the calendar year by the number of days in the calendar year) does not exceed 75,000 barrels''. After 5 years small refineries are be required to meet the same renewable fuel obligation as all other refineries.

2.2.6.5 Monitoring, reporting and verification of the fulfilment in the most efficient way

- For the calendar year commencing 1 January 2020 and each subsequent calendar year each Member State can record information for each fuel supplier supplying fuel to its territory (including aviation and shipping, next to road transport).
- By i.e. 28 February of each year, commencing in 2021, each Member State can determine and transmit to the Commission the information, in respect of the preceding calendar year. The details of the data collection and the format can be specified by the Commission.
- The Commission can keep a central register of the data reported by Member States, and can calculate the following for each supplier:
  - Amount and type of total fuel supplied in the preceding calendar year to the EU (both volumes and energy content)
  - Amount and type of total liquid and gaseous renewable fuel supplied in the preceding year (both volumes and energy content)
  - The difference between te set target in the preceding year and the actual amount supplied

[134] Under this provision, foreign small refiners and foreign small refineries can apply for an exemption from the RFS standards such that importers would not count the small refiner or small refinery gasoline volumes towards the importer's renewable volume obligation.

- The register can be publically available to enable market transparency.
- The suppliers may, within XX months of being notified of the provisional calculations, notify the Commission of any errors in the data, specifying the Member State in which it considers that the error occurred.
- Based on this, the Commission may either confirm or amend the provisional calculations.
- In case of deficit in quota obligation the Commission can notify the supplier.
- Member States can designate a competent authority for the collection and communication of the monitoring data and can inform the Commission on the competent authority designated.
    - The designated competent authority can be based on the existing administrative authority in road transport within the RED and FQD.
    - For aviation the administrative authority dedicated within the EU ETS data collection can be the starting point (each aircraft operators are requested to provide data in the framework of EU ETS GHG allowance for aviation sector[135]). This competent authority can request data for instance at the point where the fuels receive ASTM D1655 certification for aviation. After this certification it becomes certain that the fuel will be used for aviation.
- The Commission can adopt detailed rules on the procedures for monitoring and reporting of data by means of implementing act.
    - The existing reporting requirements under the REDI can be the basis for the reporting.
    - The Commission could harmonise the reporting requirements, the reporting sequence and the type of information provided so that a proper tracking of the compliance and the functioning of the certificate trading can be ensured.
    - EC can establish an online platform to foster practical implementation of reporting.
    - The reporting requirements of the MS to the EC can be integrated into the governance framework and for instance can be done every two years. An indicative list of reporting requirements is listed below.
- The Commission can request each MS to set-up a central web-based verifications systems, and can harmonise the datasets to ease data transfer among one or more MS (a brief note on the overview of the existing web-based tracking systems are introduced in Annex J).
- The Commission can issue a guidance document to assist MS on issues such as
    - Avoiding double registry of the same renewable fuels;
    - Avoiding possible fraud related to biofuels from UCO;
    - Implementation of cross border trade.

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[135] DIRECTIVE 2008/101/EC: "Article 3g Monitoring and reporting plans- *The administering Member State shall ensure that each aircraft operator submits to the competent authority in that Member State a monitoring plan setting out measures to monitor and report emissions and tonne kilometre data for the purpose of an application under Article 3e and that such plans are approved by the competent authority in accordance with the guidelines adopted pursuant to Article 14."*

- The Commission can be empowered to adopt delegated acts in order to amend the data requirements and data parameters in the course of the years based on the experiences.
- In line with the iLUC Directive requirements all data and reporting provided to the competent authority in each MS can be verified by independent organisations.

2.2.6.6 Sanctions for non-compliance

- In existing directives (i.e. EED, FQD) Member States are required to lay down rules on effective, proportionate and dissuasive penalties applicable in case of non-compliance with the national provisions adopted.
- Civil penalties are also introduced in existing obligation schemes and can be issued for a number of reasons. In the case of RTFO, these include:
    - failing to register under the respective obligation,
    - failing to pay any buy-out sum due,
    - failing to provide accurate information and evidence to the Administrator, or knowingly making a false declaration on an application for Certificates.
- A list of existing penalty levels are presented in Table 38. In average the level of penalty imposed has been around 3.9 €cent/MJ for bioethanol and 2.5 €cent/MJ for biodiesel.
- In general the level of penalty is fixed by the MS.
- In an EU-wide quota obligation, a harmonised penalty level will be necessary for the proper functioning of the obligation.
- The Commission could lay down the rules on penalties applicable in case of non-compliance (and even define the yearly penalty levels) and MS could be responsible to impose these penalties and collect the fines.
- The amount of the fines collected can be considered as revenue for the general budget of the European Union or leave it to the Member States[136] with the pre-condition that they are reinvested in RES.

[136] Since the costs of the obligation are paid for by the end consumers; the MS will not be willing to accept a revenue flow directly to the EU.

Table 38 Fees and penalty charges within the quota obligations in the EU Member States

Country		**Fees and penalty charges**
AT	Biofuel quota	If biofuels do not comply, they may not be released for free circulation.
BE	Biofuel quota (Law on blending obligation)	If a provider fails to fulfil the quota he shall pay a fine amounting to € 900 per 1,000 litres of biofuels not blended
HR	Biofuel quota	The penalty is calculated based on the formula set in Art. 3 Environmental Penalty Decree.
CZ	Biofuel Quota	The fine amounts to CZK 40 (1.48 Euro) per litre
DK	Biofuel quota (Act on Sustainable Biofuels)	If a provider fails to fulfil the quota he will be punished by a fine
FI	Biofuel quota (Distribution obligation system)	each mega joule (MJ) missing is charged 0.04 Euros
FR	Biofuel quota (Reduction of the tax on polluting activities)	In France, energetic products are subjected to a tax on polluting activities called TGAP (Taxe Générale sur les Activités Polluantes). The TGAP on fuels amounts to between € 17.29 and € 63.96 according to the fuel type. Providers of petrol or diesel fuels are subjected to an increased rate of TGAP if they release fuel products for consumption with a lower proportion of biofuels than stipulated by law As a matter of fact the increased rate of TGAP, which amounts to 7% since 2010, is reduced according to the proportion of biofuels contained in the fuel sold.
DE	Biofuel quota	The amount of the penalty varies. For the gasoline quota, the fine is € 43 per gigajoule, for diesel and the overall quota the fine is €19 per gigajoule. Since the introduction of the GHG emission avoidance based quota obligation the penalty to be paid has been 470 EUR/t CO_2
GR	Biofuel quota (Law No. 3054/2002)	If a provider fails to fulfil the quota, he will be punished with a fine or by revocation of its participation to the quota distribution scheme of the present year or even subsequent years (art. 4 FEK B 2342/2011).
HU	Biofuel quota	The penalty charge amounts to HUF 35 per MJ (app. € 0.12 per MJ) on retailers. The penalisation can be reduced in case that the supplier of biofuels was responsible for missing or invalid sustainability certifications on the obtained biofuel when that was the reason for not meeting the required quota. Further, penalty charge of HUF 100,000 – 1,000,000 (app. € 340 – 3,440) applies in case the fuel retailer does not hand in the monthly documentation of quota fulfilment to the competent authority

IE	Biofuel quota (Biofuels Obligation Scheme - BOS)	An obligated party who has a shortfall shall pay to the NORA a non-compliance fee, calculated in accordance with the formula X multiplied by Y, where X is the number of certificates short and Y is the price per liter of biofuel prescribed (currently € 0.45) (section 44J (1) BOS).
IT	Biofuel quota (Obbligo di immissione)	The amount for non-compliance with the obligation is fixed between € 600 and 900 per certificate, depending on the degree of non-compliance
LU	Biofuel quota	a pollution tax amounting to EUR 1,200 per 1,000 Litre of biofuels not blended
PL	Biofuel quota (National Indicative Target)	The amount of the fine is calculated with a formula described in art. 33 par. 5 Act on Biocomponents and Liquid Biofuels).
PT	Biofuel quota	The amount to be paid is 2,000 € per TOE
RO	Biofuel quota	Fuel retailers may be penalised for not fulfilling the quota and not respecting the sustainability criteria with RON 30,000 - 50,000 (app. € 6,700 – 11,200) Further, a penalty charge of RON 10,000 – 20,000 (app. € 2,200 - 4,500) falls due in case that fuel retailers do not hand in the yearly documentation on fulfilling the quota to the competent authority. A penalty charge of RON 30,000 – 50,000 (app. € 6,700 – 11,200) falls due in case that fuel retailers do not meet the prescribed quota in 2020 and do not follow the methodology prescribed by law for calculating the energy content of biofuels. Finally, not meeting the GHG reduction will be penalised with RON 10,000 – 20,000 (app. € 2,200-4,500)
SK	Biofuel quota	Non-fulfilment of obligations under the RES Act is subject to a fine imposed by the customs office
SI	Biofuel quota (Act on Sustainable Biofuels)	The penalties range from € 10,000 to € 100,000 and € 600 for the person responsible.
ES	Biofuel quota (support mechanism for the use of biofuels and other renewable fuels for transport means)	Penalties and fees for non-compliance are established through the formulas of Art. 11 Order ITC/2877/2008. The Order sets a value of 350 € per certificate. Each certificate indicates that the obligated party has sold or consumed 1 toe of biofuels in one year.
GB	Biofuel quota (Renewable Transport Fuel Obligations)	In case the supplier does not own sufficient certificates, it will need to pay a penalty fee ("buy-out price") of GBP 0.30 per litre (approx. €0.37 per litre) to the Authority

Reference: RES Legal, last visited in May 2016.

2.2.6.7 General framework for trading and anti-fraud measures

An EU wide quota obligation accompanied with tradable certificates would give the flexibility to fulfil all or part of the obligation through certificates. This will ensure the cost-efficient obligation fulfilment.

The common electricity certificate market set between Norway and Sweden can assist in setting the general framework for trading. In this market power producers receive one electricity certificate for each MWh renewable electricity produced over a maximum 15 years. These electricity certificates are sold in market where supply and demand determine the price. In this way producers receive extra income in addition to the power price. Below bullet points are derived from the agreement between Sweden and Norway.

- A common renewable transport fuel certificate market will be necessary that require each MS to ensure that the certificates issued in one country can be used to comply with the renewable transport fuel obligation in the other country.
- The lifetime of the certificates can be 10 years, but not beyond 2030.
- The basic principle can be that the certificates shall constitute sufficient support for the promotion of renewable fuels. Accordingly, the producers gaining income from the certificates they generate through the production of renewable fuels should not receive support in addition to certificates.

Registration and monitoring of certificates (shall be in line with section 2.2.6.5 on monitoring reporting and verification of obligation fulfilment)

- MS can designate a competent authority to maintain an electronic register of certificates. The competent authority can enable certificates to be issued, transferred and annulled under the same conditions across the EU.
- This competent authority shall be/can be the same as the monitoring, reporting and verifying of quota obligation (see section XX)
- The Commission can adopt detailed rules on the procedures for specifying the precise data needed to issue the certificates by means of implementing act.
- The relevant MS competent authority in each MS shall prepare at least one report per year that collates statistics and analysis data on the development of the certificate market and send it to the EC (or another dedicated EU authority) to comply and produce a common certificate market in the EU.

Anti-fraud measures

Certificates may need to be cancelled if inaccurate or fraudulent information was provided in the application or subsequent requested evidence. Fraud can arise in a number of ways, including (RTFO):

- Evasion of the obligation
- Under reporting of fossil fuels
- Over reporting of biofuels
- Bogus certificate claims (i.e. by persons / organisations with no biofuel capability whatsoever, but hoping to claim and sell certificates without discovery)
- Hacking into the Administrator's systems

The past relevant experiences and how they have been addressed are presented below:

- In the UK, the Administrator noted that the volumes of UCO derived biofuel being reported as coming from the Netherlands were very high. The reason was that the UCO was being misreported as of Dutch origin, rather than the material itself not being genuine UCO. it is likely that significant quantities of UCO pass through the Netherlands as Rotterdam being the main shipping port for Europe. Through communicating this risk, and enforcing the requirements for suppliers and verifiers to be able to trace material back to its origin to verify sustainability claims, the volume of Dutch UCO has decreased to realistic levels and there is greater assurance that virgin oils are not being passed off as wastes.
- In the US, EPA has issued Notice of Violation against the companies in early 2012 (Ref). Because of these RIN fraud cases (RINs were generated for fuel that did not exist), EPA planned to establishes a quality assurance program whereby RINs can be certified by third parties registered with EPA. Various policy options to address the issues of RIN fraud are indicated in REF. these are:
    - Do nothing, and let market participants determine the credibility of actors they trade with;
    - Establish a Quality Assurance Program or some other certification to provide greater credibility, but do not tie it to EPA's determination on RIN validity;
    - Establish a certification procedure with an affirmative defence such that purchasers of invalid RINs are not liable for civil penalties (EPA's proposal); and
    - Establish a system where all certified RINs are valid for RFS compliance regardless of subsequent determination that they are fraudulent or otherwise deficient.

2.2.6.8 Possible combinations of policies to support advanced (innovative) biofuels and shift the use of biofuels to sectors such as HDV, aviation and shipping

A quota obligation provides a guaranteed market for advanced/innovative biofuels but may not be enough to provide a sufficiently stable market price

Quota obligations function well in markets where the demand and supply is in balance. The past experiences, however, have shown that they were not enough to incentivizing innovative technologies. In the US, EPA has set a mandate on cellulosic biofuels providing a guaranteed market for commercial cellulosic biofuels. The aim was that the guaranteed market would function as a carrot, providing financial security for potential investors and incentivizing innovation. Yet, it took many years and the amount of biofuels reached the commercial market in 2012 was only 20.069 gallons of cellulosic ethanol. From this experience one can conclude that guaranteeing a market for cellulosic biofuels did not provide enough market certainty for private investment in innovation and development. A quota obligation combined with other support instruments can be a way forward until certain amounts of advanced biofuels until the confidence is built for advanced/innovative biofuel technologies.

- Investment premiums for a significant amount of 'first' plants can be one of the options. The issue in this option, however, is that that these plants can be profitable with lower certificate prices, thus effecting the certificate trading
- Additional tax exemptions can be another option. Countries like Poland have done that in the past, in combination with an obligation. The issue with this option is that such a decision falls under the tax policy and the EU has no fiscal authority.

A sub-quota for advanced biofuels (by setting caps to crop-based biofuels and fuels produced from /UCO and animal fats an indirect sub-quota can be set to advanced biofuels) can safeguard a market volume for advanced biofuels. However, a quota may not provide price certainty (there can be volatility in the related tradable certificate). That is particularly difficult for options with high investment costs (and risks). Additional stabilization measures could be:

- A floor price in the related tradable certificates (the penalty can already set the maximum value, a minimum value could also be defined). But this would also require the raising of funds to support the price, or the possibility to set the quota higher if the price gets too low.

Transition of biofuels to sectors with no or limited options for decarbonising their fuel supply

Biofuels have been mainly used for road transport while their use in other sectors such as aviation and shipping are preferable. In this respect it may be necessary to provide some incentives. The RED double counting mechanism has encouraged the use of waste-based biofuels produced from feedstocks such as Used Cooking Oil or Animal Fat. While this mechanism is not recommendable beyond 2020 a similar instrument, a multiplication factor, can be applied for biofuels used in aviation or shipping. The main drawback of this instrument is that the total amount of biofuels applied can decrease when such biofuels become widely used.

2.3 RES Heating and Cooling

2.3.1 Methodology

For RES-HC a long list of design variants of different policy instruments will be introduced for three different approaches including policy measures aiming at increasing the RES-HC share in DHC systems, RES-HC obligations on the HC market (addressing different agents in the fuel chain) and RES-HC use obligations on buildings. For the policy measures addressing RES-HC DHC different policy approaches will be assessed. For the other two policy measures (RES-HC obligation and use obligation on buildings) different design variants of the specific instrument will be analysed.

In a first assessment step pros and cons of the different variants will be identified. A short listed approaches will then be subject to a more detailed and systematic analysis. In this second working step the short listed variants will be investigated on their effectiveness to stimulate increased RES-HC deployment as well as their efficiency (static, dynamic, administrative burden). However, empirical and modelling data as well as detailed evaluations are lacking for most of the short listed approaches. For that reason it is not possible to deliver a detailed cost benefit analysis. However, we will develop several qualitative considerations on the effectiveness and efficiency of the different approaches and provide some rough calculations on selected quantitative impacts.

2.3.2 Screening and shortlisting of policy design options

2.3.2.1 Specific provisions on DHC and storage infrastructure to expand the share of renewable energy sources in DHC networks

2.3.2.1.1 Intro to long-list of instrument variants

District heating (DH) means a system supplying heat produced centrally in one or several locations to a number of customers. In the following analysis DH is covering all heating and cooling systems where more than one property is supplied by heat or cold through a grid. Heat or cooling generation feeding the grid can be centralised (e.g. CHP, large biomass boiler) but also decentralised (e.g. dispersed solar collectors on several buildings feeding the same grid). RES on site generation with use of efficient micro-grids for connections between nearby sites would also be considered DH.

The aim of this group of measures is to gradually increase the share of renewable energies in DHC networks. So it is not an expansion of DHC alone that should be strived for but any activity to support DHC should be indelibly linked to the integration of RES-HC in such systems (with efficient waste heat generated by conventional CHPs being accepted as transitional measure towards the vision of a decarbonised heating sector)

There are a couple of variants how such provisions could be designed:

1. Regulations for preferential third-party DHC grid access for RES-HC:
   In order to facilitate third-party grid access the EU could require Member States to adopt regulations to open DHC grids for third-parties that want to use the grid in order to supply a customer with RES-HC, RES-E, waste heat. As the decarbonisation of the energy sector will lead to an increased integration of the different sectors (e.g. electricity and heating/cooling) it should be analysed at a later stage how an integrated approach for third-party grid access including could be facilitated (e.g. preferential access to the electricity grid for surplus RES-E production if this is used for heating purposes; access to electric heaters in existing DH systems for surplus RES-E production).

2. Regulations for preferential third-party DHC grid access including a purchase obligation for RES-HC fed into the DH grid:
   In addition to preferential third-party grid access the grid operator could also be obliged to purchase the RES-HC that is fed into the grid. Both options could also be facilitated for other heat sources that should be treated preferential, e.g. waste heat from fossil fuelled CHP or industrial processes.

3. Provision that Member States increase the share (including through storage) of RES-HC in DHC systems, e.g. by
   a) requiring use of RES-HC technologies and use of energy storage infrastructure where such infrastructure increases the potential of RES integration, e.g. when new DHC systems are planned, existing DHC systems expanded or in case of substantial refurbishment of existing systems.
   b) requiring a coordinated approach between all actors (municipalities, urban planners, DH grid operator and supplier, consumers) to expand RES in DHC systems when new DHC systems are planned, existing DHC systems expanded or in case of substantial refurbishment of existing systems.

   The core of this variant is to enable increasing RES shares incl. required storage infrastructure in DHC systems that are completely new or to increase the RES share in existing DHC systems that are expanded or subject to major renovation activity.

4. Provision that Member States shall require RES DHC (and storage where necessary) e.g. in all newly developed urban areas (fall-back option: Provision that in all newly developed urban areas the economic feasibility of RES-DHC is assessed; in case no local DHC is in place this obligation could be put on the electricity DSO).

5. Provisions that Member States implement a national regulatory authority in order to ensure transparency on tariffs and to protect consumer rights.

6. Provisions that Member States oblige DHC grid operators as well as electricity and gas DSOs to develop common investment plans (or consult each other on investment plans).

7. Provision that Member States oblige DHC companies to certify their systems' performance (preferably in CEN process, CEN/TC 228 standard pr EN 15316-4-5 District heating and cooling) and/or to implement community/district/campus/city/label systems that show the energy of a given geography.

2.3.2.1.2 *Pros and Cons of the different instrument variants*

Table 39 Pros and Cons of different instrument variants

Instrument variant	Pros	Cons
Regulations for preferential third-party DHC grid access for RES-HC	• Would allow producers of RES-HC to use existing infrastructure • Would potentially incentivise investments in RES-HC production capacity • Would facilitate customers connected to DHC to search for RES-HC supply • Would help to gradually liberalise the DHC sector • Would introduce a competitive element in the DHC sector	• Complexity: System specific technical requirements for grid access and usage of grid need to be defined • Grid charges need to be determined • Unclear whether preferential grid access alone would provide sufficient incentives for an uptake of RES in DHC (unclear effectiveness)
Regulations for preferential third-party DHC grid access for RES-HC including a purchase obligation for RES-HC fed into the DH grid	• Similar pros as for option above • Purchase obligation might further incentivise RES-HC investments due to predictable income stream (however depending on rules how to determine the purchase price) • RES-HC producer doesn't need to search for customers • For RES-HC producer not necessary to synchronise production with consumption of his customers (task stays with the grid operator)	• Similar cons as for option above • Additional incentive depending on purchase price and rules how to determine this price • If purchase price is higher than production costs for non-RES-HC differential cost will be distributed among DH customers
Provision that Member States increase the share of RES-HC in DHC systems by requiring use of RES-HC technologies and use of energy storage infrastructure when new DHC systems are planned, existing DHC systems expanded or substantially refurbished	• Can be rather effective if further specifications are provided	• Provision requires further specification in order to be effective (e.g. what is meant by "increase the share") • Might be a barrier against new DHC systems due to costs • DHC system operators might step back from renovating existing DHC infrastructures

Provision that Member States increase the share of RES-HC in DHC systems by requiring a coordinated approach between all actors to expand RES in DHC systems when new DHC systems are planned, existing DHC systems expanded or substantially refurbished	• Brings together all parties involved when DHC is concerned • Can be rather effective if coordinated approach leads to an increased RES-HC deployment	• Similar cons as for option above • Weaker option than option above since only a coordinated approach is required (not connected to minimum requirements as regards a min RES share) • Could be a fall back option if option above fails
Provision that Member States shall require RES DHC (and storage where necessary) e.g. in all newly developed urban areas	• Would ensure the use of RES-HC in the areas for which the requirement applies • Could be rather effective within the scope of the regulation (newly developed urban area)	• Limited effectiveness since newly developed urban areas are limited • Limited effectiveness since heating/cooling density should be rather low in these areas (new buildings underlie high energy standards) • Conflicts with technology neutrality (DHC vs decentralised heating) • Requires further specification with respect to what minimum requirements exactly need to be met when rolling out a new urban area • Might require price regulation
Provisions that Member States implement a national regulatory authority for DHC	• Increases transparency (e.g. by providing tools that allow for an easy comparison of different heating and cooling supply technologies • Allows DHC customers to compare price levels between different DHC systems and between DHC and individual heating supply options • Avoids that DHC suppliers cross-subsidise specific areas • Protects consumer rights (e.g. by ensuring that consumer complaints are dealt with in a fair way) • Ensures that investment plans of DHC grid operators and electricity/gas DSOs are coordinated	• Does not directly incentivise investments in RES-HC • Comes along with additional transaction costs for implementing and running the regulatory authority or to extent the responsibility of existing regulatory authorities

Provisions that Member States oblige DHC grid operators as well as electricity and gas DSOs to develop common investment plans	• Obliges DHC grid operators and DSOs to think out of the box • Should trigger the development investment plans against long-term needs that derive from long-term goals (decarbonisation of the two sectors involved).	• Cross sector coordination increases complexity • Might hinder investments due to lack of long-term vision how a coordinated and integrated infrastructure could look like
Provision that Member States oblige DHC companies to certify their systems' performance and/or to implement community/district/campus/city/label system that show the energy of a given geography	• Introduces transparency by allowing for comparing the performance of different schemes • Might incentivise RES-HC investments in order to increase performance • Could be combined with a right of consumers to disconnect from a DHC system if the system efficiency is below a defined minimum standard	• Transaction costs for implementing such certification schemes • As DHC is not a competitive market (mainly "captured" customers) the incentive for improving performance might be limited

Source: Öko-Institut e.V.

2.3.2.2 RES-HC obligation addressed to different agents in the HC supply chain

Under a RES-HC obligation a defined actor group on the heating and cooling market is obliged to approve that according to a defined reference line a certain amount of RES fuel or RES-HC is delivered to the heating and cooling market within a defined period of time (e.g. one calendar year). RES-HC obligations can be designed in a very different way and different design elements have a significant impact on the effectiveness and efficiency of the instrument. In the following section for the main design elements different options are introduced and discussed.

2.3.2.2.1 Intro to long-list of design elements

Table 40 Design variants for a RES-HC obligation

Design elements	Possible options
Whom to oblige?	• Companies that bring fuel/energy sources subject to the obligation on the EU market for the first time (production/import) • Companies that supply fuel/energy sources subject to the obligation to end consumers • Only suppliers of DHC or DHC grid operators • Large consumers with an annual heating/cooling consumption above X • Manufacturer, wholesale or retail of heating systems
Which fuel type/energy sources to fall under the obligation (denominator)?	• All energy sources used for heating/cooling (incl. DH and electricity) • All fossil fuel used for heating/cooling (incl. DH, without electricity) • Only DHC
Target setting on which level?	• EU wide target set by the EU • Nationally diverging targets aligned to current share of RES-HC (e.g. current RES-HC share + x%) • Target setting left to MS • Target setting left to Member States with a minimum starting share of x%
Development of obligation target?	• Fixed obligation target • Dynamic (increasing) obligation target over the time
Separate targets for heating and cooling?	• One target covering heating and cooling • Separate sub-targets for heating and cooling
Sub-targets for specific RES fuels or RES-HC technologies?	• No sub-targets • MS allowed to define sub-targets for specific RES fuels or RES-HC technologies • No sub-targets but MS allowed to introduce weighing factors
Reference for the obligation?	• Energy content of fuel subject of the obligation • Carbon content of fuel subject of the obligation
Eligible RES or technologies to be accounted for?	• All RES fuels and RES-HC technologies excl. RES-E • All RES fuels and RES-HC technologies incl. RES-E • Limited to RES fuels
How to determine eligible RES production ("converting" capacity to energy)?	• Measure output disregarding technology and size • Small scale: deeming; large scale: measuring • Intermittent (inflexible) technologies (solar thermal): deeming, flexible technologies (e.g. heat pumps, biomass): measuring • Deeming output disregarding technology and size
Flexibility measures (obligation tradable)?	• No exchange of obligation between obliged parties • MS allowed to open system for bilateral exchange of obligation • MS allowed to introduce certificate trade, trade only national • Introduction of certificate trade, trade EU wide

How to fix penalties for non-compliance/buy-out price?	• Fixing penalty level/buy-out price left to Member States • Minimum penalty/buy-out price set by the EU
Extension to the transport sector (joint obligation for RES-HC and RES-T)?	• Obligation limited to RES-HC sector • Obligation covering RES-HC and RES-T (joint obligation)

Source: Öko-Institut e.V.

2.3.2.2.2 Whom to oblige?

Options are

- *Companies that bring fuel/energy sources subject to the obligation on the EU market for the first time (upper end of the fuel chain, e.g. producers of natural gas, coal or heating oil, importers of fossil fuels)*
- *Companies that supply fuel/energy sources subject to the obligation to end consumers (lower end of the fuel chain, e.g. gas suppliers, DH suppliers, retailer of heating fuels)*
- *Only suppliers of DHC or DHC grid operators*
- *Large consumers with an annual heating/cooling consumption above X*
- *Manufacturer, wholesale or retail of heating systems*

Table 41 Pros and Cons of different obliged parties

Options	Pros	Cons
Companies that bring fuel/energy sources subject to the obligation on the EU market for the first time (upper end of the fuel chain)	• Limited number of companies involved which reduces complexity • Fuel volume that falls under the obligation often calculated in the context of determining the energy tax	• Limited access to RES-HC technologies • Limited access to end consumers where RES-HC will be installed • The challenge is to determine which share of the imported or produced fuel will be allocated to the heating and cooling sector that is subject to the obligation scheme
Companies that supply fuel/energy sources subject to the obligation to end consumers (lower end of the fuel chain)	• Access to end-consumers (obliged company could offer RES-HC solutions to customers) • Fuel volume that falls under obligation could easily be determined	• Depending on the market structure the option would address a significant number of companies (e.g. supply side for heating oil very fragmented in many Member States) • Might lead to difficulties in determining the fuel volume that falls under the obligation • More complex administration
Only suppliers of DHC or DHC grid operators	• Limited number of companies involved which reduces complexity • Access to end-consumers (obliged DHC company could offer RES-HC solutions to customers)	• Limited effectiveness especially in Member States with low DHC rates (decentralised heating structure) • Fulfilment costs would be transferred to DHC consumers that are more or less captive • For large DHC generators interaction with ETS needs to be taken into account

Large consumers with an annual heating/cooling consumption above X	• Similar to a use obligation well known from the building sector (e.g. ES, DE) • Depending on the threshold limited number of obliged companies which reduces complexity	• Limited effectiveness as only large consumers would be involved
Manufacturer, wholesale or retail of heating systems	• Manufacturer/Wholesale: limited number of obliged companies which reduces complexity • Several manufacturer have already RES-HC technologies in their portfolio • Higher costs for RES-HC installations might be distributed among the whole technology portfolio thus increasing the price of conventional heating appliances	• Retail: Huge number of companies involved • Retail: How to deal with web-based companies? • Manufacturer: How to deal with non-EU companies?

Source: Öko-Institut e.V.

2.3.2.2.3 Which fuel/energy source to fall under the obligation (denominator)?

Options are

- *All energy sources used for heating/cooling (incl. DHC and electricity)*
- *All fossil fuel used for heating/cooling (incl. DHC, without electricity)*
- *Only DHC*

Table 42 Pros and Cons of different fuel types/energy sources to fall under the obligation

Options	Pros	Cons
All energy sources used for heating/cooling (incl. DHC and electricity)	• Broadest approach • Would also require electricity to heat to contribute to RES-HC deployment (directly via RES-E or indirectly via non-electric RES-HC technologies)	• Would require to determine the amount of electricity that is used for heating/cooling purpose (separate meters?) • Would require RES-E to be eligible under the obligation and might thus trigger heating and/or cooling technologies that might not been considered to be compatible with the long-term targets (e.g. electrical resistance heating) • Electricity is not included in the numerator and denominator of the RES-HC ratio as determined by Eurostat
All fossil fuel used for heating/cooling (incl. DHC, without electricity)	• Would be easier to implement as for electricity no differentiation between heating/cooling and other types of consumption needs to be carried out • Would be in line with statistical methodology applied by Eurostat	• Would exclude a market segment that in several Member States holds a considerable share (e.g. FR)

Only DHC	• Limited market share covered which reduces complexity	• Covers only a certain share of the heating market (in some Member States a very low share) thus having limited effectiveness

Source: Öko-Institut e.V.

2.3.2.2.4 Target setting on which level?

Options are

- *Target for all obliged agents EU wide set by EU*
- *Target setting left to Member States*
- *Target setting left to Member States with a minimum starting share of x%*

Table 43 Pros and Cons of different options how the target is set

Options	Pros	Cons
Uniform EU wide target	• Harmonised approach for all Member States • Target would ensure minimum RES-HC deployment • Target would oblige Member States with stagnant or even declining RES-HC development to strengthen their efforts	• Would not reflect specific Member State context, especially the current RES-HC share or climate conditions • Could prevent "ambitious" Member States to set targets that exceed the minimum target set by the EU
Nationally diverging targets aligned to current share of RES-HC (e.g. current RES-HC share + x%)	• Would reflect the specific Member State context, especially the current RES-HC share	• Obliged companies operating in several Member States would have to deal with different targets
Target setting left to Member States	• Allows Member States to set targets according to their specific national context (e.g. climate conditions) • "Ambitious" Member States could set ambitious targets	• Member States might set very low minimum targets -> obligation might be rather ineffective • Obliged companies operating in several Member States would have to deal with different targets
Target setting left to Member States with min starting share of x%	• Minimum target would ensure minimum RES-HC deployment • Member States would be allowed to set more ambitious targets • Minimum target would oblige Member States with stagnant or even declining RES-HC development to strengthen their efforts	• Minimum target might be rather low to be accepted by all Member States • Obliged companies operating in several Member States would have to deal with different targets

Source: Öko-Institut e.V.

2.3.2.2.5 Development of obligation target?

Options are

- *A fixed obligation target (target of x% that stays the same for the duration of the Directive)*
- *Dynamic (increasing) obligation target over the time (Directive defines how the obligation target increases over the time)*

Table 44 Pros and Cons of target development

Options	Pros	Cons
Fixed obligation target	• Low target might reduce costs and keep the investment costs low and predictable	• Does not reflect the need for step-by-step decarbonisation of the heating/cooling sector (which – apart from other contributions – requires increasing shares of RES-HC) • Risk of lock-in at low RES-HC levels
Dynamic (increasing) obligation target over the time	• Reflects the need for increasing RES-HC penetration rates in order to achieve decarbonisation of the heating/cooling sector • Reduces the risk of lock-in at low RES-HC levels	• Might increase investment burden (the higher the target the higher the initial investment costs) • Requires to develop trajectory for RES-HC development that justifies the dynamic

Source: Öko-Institut e.V.

2.3.2.2.6 Separate targets for heating and cooling?

Options are

- *One target covering heating and cooling*
- *Separate sub-targets for heating and cooling*

Table 45 Pros and Cons of the implementation of separate targets for heating and cooling

Options	Pros	Cons
One target covering heating and cooling	• Broadest approach. obliged companies would be free in choosing the best compliance options • Option with lowest complexity	• Fulfilment might mainly come from RES-H while neglecting RES-C
Separate sub-targets for heating and cooling	• Might stimulate innovation in the sub-sectors (especially in the cooling sector)	• Delivered amount of an obliged fuel or electricity would have to be split by type of consumption (heating or cooling). For consumers producing heat and cold this might require additional metering. • Obliged parties delivering in both sub-sectors would have to cope with two different targets. • How to deal with absorption and adsorption cooling, would that be classified as RES-H or RES-C (subject to the RES-H or the RES-C target?)?

Source: Öko-Institut e.V.

2.3.2.2.7 Sub-targets for specific RES fuels or RES-HC technologies?

Options are

No sub-targets

- *Sub-targets for specific RES fuels or RES-HC technologies (e.g. solar thermal, ambient heat, biomass)*
- *No sub-targets but use of weighing factors (e.g. solar thermal is weighted higher than biomass)*

Table 46 Pros and Cons of setting sub-targets for specific RES-HC technologies

Options	Pros	Cons
No sub-targets	• Does not give preference to any specific technology; technologies operate on a level playing field • Supports static efficiency	• Might not sufficiently trigger technology diversification and innovation • Might not trigger cost reductions over time thus not supporting dynamic efficiency
MS allowed to define sub-targets for specific fuels or technologies	• Technologies could be supported due to their specific market maturity • Supports dynamic efficiency (incl. technology diversification, innovation) • Allows Member States to design the obligation scheme according to the technology maturity and potentials of RES-HC in the respective country	• Would introduce an unlevelled playing field • Overall target might not be reached at lowest possible overall cost (conflict with static efficiency) • Increases complexity as compliance against different targets must be proven • Leads to fragmented markets in case of a certificate scheme
No sub-targets but MS allowed to introduce weighing factors	• Weighing factors allow for supporting technology diversification and innovation while the RES-HC technologies compete on an "artificial" level playing field • Allows Member States to design the obligation scheme according to the technology maturity and potentials of RES-HC in the respective country • Despite having sub-targets possibility to have one uniform certificate market	• Increases complexity • Weighing factors need to be determined • Overall target might not be met as different technologies deliver differently weighed contributions • Overall target might not be reached at lowest possible overall cost

Source: Öko-Institut e.V.

2.3.2.2.8 Reference for the obligation?

Options are

- *Energy content of fuel that is subject to the obligation (which would mean that the obligation target would refer to the energy content of the fuel that is subject to the obligation, e.g. 0,2 kWh final energy from RES-HC per kWh final energy supplied)*
- *Carbon content of fuel that is subject to the obligation (which would mean that the obligation target would refer to the carbon content of the fuel that*

is subject to the obligation, e.g. 2,5 kWh final energy from RES-HC per 1 kg carbon in the fuel supplied)

Table 47 Pros and Cons of different options to set the reference of the obligation

Options	Pros	Cons
Energy content of fuel subject of the obligation	• Easy to understand as all fuels (disregarding their specific climate impact) would be treated in the same way	• Would not reflect the different climate impact of different fuels (e.g. 1 kWh final energy from gas and coal differ in their climate impact roughly by a factor of 2)
Carbon content of fuel subject of the obligation	• Would reflect the different climate impact of different fuels • Since the obligation on gas supply would be "weaker" than on the supply of oil or coal, there would be an additional incentive in the fuel market to switch to fuels with less carbon intensity.	• Requires the use of generic carbon factors that might differ among Member States. • Requires to convert energy in carbon content • From the end consumer perspective the option is similar to a scheme with separate targets for different fuels (e.g. gas is connected to another RES-HC target than heating oil)

Source: Öko-Institut e.V.

2.3.2.2.9 Eligible RES fuels and RES-HC technologies to be accounted for?

Options are

- *All RES fuels and RES-HC technologies excl. RES-E*
- *All RES fuels and RES-HC technologies incl. RES-E*
- *Limited to RES fuels (biomass or RES DHC)*

Table 48 Pros and Cons of different options which RE sources and technologies are eligible under the obligation scheme

Options	Pros	Cons
All RES fuels and RES-HC technologies excl. RES-E	• Supports "classical" RES-HC technologies (e.g. solar thermal, heat pumps, bioenergy) • Might prevent heating and/or cooling technologies that might not been considered to be compatible with the long-term targets (e.g. electrical resistance heating) • Might stimulate innovation regarding non-electric cooling • Would be in line with methodology Eurostat is applying for determining the RES-HC share	• Might mainly incentivize biomass use in existing inefficient natural gas, oil and coal boilers as well as co-firing in industrial plants • Might hinder market uptake of more innovative RES-H/C and thus a shift to more efficient technologies • Does not reflect technology neutrality (exclusion of RES-E) • Would constitute a barrier against PtH • Might be another barrier for fulfilling the obligation with RES-C

All RES fuels and RES-HC technologies incl. RES-E	• Reflects technology neutrality • Depending on the definition for renewable cooling[137] this might include an important option for delivering RES-C	• Might mainly incentivize biomass use in existing inefficient natural gas, oil and coal boilers as well as co-firing in industrial plants • Might hinder market uptake of more innovative RES-H/C and thus a shift to more efficient technologies • Requires to determine the RES share in electricity mix • Requires clear rules in which sector (electricity of heating/cooling) RES-E for heating/cooling is accounted for (avoid double counting) • Including RES-E might trigger heating and/or cooling technologies that might not been considered to be compatible with the long-term targets (e.g. electrical resistance heating) • Might increase the pressure on extending RES-E capacities at the expense of "classical" RES-HC technologies • Requires to sort out relationship to existing support instruments for RES-E • Would be in conflict with Eurostat methodology to determine RES-HC share (electricity not included)
Limited to RES fuels (biomass or RES DHC)	• Might be easier to implement since no mechanism would be required to include decentralised technologies • Does not require to convert capacity into energy (see next section)	• Would cover only a limited segment of the RES-HC technology portfolio • Would not support technology diversification • Would cause problems in Member States with limited biomass resources

Source: Öko-Institut e.V.

The selection which option to prefer will amongst others depend on the cost-benefit ratio for allowing RES-E to deliver contributions to the obligation. Furthermore including RES-E would require a thorough analysis to which extent onsite RES-E production should be distinguished from RES-E grid delivery and to which extent self-consumption vs net-metering should be considered when determining the RES-E share that should be accounted towards the obligation target.

2.3.2.2.10 How to determine eligible RES production ("converting" capacity to energy)?

This design element is about options to calculate the amount of heat a RES-HC installation is delivering into the obligation scheme. The mechanism applied must ensure that the calculated or metered output of a RES-HC installation is accurate, replicable and not open to abuse. This will be vital in protecting the scheme from gaming and fraud. There are two main choices, either to meter (measure the heat production through a meter) or deem this heat (calculate the likely the level of

[137] So far there is no overall accepted definition for renewable cooling (see Kenkmann & Bürger 2012).

heat production based on a set of plant specific parameters such as the capacity of the chosen technology, location, etc.).

Options are

- *Measure output disregarding technology and size*
- *Small scale: deeming; large scale: measuring*
- *Intermittent (inflexible) technologies (e.g. solar thermal, PV): deeming, flexible technologies (e.g. heat pumps, biomass): measuring*
- *Deeming output disregarding technology and size*

Table 49 Pros and Cons of different options how to best determine the eligible RES production

Options	Pros	Cons
Measure output disregarding technology and size	• Most accurate option	• Requires metering output of each single installation • Large (inadequate?) effort for small scale installations (e.g. solar collectors on single family houses)
Small scale: deeming; large scale: measuring	• Compromise between accuracy and complexity • Only large scale installations would be required to meter output	• Less accuracy for small scale installations • No control mechanism if RES-HC installation does not work properly
Intermittent (inflexible) technologies: deeming flexible technologies: measuring	• Compromise between accuracy and complexity • Only those installations would be required to meter output for which the output is a result of the specific operation mode of the plant in question	• Less accuracy for intermittent technologies • No control mechanism if RES-HC installation for which output is deemed does not work properly
Deeming output disregarding technology and size	• Option with lowest complexity	• At least for large scale installation deeming could lead to rather false results.

Source: Öko-Institut e.V.

If RES-E is eligible to contribute to the obligation, additional rules are necessary depending on whether only self-consumption vs net-metering of onsite RES-E is eligible or whether also RES-E grid-delivery will be accepted.

2.3.2.2.11 Flexibility measures (obligation tradable)?

Options are

- *No exchange of obligation between obliged parties*
- *MS allowed to open system for bilateral exchange of obligation*
- *MS allowed to introduce certificate trade, trade only national*
- *Introduction of certificate trade, trade EU wide*

Table 50 Pros and Cons of different flexibility measures

Options	Pros	Cons
No exchange of obligation between obliged parties	• Easy to implement • All obliged companies need to act	• Very reduced flexibility • Option might be on cost of static efficiency
MS allowed to open system for bilateral exchange of obligation	• Would support static efficiency as RES potentials would in principle be exploited at lowest costs	• To a certain extent non-transparent due to bilateral trade (no uniform market place) • Increases complexity in administering the scheme
MS allowed to introduce certificate trade, trade only national	• Would support static efficiency as RES potentials would in principle be exploited at lowest costs • Higher transparency compared to option 2	• Requires implementation of national certificate system • Increases complexity in administering the scheme • Reduced liquidity compared to option 4 • Interaction with GoO for RES (e.g. RES-E) needs to be clarified • Interaction with existing support schemes (e.g. for RES-E) needs to be clarified
Introduction of certificate trade, trade EU wide	• Static efficiency higher than in option 3 as potentials could be exploited EU wide • Option with the highest market liquidity • Higher cost efficiency as only one certificate scheme needs to be put in place	• Fair balance between regional allocation of costs and benefits? • Requires implementation of a EU-wide certificate scheme • Interaction with GoO for RES (e.g. RES-E) needs to be clarified • Interaction with existing support schemes (e.g. for RES-E) needs to be clarified

Source: Öko-Institut e.V.

2.3.2.2.12 How to fix penalties for non-compliance resp. buy-out price?

Options are

- *Fixing penalty level/buy-out price left to Member States*
- *Minimum penalty/buy-out price set by the EU*

Table 51 Pros and Cons of options to establish penalties/buy-out price

Options	Pros	Cons
Fixing penalty level/buy-out price left to Member States	• Would allow Member States to set penalty/buy-out price level according to country specific compliance cost (provided only national trade available)	
Minimum penalty/buy-out price set by the EU	• Uniform EU wide obligation would require uniform penalty/buy-out price	

Source: Öko-Institut e.V.

2.3.2.2.13 Extension to the transport sector (joint obligation for RES-HC and RES-T)?

Options are

- *Obligation limited to RES-HC sector*
- *Obligation covering RES-HC and RES-T (joint obligation)*

Table 52 Pros and Cons of extending the obligation to the RES-T sector

Options	Pros	Cons
Obligation limited to RES-HC sector	• Less complex than option 2 • Ensures RES deployment in both sectors	• Smaller (certificate) market than in joint obligation • Might lead to higher overall costs than in a joint approach
Obligation covering RES-HC and RES-T	• Broader scope that potentially ensures better cost efficiency for achieving the target • Increases market liquidity	• No appropriate measure to ensure sector specific targets • Different cost levels for exploiting the RES potentials in both sectors might result in an unbalanced sector allocation of measures (e.g. obligation mainly fulfilled by RES investments in one of the two sectors) • Unbalanced technology portfolio (transport: limited to bioenergy, heating/cooling: additional technology options) • Requires rules how to include technologies or energy sources only used in one sector (e.g. DH from other RES than bioenergy, solar thermal, ambient heat etc.) • Increased complexity

Source: Öko-Institut e.V.

2.3.2.3 RES-HC use obligation on buildings

2.3.2.3.1 Intro to long-list of design elements

Another potential measure is a use obligation on buildings. Under such a system building owners are obliged to guarantee that a minimum share of their annual heating and cooling demand is supplied by RES. Use obligations have already been introduced by the Renewable Directive. Art 13 (4) requires Member States to implement *in their building regulations and codes* […] *the use of minimum levels of energy from renewable sources in new buildings and in existing buildings that are subject to major renovation*. While this obligation was due by the end of 2014 only few Member States had implemented such use obligations by the end of 2013 (Atanasiu et al. 2014).

It should be considered that in the midterm Art. 13 (4) as it currently stands will lose its effectiveness as from 2019/2021 onwards all new buildings need to comply with the nearly zero energy (nZEB) standard that in most Member States should include heat/cold production from RES-HC. However, Art 13 (4) is also addressing existing buildings that are subject to major renovation. For this building type Art. 9 of the EPBD does not call for the nZEB standard.

Table 53 gives an overview of the different variants Member States could choose when implementing national building obligations. Furthermore several options are considered of how the RED could strengthen the impact of the existing provision.

As the measure is addressing the building sector the interaction with the EPBD and also EED needs to be thoroughly taken into account.

Table 53 Design variants for a use obligation

Design element	Possible options
Whom to oblige?	• Building developers • Building owners • Installers • Variants with third party role in implementation of these obligations (e.g. through energy suppliers like DHC system operators or ESCOs)
Target (minimum share) setting on which level?	• Minimum share for all obliged parties EU wide set by EU • Target setting left to Member States • Target setting left to Member States with a minimum starting share of x%
Development of target (minimum share)?	• Fixed target • Dynamic (increasing) target over the time
Sub-targets for sub-sectors?	• One target for all sub-sectors (residential/commercial, new/existing buildings) • MS allowed to define sub-targets for residential/commercial • MS allowed to define sub-targets for new buildings/existing buildings
Eligible RES fuels and RES-HC technologies to be accounted for?	• All RES fuels and RES-HC technologies excl. RES-E • All RES fuels and RES-HC technologies incl. RES-E
What triggers the obligation?	• Construction of a new building • Major renovation of an existing building • Replacement of an existing boiler • Fixed deadline until when obligation must be met
Sub-targets for specific RES fuels or RES-HC technologies?	• No sub-targets (uniform minimum share for all RES fuels and RES-HC technologies) • MS allowed to define sub-targets for specific fuels or technologies
Alternative measures (e.g. CHP, efficiency) eligible?	• Alternative measures not eligible • Alternative measures eligible • Overcompensation by alternative measures
Flexibility measures?	• No flexibility measures • Bilateral exchange of obligation between obliged parties (only national) • Exchange of obligation via certificate (national) scheme • Payment of compensation fee if no RES installed

Source: Öko-Institut e.V.

2.3.2.3.2 Whom to oblige?

Options are

- *Building developers*
- *Installers*
- *Building owners*

- *Variants with third party role in implementation of these obligations (e.g. through energy suppliers like DHC system operators or ESCOs)*

Table 54 Pros and Cons of different obliged parties

Options	Pros	Cons
Building developers	• For new properties developers often are planning the heating and cooling systems • Allows for building up expertise at an aggregated level	• In existing buildings boilers often are replaced without involvement of developers/architects
Installers	• RES-HC involves technologies that have to be installed • Allows for building up expertise at an aggregated level	• In some countries decentralised heating technology can be installed single-handedly without involving any installer
Building owners	• Involves those who finally are responsible for running the heating system	• In case of new properties buildings often are constructed by developers while the final owner is not involved in the planning process • Each building owner needs to get informed and to take an informed decision (transaction costs)
Variants with third party role in implementation of the obligation (e.g. through energy suppliers like DHC system operators or ESCOs)	• Allows to involve third parties in order to tackle financing barrier (reducing social barriers) • Third parties might provide specific expert knowledge • Might allow for exploiting economies of scale	• Increases complexity by involving further parties

Source: Öko-Institut e.V.

2.3.2.3.3 Target setting on which level?

Options are

- *Minimum share for all obliged parties EU wide set by EU*
- *Target setting left to Member States*
- *Target setting left to Member States with min starting share of x%*

Table 55 Pros and Cons of different options how the target (minimum share) is set

Options	Pros	Cons
Minimum share for all obliged parties EU wide set by EU	• Harmonised approach for all Member States • Minimum share would ensure minimum RES-HC deployment • Minimum share would oblige Member States with stagnant or even declining RES-HC development to strengthen their efforts	• Would not reflect specific Member State context (especially climate conditions) • Could prevent "ambitious" Member States to set targets that exceed the minimum share set by the EU
Target setting left to Member States	• Allows Member States to set targets according to their specific national context (e.g. climate conditions) • "Ambitious" Member States could set ambitious targets	• Member States might set very low minimum targets -> obligation might be rather ineffective
Target setting left to Member States with min starting share of x%	• Minimum share would ensure minimum RES-HC deployment • Member States would be allowed to set more ambitious targets • Minimum share would oblige Member States with stagnant or even declining RES-HC development to strengthen their efforts	• Minimum share might be rather low to be accepted by all Member States

Source: Öko-Institut e.V.

2.3.2.3.4 Development of target (minimum share)?

Options are

- *A fixed target (target of x% that stays the same for the duration of the Directive)*
- *Dynamic (increasing) target over the time (Directive defines how the target increases over the time)*

Table 56 Pros and Cons of target development

Options	Pros	Cons
Fixed target	• Might be in line with a static nzeb standards defined by Member States according to the EPBD	• Does not reflect the need for increasing shares of RES-HC supply in the building sector • Risk of lock-in at low RES-HC levels
Dynamic (increasing) target over the time	• Reflects the need for increasing RES-HC penetration rates in order to achieve the building sectors long-term targets • Reduces the risk of lock-in at low RES-HC levels	• Might increase investment burden (the higher the minimum share the higher the investment costs) • Might be in conflict with a static nzeb standard defined by Member States • Requires to develop trajectory for RES-HC development in buildings that justifies the dynamic

Source: Öko-Institut e.V.

For new buildings defining the minimum RES-HC share needs to be thoroughly aligned to the nzeb standards that Member States need to implement following Art. 9 of the EPBD.

2.3.2.3.5 Sub-targets for sub-sectors?

Options are

- *One target for all sub-sectors (residential/commercial, new/existing buildings)*
- *MS allowed to define sub-targets for residential/commercial*
- *MS allowed to define sub-targets for new buildings/existing buildings*

Table 57 Pros and Cons of the implementation of sub-targets for sub-sectors

Options	Pros	Cons
One target for all sub-sectors (residential/ commercial, new/existing buildings)	• Option with lowest complexity	• Identical target for all sub-sectors might lead to different cost burdens per sub-sector (e.g. compliance costs for new buildings lower than for existing buildings)
MS allowed to define sub-targets for residential/commercial	• Many commercial buildings have other consumption patterns than residential buildings (e.g. higher cooling demand, higher electricity consumption) and might be more or less suitable for the use of RES-HC	• Might slightly increase the complexity to manage the obligation scheme
MS allowed to define sub-targets for new buildings/existing buildings	• For some technologies (especially solar thermal) higher RES-HC shares can be achieved in new buildings due to higher energy standards	• Might slightly increase the complexity to manage the obligation scheme

Source: Öko-Institut e.V.

2.3.2.3.6 Eligible RES fuels or RES-HC technologies to be accounted for?

Options are

- *All RES fuels and RES-HC technologies excl. RES-E*
- *All RES fuels and RES-HC technologies incl. RES-E*

Table 58 Pros and Cons of different options which RE sources and technologies are eligible under the use obligation

Options	Pros	Cons
All RES fuels and RES-HC technologies excl. RES-E	• Supports "classical" RES-HC technologies • Might prevent heating and/or cooling technologies that might not been considered to be compatible with the long-term targets (e.g. electrical resistance heating) • Would be in line with methodology Eurostat is applying for determining the RES-HC share	• Eligibility of RES fuels under a use obligation in existing buildings might mainly incentivize biomass use in existing inefficient natural gas, oil and coal boilers • Does not reflect technology neutrality • Some commercial building types (e.g. large production halls with radiant heating lack options to use "classical" RES-HC technologies • Potential problems to deliver minimum shares of RES-C
All RES fuels and RES-HC technologies incl. RES-E	• Reflects technology neutrality when it comes to accounting towards the minimum share • Depending on the definition for renewable cooling this might include an important option for delivering RES-C • Some commercial building types (e.g. large production halls with radiant heating lack options to use "classical" RES-HC technologies	• Eligibility of RES fuels under a use obligation in existing buildings might mainly incentivize biomass use in existing inefficient natural gas, oil and coal boilers • Requires clear rules in which sector (electricity of heating/cooling) RES-E for heating/cooling is accounted for (avoid double counting) • Including RES-E might trigger heating and/or cooling technologies that might not been considered to be compatible with the long-term targets (e.g. electrical resistance heating) • Requires to determine the RES share in electricity mix • Might increase the pressure on extending RES-E capacities at the expense of "classical" RES-HC technologies • Would be in conflict with methodology Eurostat is applying for determining the RES-HC share (electricity not included)

Source: Öko-Institut e.V.

Including RES-E would require a thorough analysis to which extent onsite RES-E production should be distinguished from RES-E grid delivery and to which extent self-consumption vs net-metering should be considered when determining the RES-E share that should be accounted towards the required minimum RES-HC share.

2.3.2.3.7 What triggers the obligation?

The trigger of the use obligation is one of the key design elements which has a very significant impact on the effectiveness of the measure. With Art 13 (4) the RED has already implemented a use obligation in the building sector. However, only few countries have implemented such obligations. This might be due to several reasons, e.g.

- the Directive does not specify the RES technologies needed to comply with the regulation

- the somewhat unclear legal interpretation of the insertion […] or by other means with equivalent effect, where appropriate […] in Art 13 (4)

Options are

- *Construction of a new building*
- *Major renovation of an existing building*
- *Replacement of an existing boiler*
- *Fixed deadline until when obligation must be met*

The first two options are already covered by Art 13 (4) of the RED. Member States should have implemented such obligations by 31.12.2014. However the options could be strengthened by reinforcing Art 13 (4) specifying that the obligation should apply for all addressed buildings without exemption.

Table 59 Pros and Cons of different options of what triggers the use obligation

Options	Pros	Cons
Construction of a new building	• Use of RES-HC technologies in new buildings is already rather common in a couple of Member States • RES-HC technologies could be considered from the very beginning of the planning phase • Whole heating system (incl. storage, distribution) could be adapted to the needs of RES-HC technology in question (e.g. low temperature distribution system)	• New building rate is rather low in many Member States resulting in a rather limited effectiveness • nzeb standards for new buildings might already involve minimum RES shares leading to an potential overlap between RED and EPBD
Major renovation of an existing building	• Major renovations often also involve the heating system • Major renovation may allow for also adapting the whole heating system (incl. storage, distribution) to the needs of RES-HC technology in question	• Rate of major renovations as defined by the EPBD is rather low in many Member States resulting in a rather limited effectiveness • May impact property rights of building owners
Replacement of an existing boiler	• Rather effective since all buildings would be effected over the time	• How to deal with single-storey heating systems? (might need to be excluded from the obligation) • May impact property rights of building owners • Might have social implications due to high initial investment costs • Often boilers are only replaced when the existing boiler breaks down (e.g. in the heating season); fast replacement decisions might be in conflict with the time required to take an informed decision in favor of a RES-HC system • Obliged parties might step back from

		• replacing a boiler in order to avoid the use obligation • Efficiency of RES-HC technologies (especially heat pumps) depends on distribution system (e.g. temperature level) but boiler replacement generally does not include an adaptation o the distribution system
Fixed deadline until when obligation must be met	• Rather effective since all buildings would be effected over the time • Buildings with single-storey heating systems could be switched to central heating (incl. RES-HC) in a coordinated approach • Replacement decision could be better prepared since each building owner would know in advance until when he needs to fulfil the obligation the latest.	• Might have social implications due to high investment costs • Obliged parties might wait for fulfilling the obligation until the deadline. • Efficiency of RES-HC technologies (especially heat pumps) depends on distribution system (e.g. temperature level) but boiler replacement generally does not include an adaptation o the distribution system

Source: Öko-Institut e.V.

2.3.2.3.8 Sub-targets for specific RES fuels or RES-HC technologies?

Options are

- *No sub-targets (uniform minimum share for all fuels and technologies)*
- *MS allowed to define sub-targets for specific fuels or technologies*

Table 60 Pros and Cons of the implementation of sub-targets for different technologies

Options	Pros	Cons
No sub-targets (uniform minimum share for all fuels and technologies)	• Does not give preference to any specific technology; technologies operate on a level playing field • Supports static efficiency	• Might not sufficiently trigger technology diversification and innovation • Might not trigger cost reductions over time thus not supporting dynamic efficiency
MS allowed to define sub-targets for specific fuels or technologies	• Technologies could be supported due to their specific market maturity • Supports dynamic efficiency (incl. technology diversification, innovation)	• Would introduce an unlevelled playing field • Overall target might not be reached at lowest possible overall cost (conflict with static efficiency)

Source: Öko-Institut e.V.

2.3.2.3.9 Alternative measures eligible?

Options are

- *Alternative measures not eligible*
- *Alternative measures eligible*
- *Overcompensation by alternative measures (e.g. alternative measure must lead to higher GHG-reductions than is being achieved by the minimum RES-HC requirement)*

Table 61 Pros and Cons of the eligibility of different types of alternative measures

Options	Pros	Cons
Alternative measures not eligible	• Clear focus on RES-HC technologies thus supporting the effectiveness regarding RES-HC deployment • No conflict with EED	• Might require exemption rules in hardship cases (RES-HC installation not feasible) which would lead to considerable administrative burden
Alternative measures eligible	• Provides obliged parties more flexibility (especially in the commercial sector) • Could serve as some form of cost control mechanism if fulfilment by RES-HC might led to very high costs	• Reduced effectiveness regarding RES-HC deployment • Needs clarification how to avoid conflict with the EED (especially Art. 7 and 14)
Overcompensation by alternative measures	• Provides obliged parties more flexibility while underlining that RES-HC is the lead-technology under the obligation • Could serve as some form of cost control mechanism if fulfilment by RES-HC led to very high costs	• Reduced effectiveness regarding RES-HC deployment • Needs clarification how to avoid conflict with the EED (especially Art. 7 and 14)

Source: Öko-Institut e.V.

2.3.2.3.10 Flexibility measures?

Options are

- *No flexibility measures*
- *Bilateral exchange of obligation between obliged parties (only national)*
- *Exchange of obligation via (national) certificate scheme*
- *Payment of compensation fee if no RES installed*

Table 62 Pros and Cons of the introduction of different types of flexibility measures

Options	Pros	Cons
No flexibility measures	• Easy to implement	• Would require exemption rules in hardship cases which would lead to considerable administrative burden
Bilateral exchange of obligation between obliged parties (only national)	• Would support static efficiency as RES potentials would be exploited at buildings with best conditions • Would avoid administrative burden to deal with hardship cases	• Bilateral exchange between building owners would require third parties (broker) to facilitate the exchange • Increases complexity in administering the scheme
Exchange of obligation via certificate (national) scheme	• Would support static efficiency as RES potentials would be exploited at buildings with best conditions • Would avoid administrative burden to deal with hardship cases	• Requires implementation of a certificate system • Certificate trade between building owners might require third parties (broker) to facilitate the trade • Increases complexity in administering the scheme
Payment of compensation fee if no RES installed	• Easy to implement • Would avoid administrative burden to deal with hardship cases • Compensation fee could be used for supporting specific innovative RES-HC technologies	• Requires rules how to fix the compensation fee (e.g. in the sense of a penalty or in the sense of an equal alternative this being aligned to the specific costs of fulfilling the obligation by RES-HC)

Source: Öko-Institut e.V.

2.3.3 Detailed analysis of selected policy approaches

In this section a detailed analysis of different approaches will be carried out. First, different options will be investigated how to improve the competition and third party access rights for RES to DHC systems. The second option to be further analysed will be RES-HC obligations. Finally, a rough estimate of the impact of a RES-HC use obligation on buildings will be provided.

For part of the analysis, the following evaluation criteria will be applied (see also Bürger & Varga 2009).

Table 63 Evaluation criteria

Criteria	Explanations
Effectiveness	• Extent to which the policy options are capable to achieve the overarching objective to enhance the market penetration of RES-HC technologies and thus to increase the share of RES-HC in the European heating and cooling sector • Extent to which the policy options are capable to achieve specific objectives in the sector targeted by the measure (e.g. RES deployment in DHC) • Degree of the estimated quantitative impact in terms of

	additional RES-HC deployment stimulated by the measures
Static efficiency	• Extent to which the policy options are capable to achieve the objectives at the lowest cost (considered from a short-term perspective)
Dynamic efficiency	• Degree to which the instrument will trigger innovation, technology diversity and cost reductions over time
Administrative efficiency	• Degree of transaction and administrative costs incurring for authorities and private stakeholders

Source: Öko-Institut e.V.

2.3.3.1 Provisions on DHC and storage infrastructure to expand the share of renewable energy sources in DHC networks

2.3.3.1.1 Short list of potential provisions on DHC and storage infrastructure to expand the share of renewable energy sources in DHC networks

The following table illustrates the variants of potential DHC provisions that will be further analysed.

Table 64 Design variants for potential DHC provisions

Regulations for preferential third-party DHC grid access for RES-HC
Regulations for preferential third-party DHC grid access for RES-HC including a purchase obligation for RES-HC fed into the DHC grid
Provisions that Member States implement a national regulatory authority for DHC
Provision that Member States oblige DHC companies to certify their systems' performance and/or to implement community/district/campus/city/label systems that show the energy of a given geography

Source: Öko-Institut e.V.

2.3.3.1.2 Regulations for preferential third-party DHC grid access for RES-HC

Functionality

DH systems in the EU are often characterised by vertical integration involving generation, distribution and supply. As a result it is mainly depending on the utility operating the DH grid whether RES-HC generation in included.

In this option, Member States would have to adopt regulations in order to allow third parties to use the existing DHC grids for supplying customers with RES-HC. The obligation could also be extended to waste heat from industrial processes or CHP. Thus, the grids would be opened to be used by parties other than the integrated grid operator. Grid operators would be required to publish technical specifications for connecting and using the DHC grid while these rules need to be non-discriminatory. Furthermore, grid charges must be transparent and non-discriminatory.[138] Priority grid access for RES-HC could be arranged by two different models, the single-buyer model and the network access model in which

[138] A variant of this model is already implemented in Poland (preferential third-party DHC grid access for RES-HC). However it is regulated that the price level of the DHC system must not increase due to the RES-HC contribution to the system.

independent heat producers use the DHC grid in order to supply heat or cold to their own customers (Korhonen 2014).

Table 65 Functional evaluation of the option "Preferential RES-HC third-party DHC grid access"

Criteria	Evaluation
Effectiveness	The option would broaden the range of investors potentially investing in additional RES-HC capacity. However it is unclear how much additional capacity would be triggered if this measure was implemented isolated (without flanking measures, e.g. providing financial support). The impact of implementing preference access rights for RES-HC is mainly depending on • the attractiveness of the conditions to connect (technically, grid charges, provision of reserve capacity, risk allocation etc.) • the availability of customers willing to purchase the additional RES-HC. Considering the rather long lead times for planning and licensing DHC systems in the short-term the impact of the measure would be restricted to existing DHC systems which make up for about 10-15% of the current European heat market for buildings in the residential and service sector while the corresponding market share for the industrial sector is about 9% (Aalborg et al. 2013; Szabó, L. et al. 2015). However, in some Member States DHC shares are in the range of 40-60% (e.g. DK, FI, LT, LV, SE).[139] Assuming that the measure would trigger the RES contribution in existing DHC systems to be increased by 20% roughly additional 2 Mtoe RES-HC would enter the heating and cooling market which would add to the 87,5 Mtoe RES-HC in 2014 (Eurostat 2016a).[140]
Static efficiency	Diversification of the heat producers connected to the DHC grid might require investments in upgrading the grid infrastructure. An allocation mechanism needs to be applied how to distribute these additional costs among the customers supplied by the DHC system. If the measure stimulates many RES-HC to access the DHC system and if increasing demand within the DHC does not compensate for the additional RES-HC production, existing non-renewable heat and/or cold producers will be replaced by the new entrants. This might lead to stranded investments if the replaced capacities had not been fully amortised. Consequently the question arises of how to allocate the respective costs among the system participants (should these costs be integrated in the grid charge or should they be assigned to production (Wissner 2014)). And there might be a trade-off between minimising the economic impact at the production side (which might support taking gas-fired CHP DHC out of the market) and maximising the ecological impact (which would be supported if heat from inefficient coal-fired heat only plants was replaced).
Dynamic efficiency	Might stimulate technology diversification within an existing DHC system and trigger innovation and technology diversification with regard to RES-HC production (e.g. large solar collectors, large heat pumps) and grid infrastructure.

[139] In the EU-28 the RES share in DHC is currently in the range of 24% (Fraunhofer ISI et al. 2016).

[140] According to (Fraunhofer ISI et al. 2016) in 2012 about 480 TWh of the final energy demand for heating and cooling came from DHC from which about 24% was generated by renewables. If the RES share was increased by 20% until 2030 (while the overall DHC volume stays the same), the RES share would increase to 28% corresponding to additional RES-HC generation of about 2 Mtoe.

Administrative efficiency	The option increases the costs for administering and regulating DHC systems: Existing DHC systems are rather heterogeneous regarding their technical parameters which calls for defining system specific technical requirements RES-HC would have to meet for grid access. In addition many DHC systems lack clear information about the technical requirements for third-party grid usage (requirements regarding feed-in and offtake from the grid, provision of reserve capacity, risk allocation etc.). All producers using the network must be coordinated, grid charges must be determined. Finally, priority grid access for RES-HC might require greater unbundling and/or regulatory oversight of DHC systems.

Source: Öko-Institut e.V.

2.3.3.1.3 Regulations for preferential third-party DHC grid access for RES-HC including a purchase obligation for RES-HC fed into the DHC grid

Functionality

In addition to priority grid access for RES-HC producers the grid operators could be obliged to purchase the RES-HC fed into the DHC grid. This option would correspond with the single buyer model. One important element of such a purchase obligation would be the mechanism how the price is set for RES-HC. Fixing a minimum price higher than the average market price for DHC would correspond to an economic support for RES-HC producers.

Table 66 Functional evaluation of the option "Regulations for preferential RES-HC third-party DHC grid access including a purchase obligation"

Criteria	Evaluation
Effectiveness	Higher effectiveness than in the option above: The purchase obligation increases investment security since the RES-HC producer has a) a predictable income stream and b) is not obliged to search own customers and negotiate supply contracts with them. The measure has the potential to stimulate additional RES-HC capacity if the minimum purchase price is high enough. However, similar to above option the short-term effectiveness is limited to the existing DHC market share. Assuming that the measure would trigger the RES contribution in existing DHC systems to be increased by 30% roughly additional 3 Mtoe RES-HC would enter the heating and cooling market which would add to the 87,5 Mtoe RES-HC in 2014 (Eurostat 2016a).
Static efficiency	Similar to above option: The measure might require investments in upgrading the grid infrastructure to cope with newly connected RES-HC producers. Furthermore stranded investments could occur in case conventional DHC production is driven out of the market. Here again the trade-off between minimising the economic impact and maximising the ecological impact needs to be thoroughly taken into account. A fixed minimum price for RES-HC production higher than the average market price incurs an increase of the DHC price level in the system. This effect could be even higher if RES-HC priority third-party grid access was motivating many small scale installations to get connected (provided they fulfil the technical requirements for grid access). Multiple small scale producers might lead to a higher DHC price level than if only few but larger RES-HC installations delivered the same volume of RES-HC.

Dynamic efficiency	Similar to above option while dynamic efficiency could be even higher if the fixed minimum price was that high that innovation was triggered or a technology specific minimum price was set that reflects the market maturity of different RES-HC technologies.
Administrative efficiency	Similar to above option

Source: Öko-Institut e.V.

2.3.3.1.4 Provisions that Member States implement a national regulatory authority for DHC

Functionality

In this option Member States would be obliged to implement independent national regulators (where such regulators are not in place) or to strengthen the competence of existing DHC regulators in order to monitor the activities on the DHC market. The overall task of the regulatory authority would be to regulate grid-access and pricing. In concrete terms the regulatory authority would have to ensure that tariffs applied by DHC suppliers are transparent, publicly available and comparable with the tariffs and prices of other district heating and cooling companies and of individual heating supply options. The authority would have to ensure that DHC tariffs are fair and competitive to alternative heating and cooling options. In the sense of a price control the authority would be entitled to define maximum thresholds for the difference of DHC prices and the price of competing non-grid-based technologies.

The regulatory authority would further be responsible for monitoring whether priority producers (e.g. RES-HC producers) have non-discriminatory access to DHC grids and (if applicable) a purchase obligation works out.

Furthermore, the regulatory authority would have to control and avoid that DHC suppliers cross-subsidise specific areas (e.g. cross-subsidisation of gas price by DH price, "captured" DH customers need to pay or cross-subsidisation of other stages of the DHC value chain in order to force competitors out of the market), to protect consumer rights (e.g. by ensuring that consumer complaints are dealt with in a fair way or by providing tools that allow for an easy comparison of different heating and cooling supply technologies) and to ensure that investment plans of DHC grid operators and electricity/gas DSOs are coordinated.

Table 67 Functional evaluation of the option "National Regulatory Authority for DHC"

Criteria	Evaluation
Effectiveness	DHC regulation basically combines several aspects, in particular grid access, pricing and market transparency, which theoretically all can have an impact on the RES-HC share in DHC systems. Grid access: An incentive for connecting additional RES-HC to existing DHC systems might result from priority grid access with or without purchase obligation. For that reason the effectiveness of the option might be similar to above options. Pricing: The effectiveness of the option might potentially be further increased by regulating the grid charge third parties would have to pay. Regulating grid charges would aim at protecting RES-HC market entrants from unjustified high fees. Regulating end-user prices might further

	incentivise investors in RES-HC as they can trust in being protected from discrimination by incumbent market players. Market transparency: From the consumer perspective a higher market transparency would affect the effectiveness of the option if the transparency of life-time costs of DHC connection compared to alternative heating and cooling options led to more customers opting for RES-HC that is supplied through DHC. However, such decisions only occur when constructing a new building or at the end of the technical lifetime of an existing heating system. Once a decision in favour of a heating system has been taken the customer is more or less locked in and will not change the system for a rather long period in time. Although all three aspects might incentivise further investments in RES-HC DHC it is impossible to provide a quantitative estimate of the impact of the policy option.
Static efficiency	It is difficult to evaluate whether the establishment or strengthening the competences of a regulatory authority would be a policy measure to achieve the objectives (increase of RES-HC share in DHC) at the lowest cost. In any case increasing market transparency and pricing control are elements that can help to avoid too high prices on a market that in most Member States is not subject to effective competition with alternative heating and cooling options (Wissner 2014).
Dynamic efficiency	Might stimulate technology diversification and innovation to the extent to which the conditions for priority grid access and minimum purchase price are sufficiently attractive for heating technology options to enter the market.
Administrative efficiency	The option involves controlling grid access, price regulation (end use price and/or grid charges in Member States that do not have such regulation yet) and the introduction of several tools that aim at enhancing market transparency. Establishing a regulatory authority that would be entitled to cover these tasks causes administrative costs. At the side of the regulated market actors additional administrative burden would also occur to a certain extent.

Source: Öko-Institut e.V.

2.3.3.1.5 Provision that Member States oblige DHC companies to certify their systems' performance and/or to implement community/district/campus/city-label systems that show the energy of a given geography

Functionality

The option foresees an obligation of all DHC companies to certify their DHC systems' performance based on a common standard (e.g. in CEN process, CEN/TC 228 standard pr EN 15316-4-5- District heating and cooling) including indicators such as the energy production mix (especially the RES share in the system) as well as the system efficiency (including generation and transmission efficiency). The certification/labelling scheme should also involve an assessment of possible improvements of the overall system performance taking into account the requirements of Art. 14 EED. The indicators should be selected as to allow customers to compare the environmental performance of DHC supply with alternative non-grid based heating options. A potential set of criteria and methodology how to assess the energy and environmental performance of DHC systems has been developed by the Ecoheat4cities project (http://ecoheat4cities.eu/en/Results/Results/). The labelling scheme could be combined with a right of consumers to disconnect from a DHC system if the system's energy performance is lower than what a consumer could achieve by alternative means (disconnection right).

The second element of this measure is a labelling approach for certain geographic areas. That could be communities, districts, cities or a campus. Such a label would reflect the performance of a given geography. Indicators could include energy efficiency, the share of renewable to the electricity or heating/cooling mix, efficiency, CO_2 emissions caused by the activities in the geography concerned etc. Unlike the DHC certification the green community/district/city/campus label would not automatically address DHC suppliers. The label could also address or be applied for by a political body or a public authority in the given geography. Furthermore the labelling indicators would not only cover the overall heating system but could also include the efficiency of the demand side (e.g. energy standard of buildings, energy intensity of industry and the service sector in the region etc.), the performance of electricity consumption and local generation etc.

Table 68 Functional evaluation of the option "Certification of DHC system performance and/or implementation of community/district/ campus/city/label systems"

Criteria	Evaluation
Effectiveness	Certification of DHC systems: Although DHC companies are not in direct competition to each other (DHC systems are generally not connected to each other and unlike the gas/electricity market each single consumer usually has no choice between different suppliers) quality certification of DHC system performance would improve transparency on the DHC market. This would allow third parties (e.g. energy and consumer agencies, environmental NGOs etc.) to compare and rank DHC systems and companies. Such public ranking might to a certain degree encourage DHC companies to improve the performance of their systems in order to be ranked better. However it is not possible to give an estimate about the quantitative impact regarding additional RES-HC deployment. Ann additional impact is linked if a consumer right of disconnecting from underperforming DHC scheme was introduced. The estimate of the potential impact of introducing a DHC disconnection right is mainly based on data provided by (Fraunhofer ISI et al. 2016), Eurostat and (EuroHeat & Power 2015), although there are considerable differences between the figures provided by these sources. • According to (Fraunhofer ISI et al. 2016) in 2012 DHC was contributing about 480 TWh to the final energy demand in the heating sector, corresponding to a DHC share of about 7.6% of the total heating and cooling market. • According to Eurostat in 2013 about 28% of all DHC was produced by heat only plants while the remaining 72% were contributed by CHP. • According to (Fraunhofer ISI et al. 2016) 53% of the total capacity of CHP plants > 1 MWth was installed before 1992 while 26% of the capacity was installed between 1992-2002 and 21% after 2002. Since no data is available on how different DHC systems can be distributed among different efficiency categories (incl. the efficiency of production in the heat only and CHP plants as well as the efficiency of the distribution) an assumption needs to be done on how many DHC systems would not comply with the energy performance benchmark a DHC system needs to meet in order to be protected against the disconnection right. For reasons of simplification we assume that all heat only plants and all

	CHP plants that have been installed before 1992 (these plants are now older than 24 years) would underperform. This would correspond to a maximum disconnection potential in the range of 320 TWh. If it is further assumed that per annum about 1% of all customers that are connected to DHC systems that underperform will use their right to disconnect in favour of a decentralised heating system, in the first year in principle a heating and cooling volume of about 3.2 TWh would be open to be replaced by RES-HC. Between 2020 and 2030 this potential would sum up to 32 TWh. If we finally assume that about 25% of all disconnected costumers will decide for a RES-HC technology (e.g. a heat pump or wood pellet boiler instead of a gas or fuel oil boiler), this would result in additional RES-HC of about 0.8 TWh (= 0.07 Mtoe) in the first year. Between 2020 and 2030 this would sum up to 8 TWh (0.7 Mtoe) additional RES-HC compared to a scenario without disconnection right. Community/district/city/campus label: Similar to the DHC label the community/district/city/campus label would create transparency between different geographies. A ranking could incentivise public bodies to strengthen their efforts in decarbonising the given geography. Activities could comprise the definition of decarbonisation targets, better coordination of planning processes etc. finally leading to more investments in CO_2 mitigation measures. As heating and cooling makes up for a substantial part of the GHG emissions in most geographies whatever size additional investments in RES-HC would follow. However, similar to the DHC label it is not possible to give an estimate about the quantitative impact regarding additional RES-HC deployment.
Static efficiency	Similar to the two above options it is difficult to evaluate whether the degree to which the introduction of a quality certification scheme for DHC companies would increase the RES-HC share in DHC would be cost efficient. The same applies to the community/district/city/campus label. The costs associated to the introduction of such schemes seem to be moderate. All other costs resulting from additional investments in RES-HC DC or RES-HC technologies in general that are triggered by the measures should be comparable to the other policy options.
Dynamic efficiency	The degree to which the policy measures would incentivise technology diversification and innovation would partly depend on the way the certification schemes would highlight these elements. If the labels displace only indicators such as primary energy, CO_2, fuel mix the schemes would not explicitly provide an incentive to invest in technologies supporting dynamic efficiency.
Administrative efficiency	The development, introduction and operation of certification schemes involve an administrative burden. However, the associated costs seem to be moderate.

Source: Öko-Institut e.V.

Conclusions

Generally it can be stated that all analysed options to improve the conditions for RES-HC in DHC could be implemented in parallel. The most effective option seems to be the implementation of priority third-party DHC grid access for RES-HC combined with a purchase obligation for RES-HC. However considering the rather long lead times for planning and permitting DHC infrastructures the short to mid-term effectiveness would be limited to the existing DHC market share.

Increasing the share of renewable contributions to DHC might have a displacement effect in existing DHC generation. Here the potential trade-off between maximising the ecological impact (which would favor the replacement of inefficient coal-fired heat only plants) and minimising the economic impact on production (which might lead to the replacement of efficient gas-fired CHP) needs to be taken into account

Combining preferential RES-HC third-party DHC grid access including a purchase obligation with a broader RES-HC obligation that would also (directly or indirectly) address DHC suppliers (see next section) might lead to some form of overregulation of the DHC sector. Under the broader RES-HC obligation DHC suppliers would be impacted by a direct obligation on their portfolio or indirectly by sharing the burden the obligation is putting on the fossil fuel suppliers that deliver fossil fuel to the DHC plants. At the same time DHC suppliers would be obliged to purchase RES-HC from installations connected to their grid. Although both measures could be combined as to allow these RES-HC volumes to be accounted towards the broader RES-HC obligation, the combination might not ensure that the overall target to deliver a certain volume of additional RES-HC would be realised at lowest costs (which for instance would be the case if the minimum purchase price was higher than the average price level for complying with the RES-HC obligation).

2.3.3.2 RES-HC obligation addressed to different agents in the HC supply chain

The design options discussed in section 2.3.3.2 determine the effectiveness and efficiency of the use obligation. The following analysis underlies a couple of considerations:

- Since RES-HC obligations are rather new on the political agenda in the EU it is assumed that the RED will include only few “hard” requirements while most of the design of how the instrument will be implemented in the specific national context will be left to Member States. Nevertheless for many of the design variants introduced in section 2.3.3.2 some form of guideline should be provided to Member States. These considerations are presented in Table 69.
- The minimum design requirements for the RES-HC obligation take into account that the instrument could be used as potential “gap filler” at a certain stage towards the at least 27% target for 2030. This means that the minimum requirements must be designed as to allow for reinforcing the obligation on the basis of Commission's mid-term assessment of EU progress towards the 2030 target. Allowing the instrument to be activated as “gap-filler” requires that the minimum target of the obligation is set by the EU.

Table 69 Member State guidance on how to implement a RES-HC obligation

Design element	Guidance for implementation
Whom to oblige?	Suppliers that deliver grid-based fossil fuels (mainly natural gas) to consumers who extract the gas from the grid for the purpose of heat or cold production, and upstream suppliers that produce or import non-grid based fossil fuels (e.g. heating oil, coal) used for the purpose of heat and cold production (further analysis see below)
Which fuel type/energy	All energy sources used for heating/cooling

sources to fall under the obligation (denominator)?	For DHC from non-RES that would mean that the obligation would apply to the energy sources used to produce heat and cold in the DHC plants whereas the delivered heat and cold to DHC customers would not be subject to the obligation.[141] Electricity that is used to produce heating or cooling should not be subject to the obligation as it is covered by the EU RES target for the electricity sector.
Target setting on which level?	EU level, see below
Development of obligation target?	See below
Separate targets for heating and cooling?	One target covering heating and cooling, no sub-targets
Sub-targets for specific RES fuels or RES-HC technologies?	No sub-targets for different furls or technologies; If not introduced EU wide Member States could be allowed to introduce weighing or banding factors[142] that allow for supporting technology diversification and innovation (weighing/banding factors could be used to balance cost differences between different eligible technologies or energy sources depending upon their relative maturity, development cost and associated risk).
Reference for the obligation?	Left to Member States (design element of minor importance)
Eligible RES fuels or RES-HC technologies to be accounted for?	All RES fuels and RES-HC technologies (see below); RES-E should not be included.
How to determine eligible RES production ("converting" capacity to energy)?	Intermittent (inflexible) technologies: deeming Flexible technologies: measuring (this option seems to be a compromise between accuracy and complexity)
Flexibility measures (obligation tradable or introduction of a certificate scheme)?	If not introduced EU wide Member States should be allowed to introduce national certificate trade or "trade" of the quota between obliged parties. In the case of quota fulfilment through RES fuels it should be considered to regulate that the certificates are attached to the commodity/RES fuel. In the case of e.g. wood pellets or log wood this would mean that the certificate, representing the "greenness" of the wood product can't be traded separately from the commodity. This would mainly be important if existing RES fuels were eligible under the obligation.
How to fix penalties for non-compliance/buy-out price?	Depending on how the target is set; a uniform EU wide target would require a uniform penalty/buy-out price
Extension to the transport sector (joint obligation for RES-HC and RES-T)?	No extension

Source: Öko-Institut e.V.

[141] If district heating is produced by fossil fuels, the respective fuels used to produce district heating would be already covered by the supplier obligation at the upstream end, and thus, be already reflected in the purchase price. This would accordingly already provide an incentive for integrating RES in district heating.

[142] This is similar to the approach taken within the Renewable Obligation for RES-E in the UK.

For the further analysis the main focus will be laid on the questions

- whom to oblige,
- what is the market share that would be addressed by the obligation,
- on which level the target is set as well as how the target is developing over time,
- which RE sources or technologies should be eligible to be accounted for (fulfilment options),
- how to exploit synergies to Art 7 EED (Energy efficiency obligation schemes).

2.3.3.2.1 Functionality criteria

Whom to oblige

The obligation could be put on different stages of the fuel chain. On the upper end of the fuel chain would be companies that bring fuel or energy sources on the EU market for the first time. This includes producers of natural gas, coal or heating oil, companies that import fossil fuels, electricity producers etc. The lower end of the fuel chain involves companies that supply fuel or energy sources (incl. DH) to the end consumer, e.g. gas suppliers, DH suppliers, retailers of heating oil and coal etc.

The main advantage of the option to oblige fuel/energy source producers/ importers is the limited number of companies involved which reduces complexity significantly. However, companies at the upper end of the fuel chain usually have only limited access to end consumers while some RES-HC technologies such as heat pumps or solar thermal collectors are installed in this end consumer sector. Putting the obligation on the upper end of the fuel chain would therefore require connecting the obliged companies with the "physical realisation" of the obligation at end consumers. Regarding "physical realisation" putting the obligation downstream would therefore be of advantage.

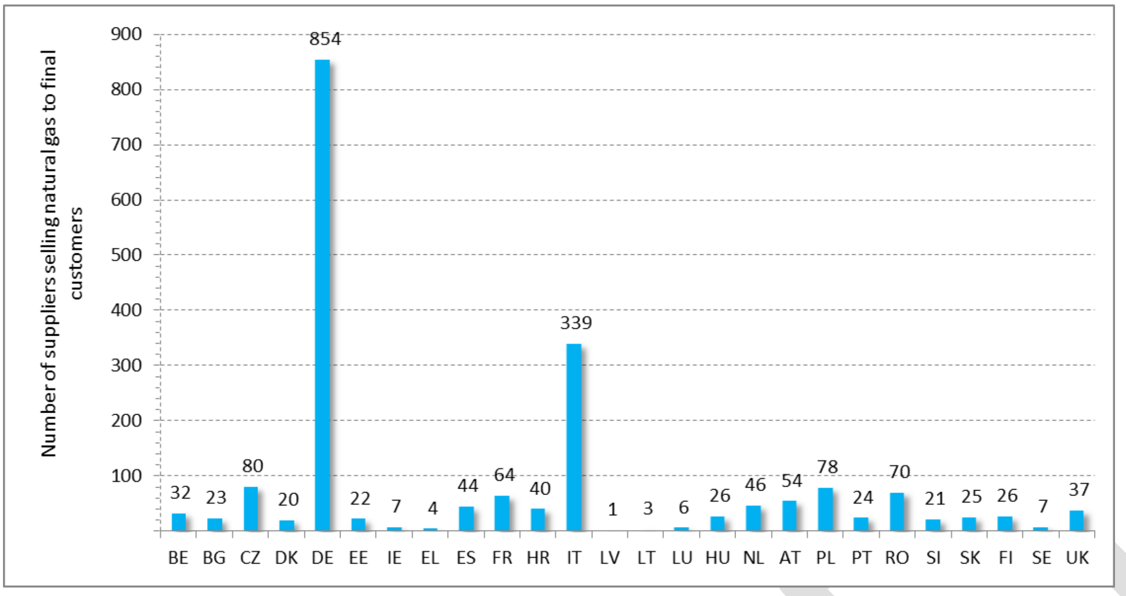
In order to get a better view of the impact of the different options where to place the obligation a closer look at the market structure needs to be taken regarding the market players.

1. Natural gas

According to Eurostat (2016b) in 2014 there were about 400 companies bringing natural gas into the country (representing the upper end of the fuel chain). With 78 Italy had the largest number of gas entities at this end of the fuel chain, followed by Poland with 47 companies.

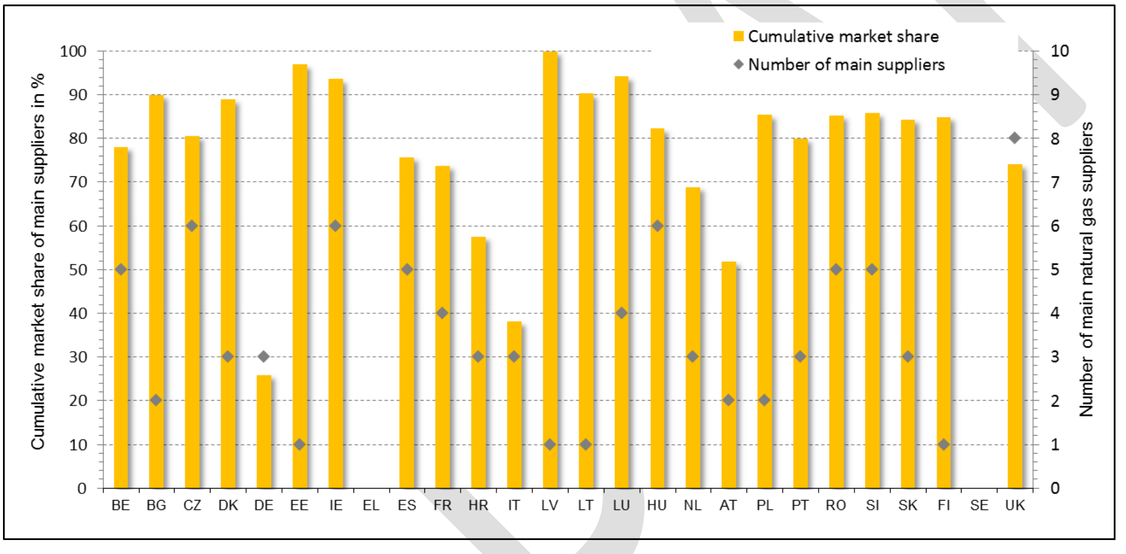
The retail market has a much more heterogeneous structure. In 2014 nearly 2.000 companies supplied gas on the EU retail market to final customers (see Figure 26). With more than 850 suppliers Germany had the most diversified supply structure. In Italy there were about 340 suppliers while in most Member States the number of suppliers was in the range of 20 to 80.

Figure 27 shows the number of main suppliers per Member State. Suppliers are considered as "main" if they sell at least 5% of the total natural gas consumed by final customers in a country. In each Member States less than eight companies had a market share exceeding 5%. However, in many Member States the main suppliers were dominating the market. In Spain for instance the five main suppliers together had a market share of about 75%. In the Baltic States and Finland one company is dominating the retail market while in Bulgaria and Poland the market is dominated by two suppliers. The other end of the market spectrum is represented by Germany and Italy, countries in which only three companies have a market share above 5% and having together a cumulative market share of "only" 30% (Germany) and 38% (Italy).



Source: Own illustration based on Eurostat (2016b)

Figure 26 Number of suppliers selling natural gas to final customers (2014)



Source: Own illustration based on Eurostat (2016b); data for EL and SE not available

Figure 27 Number of main natural gas suppliers and their cumulative market share (2014)

2. Heating oil

According to Fraunhofer ISI et al. (2016) in 13 Member States the share of heating oil in the final energy demand for heating and cooling in 2012 was above or in the range of 10%. These countries are AT, BE, DE, DK, EL, ES, FI, FR, HR, IE, LU, SI, UK. Since no statistic is known about the number of companies upstream (producing or importing heating oil) or downstream (heating oil suppliers) the market structure can only be illustrated in form of some examples:

- According to UPEI (2015) the European heating oil market is predominantly supplied by around 12500 small and medium-sized enterprises.
- In Germany about 100 companies produce or import oil products (upper end of the fuel chain and operators of the tax warehouses) while several thousand companies supply heating oil to end consumers. Among the latter there are a significant number of very small retail traders often operating only one tank lorry (Seefeldt et al. 2011).
- In the UK in 2010 about 380 companies distributing heating oil (mainly kerosene which is most commonly used for heating homes in the UK) to final customers in the domestic sector. Among those there were
    - 3 companies with large national networks
    - 8 firms with large regional and smaller national networks having a market share > 1%
    - around 20 smaller companies with a market share in the range of 0.5-1%
    - about 350 small local firms with less than 0.5% market share

  In 2010 the ten largest distributors had a combined share by volume of the domestic market of just over 40% (OFT 2011).
- In Finland no data is available on the exact number of companies supplying heating oil. According to the Finnish Petroleum and Biofuels Association in 2015 about 95% of the retail market was covered by three companies (FPBA 2016).

3. Coal

According to Fraunhofer ISI et al. (2016) in six Member States the share of coal in the final energy demand for heating and cooling in 2012 was above or in the range of 10%. These countries are BG, CZ, LT, PL, IE, SK. The coal market is even more heterogeneous than the market for heating oil. Some examples:

- In the UK in 2010 there were about 1000 merchants of solid mineral fuels (mainly coal, anthracite, coke). While only 3% of all merchants are larger suppliers selling more than 3000 t/a, the majority of coal suppliers sell less than 1000 t/a (typically delivered by two men and a single lorry). Mineral solid fuels are also sold at outlets such as garage forecourts, DIY shops, corner shops, and garden centres. The total number of such retailers is estimated to be as high as 10000 (OFT 2011).
- In 2011 Germany registered eight companies on the wholesale market for coal for the energy tax. This includes companies that exclusively deliver coal to power plants or industry. The wholesale market for heating coal is

dominated by two companies. On the retail market heating coal mainly is sold by DIY shops or fuel suppliers (Seefeldt et al. 2011).

4. District Heating

According to Euroheat&Power (2015) in 2015 about 10000 district heating systems were operated in the EU-28. Since several DH suppliers run more than one DH system the total number of DH systems represents the upper limit of DH suppliers in the EU. For instance in Finland the 400 DH systems are operated by about 100 DH suppliers (Energiateollisuus 2014). In Germany in 2014 the nearly 1400 DH systems were operated by about 550 companies (BMWI 2016). In Lithuania about 50 DH suppliers (33 municipal companies and 17 undertakings operating on the basis of leasing agreements) were operating about 360 DH systems in 2013.

Interim conclusions:

The market structure of the heating and cooling market is quite diverse in the Member States.

- Despite significant differences between the Member States the structure of the gas and to a certain extent district heating markets (wholesale and retail) is quite well known and the markets are regulated to a certain extent. Putting the RES-HC obligation at the market players on the retail market seems to be feasible as the obligation would address companies that – apart from some very small suppliers – seem to have a company size that would allow for handling the obligation placed on them.
- In contrast to the gas and DH sector the retail markets for heating oil and coal seem to be extremely fragmented in many Member States. In many Member States heating oil and coal is delivered by a considerable number of small scale retailers going down to one-man-business (e.g. operating one tank lorry or running business on a garage forecourt). It does not appear feasible to include these very small market players in an obligation scheme. This would mean that market players below a certain size would have to be exempted from the quota. However, for many Member States it is not known which part of the retail market for heating oil or coal is covered by these small scale firms. Therefore, it would be necessary to estimate the market share that would not be addressed by the obligation in order to define the overall obligation target.

Taking these considerations into account we would suggest that the obligation should be put on

- suppliers that deliver grid-based fossil fuels (mainly natural gas) to consumers who extract the gas from the grid for the purpose of heat or cold production, and
- upstream suppliers that produce or import non-grid based fossil fuels (e.g. heating oil, coal) used for the purpose of heat and cold production.

For DHC from non-RES that would mean that the obligation would apply to the energy sources/fuel suppliers that deliver their fuel to DHC plants where the fuel is used to produce heat and cold whereas the delivered heat and cold to DHC customers would not be subject to the obligation.

In order to reduce the burden on small-scale operators, Member States could have the possibility to apply certain exemptions to the scheme, as long as the obligation scheme covers at certain minimum share of all the final energy used for heating and cooling.

Relation to energy tax

Another challenge of an obligation in the HC sector is the question how to determine the share of fossil fuels that will be subject to the obligation. A RES-HC obligation should generally only be put on those energy sources that are going to the HC market respectively be used for heating and cooling purposes. For instance for natural gas it must be determined which part of a gas company's turnover of natural gas has been used for the production of heat/cold. Therefore the delivery stream needs to be distinguished from gas delivery e.g. for cooking or electricity generation. For oil it must be distinguished between oil that is going in the HC market and oil going in the transport sector. Considering this requirement it might be problematic to put the obligation on companies on the upper end of the fuel chain since at this level the final use of an energy source often is not known yet. This would require tracing back an energy source from the final customer (who determines its use) to the company bringing the respective fuel on the EU market.

Nast et al. (2006) as well as Seefeldt et al. (2011) suggest deploying the Energy Tax Mechanism as the basic administrative structure for an obligation. For some energy sources the energy tax rate differs according to the specific application area. Tax rates might be differentiated by fuel use – heating, transport, electricity or industrial process heat. In these cases the energy tax scheme might already collect the required data that could then also be used by the obligation scheme. Where this is the case the obligation could be put on the companies (resp. that level of the fuel chain) that are subject to the energy tax. Since the Energy Tax Directive 2003/96/EC does not specify on which level of the fuel chain the energy tax needs to be collected, the level differs between Member States. In some Member States the Directive has been implemented in combination with a carbon tax (e.g. SE, UK). For district heating in most Member States the tax is put on the fuel input. Table 70 provides ab overview at which level the energy tax is collected in some selected Member States.

Table 70 Allocation/collection of energy tax in selected Member States

Member State	Energy source	Tax Payer
Germany	Natural gas	Gas supplier (retail, downstream)
	Heating oil	Owner of tax warehouse (upstream)
	Coal	Companies that bring coal on the market (wholesale, upstream)
	Electricity	Electricity supplier (retail, downstream)
Denmark	Natural gas	Gas supplier
	Heating oil	Oil supplier
	Coal	Coal supplier
	Electricity	Electricity supplier
Finland	Natural gas	Importing companies (upstream)
	Heating oil	Importing companies (upstream)

	Coal	Importing companies (upstream)
	Electricity	Grid operators
The Netherlands	Natural gas	Gas supplier (retail, downstream)
	Heating oil	Importing company or authorised distributors from where mineral oil is released for consumption
	Coal	Producer or holder of tax warehouse (upstream)
	Electricity	Electricity supplier (retail, downstream)
Slovakia	Natural gas	Gas supplier (retail, downstream)
	Heating oil	Owner of tax warehouse (upstream)
	Coal	Coal supplier (retail, downstream)
	Electricity	Electricity supplier (retail, downstream)
UK	Natural gas	Climate change levy on gas supplier (retail, downstream)
	Heating oil	Climate change levy on heating oil supplier (retail, downstream)
	Coal	Climate change levy on coal supplier (retail, downstream)
	Electricity	Fossil fuel levy on electricity supplier (retail, downstream)

Source: Öko-Institut e.V.

Table 71 Functional evaluation of the different options for "Whom to oblige"

Criteria	Evaluation
Effectiveness	The effectiveness of the instrument is independent from the question on which level of the fuel chain companies will be obliged.
Static efficiency	Putting the obligation at the upper end of the fuel chain might lead to a bigger number of large scale RES-HC installations since upstream companies are used to realise larger projects and to deal with large investments. Large scale RES-HC might deliver the overall target at lower costs than many small scale installations. On the other hand downstream companies that feature RES-HC as part of their product portfolio might be able to deliver RES-HC to lower costs already today due to expertise and experience.
Dynamic efficiency	Independent from this design element the question must be raised whether a pure quota will incentivise any form of technology diversification or innovation as competition between the obliged parties will motivate all parties to look for the least-cost options to comply with the quota (Connor et al. 2013). However, dynamic efficiency might be somewhat higher if companies at the lower end of the fuel chain were obliged. Suppliers of end consumers might have an incentive to carry out small scale RES-HC solutions at their own customers, e.g. motivated by the aim to strengthen customer relationship.
Administrative efficiency	Regarding the question 'whom to oblige' administrative costs mainly result from verifying compliance. These costs are obviously the higher the more companies need to be checked. Another administrative burden is deriving from the necessity to determine the fuel volumes that are subject to the obligation (see above). Regarding this challenge the idea of linking this task to the established routines of collecting the energy tax might be without alternative.

Source: Öko-Institut e.V.

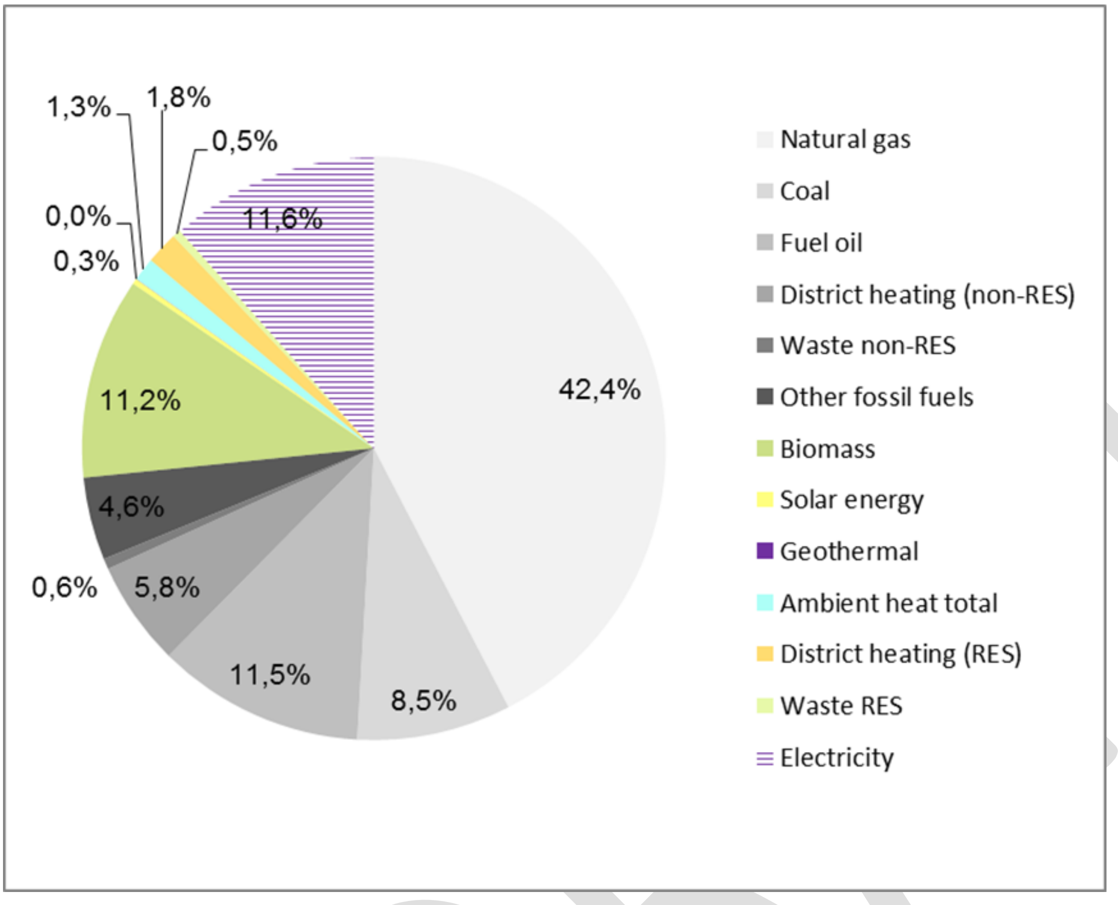
Which market share would be addressed by the obligation

There are different options to apply the RES-HC obligation and to determine the market share covered by the obligation. The market share that would be addressed by the RES-HC obligation is depending on

a) the market actors/segments that would be subject to the obligation (numerator)

b) the market segments of the HC market (e.g. only fossil part of the market) the share is referring to (denominator)

Figure 28 shows the final energy demand for H/C in the EU28 by energy carrier in 2012 (data from Fraunhofer ISI et al. 2016).

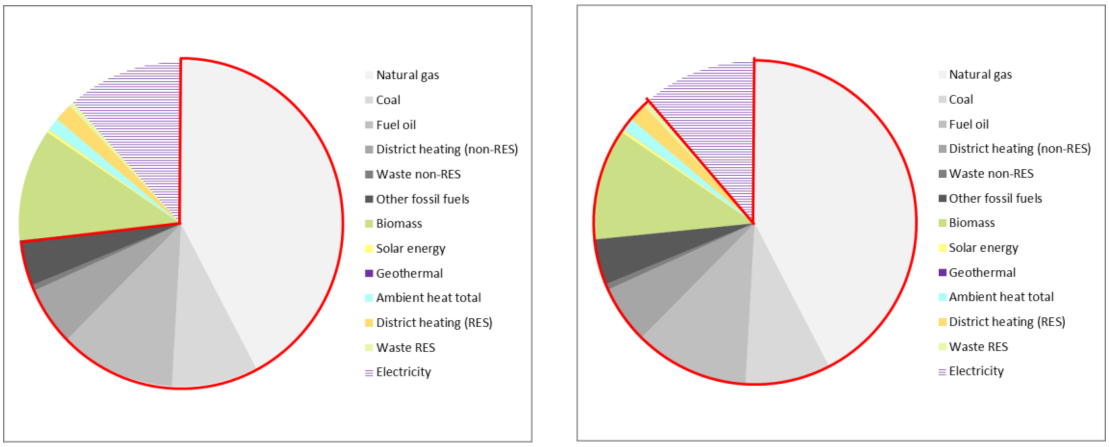


Source: Öko-Institut e.V. based on data from (Fraunhofer ISI et al. 2016)

Figure 28 Final energy demand for H/C in the EU28 by energy carrier in 2012

Figure 29 illustrates two possible references against which the market share could be determined. If the RES-HC obligation only addressed the non-RES part of the HC market then the reference for determining the market share could respectively be limited to the non-RES segments (figure on the left). If the obligation covered all fuel suppliers (including RES suppliers) the reference should extended to the whole HC market (figure on the right). The latter would include all RES fuels and also RES technologies (solar thermal, heat pumps, geothermal).

In both options we assume that electricity that is used to produce heating or cooling will not be subject to the obligation as it is covered by the EU RES target for the electricity sector. For that reason none of the two reference options includes electricity.



Source: Öko-Institut e.V. based on data from (Fraunhofer ISI et al. 2016)

Figure 29 Different options to define the reference for determining the market share covered by the RES-HC obligation

Based on these considerations different options exist for indicating the market share that would be covered by the RES-HC obligation:

1a) Obligation on all fossil fuel suppliers (mainly natural gas, coal, fuel oil, non-RES waste) while the addressed market share is determined against the total fossil fuelled HC market (apparently in this option the market share is 100% for all Member States)

1b) Obligation on all large fossil fuel suppliers (assumption that 50% of all coal and fuel oil suppliers are exempted from the obligation in order to reduce the burden on small scale suppliers; for all other non-RES fuel suppliers no exemptions are assumed) while the addressed market share is determined against the total fossil fuelled HC market

2a) Obligation on all fuel suppliers (incl. biomass suppliers) while the addressed market share is determined against the total HC market (incl. all RES fuels and RES technologies)

2b) Obligation on all large fuel suppliers (assumption that 50% of all coal, fuel oil and biomass suppliers are exempted from the obligation in order to reduce the burden on small scale sup-pliers; for all other RES and non-RES fuel suppliers no exemptions are assumed) while the ad-dressed market share is determined against the total HC market (incl. all RES fuels and RES technologies)

2c) Obligation on all fossil fuel suppliers while the addressed market share is determined against the total HC market (incl. all RES fuels and RES technologies)

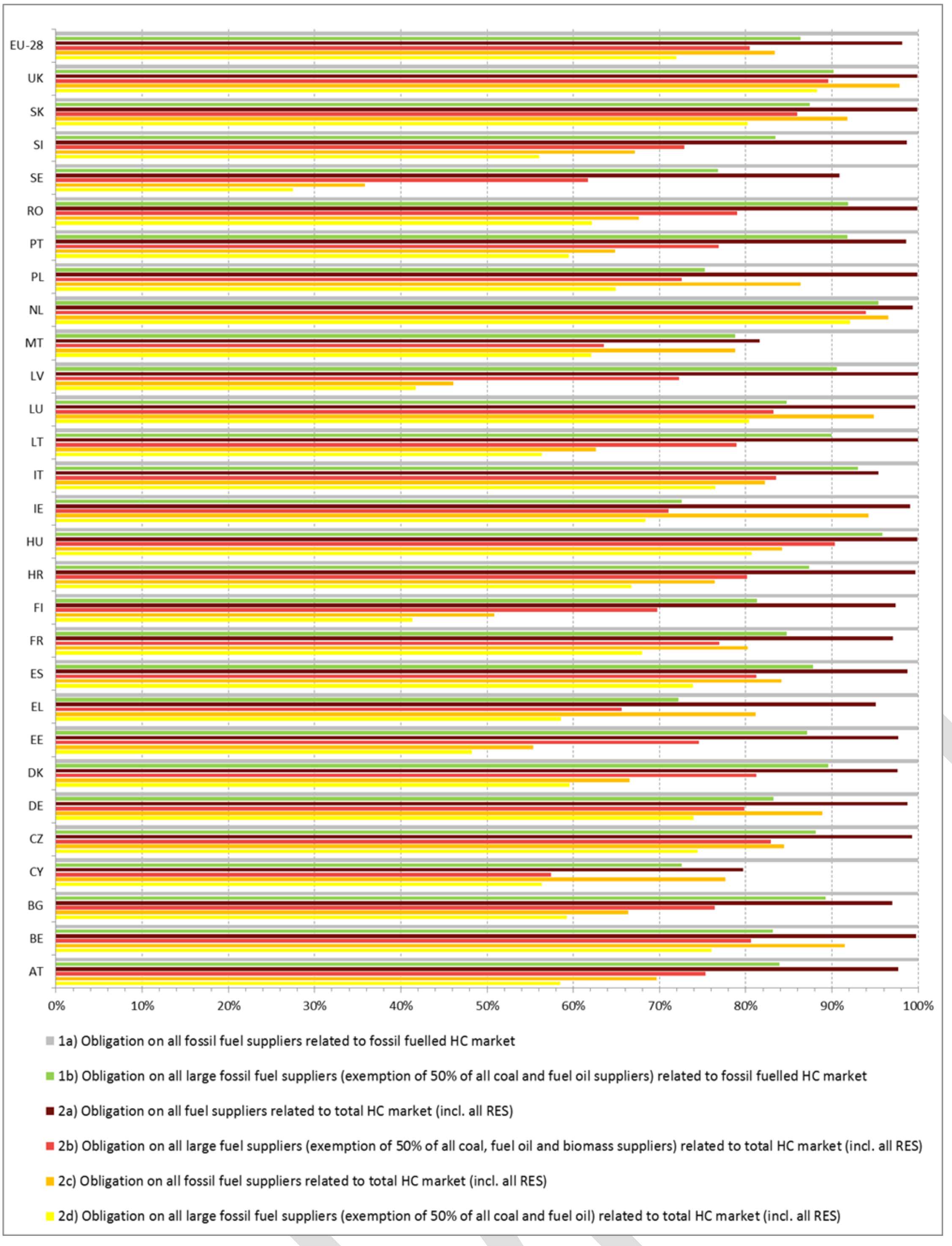
2d) Obligation on all large fossil fuel suppliers (assumption that 50% of all coal and fuel oil suppliers are exempted from the obligation in order to reduce the burden on small scale suppliers; for all other non-RES fuel suppliers no exemptions are assumed) while the addressed market share is determined against the total HC market (incl. all RES fuels and RES technologies)

For each Member State Figure 30 provides an overview of the different market shares that can be estimated when the different options are applied.

For the EU28 the average market shares are as follows:

1a	Obligation on all fossil fuel suppliers (mainly natural gas, coal, fuel oil, non-RES waste) while the addressed market share is determined against the total fossil fuelled HC market (apparently in this option the market share is 100% for all Member States)	100%
1b	Obligation on all large fossil fuel suppliers (assumption that 50% of all coal and fuel oil suppliers are exempted from the obligation in order to reduce the burden on small scale suppliers; for all other non-RES fuel suppliers no exemptions are assumed) while the addressed market share is determined against the total fossil fuelled HC market	86%
2a	Obligation on all fuel suppliers (incl. biomass suppliers) while the addressed market share is determined against the total HC market (incl. all RES fuels and RES technologies)	98%
2b	Obligation on all large fuel suppliers (assumption that 50% of all coal, fuel oil and biomass suppliers are exempted from the obligation in order to reduce the burden on small scale sup-pliers; for all other RES and non-RES fuel suppliers no exemptions are assumed) while the ad-dressed market share is determined against the total HC market (incl. all RES fuels and RES technologies)	80%
2c	Obligation on all fossil fuel suppliers while the addressed market share is determined against the total HC market (incl. all RES fuels and RES technologies)	83%
2d	Obligation on all large fossil fuel suppliers (assumption that 50% of all coal and fuel oil suppliers are exempted from the obligation in order to reduce the burden on small scale suppliers; for all other non-RES fuel suppliers no exemptions are assumed) while the addressed market share is determined against the total HC market (incl. all RES fuels and RES technologies)	72%

If for instance the RES-HC obligation was put on all large fossil fuel suppliers and if we assume that half of the coal and fuel oil market volume was exempted in order to minimise the burden on small scale suppliers the obligation would address 72% of the total HC market (incl. all RES fuels and RES technologies) or 86% of the total fossil fuelled HC market. However, these shares differ significantly between Member States, mainly depending on their current RES share on the HC market.



Source: Öko-Institut e.V. based on data from (Fraunhofer ISI et al. 2016)

Figure 30 Market shares covered by a RES-HC obligation

Quota fulfilment options (eligible RE sources or technologies to be accounted for)

The definition of the fulfilment options is crucial for reaching not only 2030 targets but also for the long-term decarbonisation of the heating and cooling market. There are two different approaches by defining the fulfilment options,

- fulfilment based on the sale of renewable fuels such as biogas, liquid and solid biofuels and
- fulfilment based on the produced heat or cold from RES.

Quota fulfilment based on the sale of renewable fuels

The obligation could be fulfilled by the delivery of renewable fuels (feed-in of bio-methane to the gas grid, blending heating oil with bio-liquids, delivery of solid biofuels). Quota fulfilment based on renewable fuels is similar to the biofuel quota in the transportation sector. However, there are several issues with such a design in the heating and cooling market. Feed-in of bio-methane, blending of bio-liquids or co-firing of solid biomass would facilitate short term compliance in the current market structure for most Member States (for natural gas, heating oil and fossil fuel suppliers), but would go against the long term objectives of sustainability and would also hinder market uptake of more innovative RES-H/C supply technologies. This fulfilment option would not incentivize a shift to more efficient technologies The option would rather lead to biomass use in existing inefficient natural gas, oil and coal boilers as well as co-firing in industrial plants and fireplaces for producing comfort heat.

There are different alternatives how this fulfilment option could be limited, e.g. by

- introducing a cap on this option which would mean that only a limited share of the overall obligation could be fulfilled by renewable fuels while the remaining share would have to be delivered by technology implementation options (see below)
- introducing weighing factors that allow for incentivising specific fulfilment options (e.g. technology implementation options could be weighted higher than renewable fuels)
- implementing efficiency standards to be met by the conversion plants using the renewable fuel that contributes to the obligation (this option is facing the challenge that the obliged party would have to provide evidence for each supplied conversion plant that the efficiency standard was met)
- limiting the fulfilment option to new (additional) RES plants. Under this option supply of RES fuel would only be eligible if it was used in a new conversion plant; however, this option is already covered by option 2 below.

Beside the aspect, that a quota fulfilment by the delivery of renewable fuels will likely hinder the market uptake of more innovative RES-H/C supply technologies, another aspect has to be considered: the burden for gas, fuel oil and coal suppliers would be different due to technical restrictions and different costs for blending bio-fuels, e.g. in heating oil and biogas in natural gas. From a legal viewpoint, both aspects raise the question if certain limits for physical feed-in/blending of gaseous, liquid and solid biofuels can be introduced. Such an introduction could be required to safeguard the purpose of the regulation (incentivising innovative RES-H/C supply technologies) and to create a level playing field between the different fulfilment options.

In general, the legislator has a certain discretion when denominating which measures and instruments shall be used to achieve certain political targets. The definition of certain upper limits for the different fulfilment options could be seen as an unequal treatment of market participants (however, it is also used to create certain equality). But such an unequal treatment can be justified if the legislator introduces – on European or national level – a well-designed cap which (1) is appropriate to hinder dis-incentivising innovative RES-HC technologies, (2) equalizes the different burdens of the different types of suppliers and (3) takes into account the different challenges of the suppliers in the different Member States as to not distort the cross-border competition between the suppliers in the EU.

When designing a limitation on the option to fulfil the obligation by the sale of renewable fuels, it is indispensable to consider whether the obliged parties have a fair opportunity at all to fulfil their obligation. To assess the proportionality of such a limitation, the following questions have to be answered:

- Would the obliged parties – because of their current business models – actually tend to fulfil their obligations solely by the sale of renewable fuels (esp. fuel only suppliers)?
- If yes, are they hindered to ensure full compliance with this obligation due to the introduced limitation?
- If yes, do they have a real possibility to opt for option 2, which foresees the fulfilment of the obligation based on the produced heat or cold from RES (technology implementation)?

The answer to the last question depends on several aspects. Energy suppliers whose core business does not include producing heat and cold from RES so far, would have to start completely new business models from scratch (rather unlikely) or rely on existing structures in the market. If a liquid market for alternative business models obliged parties could join or for certificates (provided that the host Member State has introduced such a scheme) didn't exist or was just under development, it might de facto be impossible for an obliged party to comply with its obligation. In this case, the introduction of one of the limiting options would be the reason that none of the options would be a feasible option for the obliged party. Insofar it would be necessary to reflect on the introduction of exemptions for obliged parties (hardship clause), if further instruments (e.g. buy-out-clauses) were not appropriate to prevent an undue burden.

Quota fulfilment with heat or cold generated from RES (technology implementation options)

The obligation could also be fulfilled by producing heat and cold from RES. In order to fulfil the quota, obliged parties need to provide evidence that heat and cold from highly efficient newly installed RES-H/C devices has been produced. Such a policy design is similar to a quota mechanism in the electricity sector where produced electricity from RES-E generators is eligible for quota fulfilment. The following table gives an overview of potential technology oriented quota fulfilment options. The minimum requirements regarding efficiency and quality of technologies based on the EU energy performance framework[143] could be applied as prerequisite to qualify for eligibility. A wide range of renewable heating and

[143] E.g. the highest Ecodesign and energy labelling requirements for space and water heaters.

cooling solutions are already available on the market (see Table 77). The proposed RES-HC obligation scheme could further scale-up the market of these RES heating and cooling solutions and contribute to further price reductions of these heating and cooling solutions.

Table 72 Overview of potential quota fulfilment options

Technology	Eligible renewable energy for quota fulfilment
On-site technologies	
Electrical heat pumps	Ambient heat
Gas heat pumps	Ambient heat
Wood log boilers	Heat output generator
Wood chip boilers	Heat output generator
Wood pellet boilers	Heat output generator
Solar thermal collectors	Solar heat output
District heating/ cooling technologies	
Biomass heat-only boilers	Feed-in district heating / heat storage
Biomass CHP systems	Feed-in district heating / heat storage
Heat pumps	Feed-in district heating / heat storage
Solar thermal collector field	Feed-in district heating / heat storage
Geothermal	Feed-in district heating / heat storage

Source: Öko-Institut e.V.

For the technology implementation options a methodology is required to calculate the amount of heat a RES-HC installation is delivering into the obligation scheme. The mechanism applied must ensure that the calculated or metered output of a RES-HC installation is accurate, replicable and not open to abuse. This will be vital for protecting the scheme from gaming and fraud. Options how the amount of heat can be derived have been discussed in the sections above. A compromise between accuracy and complexity could be to apply deeming for all small scale and intermittent (inflexible) technologies while the heat and cold output of flexible large scale installations (e.g. large biomass installations, large heat pumps) would be measured. Both methods are applied within the Renewable Heat Incentive in the UK. Deeming is also applied within the Australian Small-Scale Technology Certificates (STCs) system and – for calculating energy savings – in many Energy Efficiency Obligation schemes following Art. 7 of the EED.

For energy suppliers whose core business does not include renewable energy supply to its customers, compliance with the proposed RES heating and cooling obligation could require extending into new business branches, including entering in commercial partnerships with renewable energy producers, and/or RES technology suppliers and installers, energy service providers etc.

On which level target is set

The potential use of the RES-HC obligation as "gap-filler" for achieving the overall 27% RES target implies that the obligation target is set by the EU. However, Member States should be free in setting targets above the minimum levels defined by the EU.

There are several options how the target could be defined, e.g.

- A uniform absolute EU wide target that applies to each obliged party in the Member States (e.g. x% in 2030).
- A uniform relative EU wide target that applies to each obliged party in the Member States and that relates to the current specific RES-HC share of the respective party (e.g. each obliged party would be required to ensure that each year, e.g. for the period 2021-2030, an additional share of x% of the sold energy portfolio comes from RES-HC).
- A combination of the two options: A uniform absolute EU wide target that applies to each obliged party in the Member States (e.g. x% in 2030). In order to activate also those companies that fulfil the targets already now (due to having a RES-HC share above the target) all obliged parties would have to ensure that each year (e.g. for the period 2021-2030) an additional share of x% of the sold energy portfolio comes from RES-HC.

Depending on how the minimum shares are parameterized the three options can differ significantly with regard to their impact on the obliged parties in MS.

Table 73 Functional evaluation of options for "On which level target is set"

Criteria	Evaluation
Effectiveness	The effectiveness of a quota is per se given. However, different options how the target is set respectively how the target is distributed among the obliged parties do have an impact of the overall effectiveness.
Static efficiency	Disregarding the option how the target is set and distributed among the obliged parties the highest static efficiency would be given if the national obligations went with the implementation of an EU wide certificate scheme. In theory this would allow for exploiting the necessary RES-HC volumes at lowest costs. However, it should be thoroughly analysed how or whether a fair balance of the regional allocation of costs and benefits would be ensured.
Dynamic efficiency	An obligation that is not distinguishing between technologies (e.g. by setting technology specific sub-targets or introducing weighing factors) would not support dynamic efficiency since the obliged parties would strive for fulfilling the quota at lowest costs possible. Technology diversification could be supported by technology specific sub-targets. However, this would be on cost of market liquidity. Introducing weighing factors (e.g. solar thermal is weighted higher than biomass[144]) would be in conflict with the potential gap-filler role of the obligation as certificates would be awarded without corresponding generation (e.g. 1 kWh of RES-HC would be accounted for differently depending on the weighing factor applied for the respective technology, see (Connor et al. 2009)).
Administrative efficiency	All options would go along with similar administrative costs. Costs incur for verifying compliance and implementing/operating the certificate scheme.

Source: Öko-Institut e.V.

[144] For the concept of weighing factors please see Steinbach et al. (2013) which is based on Seefeldt et al. (2011).

Cost-considerations

For obligated parties costs incur trough the delivery of the quota and for administering the obligation internally.

Delivery costs

Delivery costs are the costs of installing RES-HC technologies or producing/purchasing eligible RES fuels. These costs could incur through a support scheme that an obliged supplier might have introduced in order to incentivise the installation of RES-HC technologies in residential buildings. In the case of RES fuels the delivery costs would reflect the cost difference between the RES fuel to conventional fossil fuel, in the case of technology implementation the cost difference between heat from a fossil fuelled technology (e.g. a gas boiler) and heat from the RES technology. In order to derive an estimate for the potential delivery costs, current generation costs for RES fuels and current support levels for RES-HC technologies are considered. The latter assumes that obliged actors need to spent similar subsidy levels in order receive certificates of RES-HC generators.

- Delivery cost of a fulfilment with RES-fuels: As an estimate, the costs of generating and processing biogas into the gas grid are considered. According to Bundesnetzagentur (2014), the average generation and processing costs in Germany are 7.5 €-cent/ kWh leading to differential costs in the range of 5.0-5.5 €-cent/kWh.
- Delivery cost of installing RES-H/C technologies: Current subsidy levels for RES-H/C generators vary to a large extent depending on the technology, the size/capacity and policy design in Member States. One of the largest RES-HC support programmes is currently the Market Incentive Programme in Germany[145]. Based on the investment grants provided in this program specific subsidy levels can be derived per renewable heat reflecting the delivery costs for an obliged actor. In order to gain certificates from investors installing RES-HC technologies (e.g. building owners) it is likely that the remuneration is provided in form of a one-time payment. Therewith, the obliged supplier will receive certificates of RES-HC energy generated over the lifetime of the technology.
  - Biomass boilers (20 to 100 kW): 0.31 to 0.59 €-cent/kWh[146]
  - Ambient heat from heat pumps (15 to 50 kW): 0.19 to 0.47 €-cent/kWh[147]

Since energy suppliers would be required under the obligation scheme to increase the volumes of renewable energy sold to their customers on an annual basis, the compliance costs will also increase from year to year. Furthermore the estimate

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[145] Federal Ministry of Economic Affairs and Energy (2016). Market Incentive Programme. https://www.bmwi.de/EN/Topics/Energy/Buildings/market-incentive-programme.html

[146] Subsidies for wood pellet boilers according to Market Incentive Programme 2015: 80 €/kW, minimum of 3 000 € per installation; annual efficiency: 85%; full load hours: 1 500; life time: 20 years; interest rate: 4%

[147] Subsidies for air/water heat pump according to Market Incentive Programme 2015: 40 €/kW, minimum of 1 500 € per installation; seasonal performance factor: 3.5, full load hours: 1 500; life time: 20 years; interest rate: 4%

shows that under the fuel incorporation option delivery are higher than implementing technologies.

The following example illustrates the potential cost burden for suppliers: For a supplier who is supplying 100 GWh of fossil fuels per year, with an obligation to increase the shares of renewable by 1% (i.e. 1 GWh) every year, the cost of compliance could range between €1 900 and around €50 000 in the first year, depending on how the obligation is fulfilled (incorporation or installation). The additional levy on fossil fuel sales could therefore range between 0.002 and 0.05 €-ct/kWh, which represents less than 0.1% of the current price level for natural gas for households.

Administration costs

Administration costs include costs for the management of potential funding programs, motivation campaigns to incentivise RES-HC installations, costs for audits and verification or costs associated to establishing regional networks delivering RES-HC installations. Since a certain share of the administration costs are fixed costs that are independent from the size of the obligated company, small companies might have a systematic competitive disadvantage. This fact justifies the exemption of small scale companies. For the variable administrative costs large companies might have a further competitive advantage due to potential scaling effects, e.g. regarding the search for eligible RES-HC projects.

How to exploit synergies to Art 7 EED (Energy efficiency obligation schemes)

The implementation of the RES-HC obligation could also potentially have certain overlaps with the national implementation and monitoring structures put in place for compliance with Art.7 of the Energy Efficiency Directive (energy efficiency obligation schemes, EEOS). For Member States that have implemented an energy efficiency obligation synergies could be exploited on the level of the obligated party as well as the administration of the schemes:

- Obligated party (see Table 74): All existing energy efficiency obligation schemes oblige electricity and gas suppliers on different stages of the supply chain. For natural gas synergies could be exploited by putting the RES-HC obligation on the same market actors as far as they are active in the heating and cooling market. However, suppliers of heating oil as well as solid fossil fuels are not covered by all existing energy efficiency obligations. Furthermore, in order to limit the administrative burden some Member States have established a lower limit of energy sales or number of customers, below which companies are not subject to the energy efficiency obligation. However, this threshold varies considerably between countries. Due to the threshold level but also the market structure the number of obligated parties differs significantly in the different schemes, ranging from less than 10 (UK) up to thousands (e.g. DK).
- Administration: For operating a RES-HC obligation similar procedures need to be established as for an energy efficiency obligation. In particular this involves issue, trade, submission and redemption of certificates, verification, monitoring, control etc. The administrative and institutional set-up that needs to be implemented in order to facilitate these processes could be aligned to the set-up of the energy efficiency obligation.

Experience from operating existing energy efficiency obligation schemes could help to design RES-HC obligations in a straightforward way and to minimise the additional administrative burden for the involved parties.

Table 74 Obligated parties under the existing EEOS in the EU

	Obligated party	Administration of the scheme
DK	• All electricity grid operators (74 companies), natural gas distributors (3 companies), district heating companies (417 companies) and oil suppliers (6 companies) • For electricity, natural gas and district heating companies, the savings targets apply as a whole to all companies in the respective sectors while it is assumed that these companies will agree the allocation of the sector obligation between themselves; oil companies' savings targets are apportioned proportionately between the companies according to their market share of the heating oil market • No exemption of small companies	All obligated companies must each year carry out an audit to ensure and demonstrate that the notified savings have been realised and documented. In alternate years, the audit may be carried out internally by the company itself, with intervening audits being carried out externally by an independent auditor. The Danish Energy Agency carries out impartial sampling across all obligated companies in order to check whether they are meeting the requirements.
FR	• Electricity, gas, district heating/cooling suppliers that supply more than 400 GWh/a • Suppliers of liquefied petroleum gas for heating purposes that supply more than 100 GWh/a • Suppliers of domestic fuel oil that supply more than 500 m^3/a • Wholesalers, that supply more than 7000 t/a of autogas or 7000 m^3/a of gasoline/diesel In total 20 electricity suppliers, 12 natural gas suppliers, 11 district heating/cooling suppliers, 20 heating LPG suppliers, 1900 domestic heating oil suppliers, 6 autogas wholesalers and 40 automotive fuel wholesalers are subject to the scheme.	The scheme is administered by the National Authority for Energy Saving Certificates (PNCEE). At the end of each period, the PNCEE verifies that according to their obligation each obligated party holds a sufficient number of certificates within the certificate registry. PNCEE has the principle right to carry out audits in order to verify the measures that account towards the obligation.
IT	Electricity and gas distributors having more than 50000 end users. In 2013 the obligation involved 13 electricity and 50 gas supplier covering 85% (electricity) and 89% (gas) of the total distributed energy in these markets.	The scheme is administered by GSE, a state-owned company that promotes and supports renewable energy sources in Italy. GSE is verifying compliance and is supported by other public institutions (e.g. ENEA, a government-sponsored research and development agency). Different control mechanism are applied in order to ensure the savings for which certificates have been issued and to protect the scheme against fraud.

PL	• Electricity, gas and district heating suppliers (500-600 companies are estimated to be subject to the obligation, largely involving small companies supplying electricity (415), gas (114) and heat (110), • Large consumers who conduct transactions on the Polish Power Exchange on their own, • Commodity and trade brokerage houses making transaction, e.g. buying electricity, gas or heat on the Polish Power Exchange; • Small district heating suppliers are exempted from the obligation	The scheme is mainly administered by the Polish Energy Regulation Office (ERO). Obligated parties have to submit the number of certificates that is reflecting their obligation to ERO for redemption. ERO is responsible for monitoring and verification. While large efficiency projects require an ex-post energy audit to verify the savings smaller projects are subject to random sampling verification.
UK	Electricity and gas suppliers with more than 250000 domestic customers and supply more than 400 GWh/a of electricity or 2000 GWh/a of gas, in total 7 companies are subject to the scheme.	Obliged suppliers are required to submit an overview of implemented measures on a monthly basis to Ofgem that is administering the scheme. Suppliers are required to carry out technical monitoring of a sample of notified efficiency measures to ensure that they are installed in a proper way. Ofgem runs a system of checks (incl. audits and technical monitoring) to confirm that the information provided by suppliers is reliable. In addition Ofgem conducts audits of a sample of notified measures.

Source: Öko-Institut e.V. based on national notifications setting out how Member States intend to transpose Article 7 of the EED, NEEAPs and (VITO et al. 2015)

While synergies occur regarding the obliged party as well as administrative set-up rules need to be adopted regarding the eligibility of measures. Some Member States have implemented energy efficiency obligations that allow RES-HC measures to contribute to the energy savings targets (e.g. in Italy the use of RES for heat and hot water generation). In order to avoid double counting it has to be ensured that the investment in a RES-HC installation can be accounted for against the target of only one of the two obligation schemes. An option to avoid this kind of double counting would be to delete all RES measures from the list of Article 7 measures (e.g. Ricardo AEA et al. 2015).

2.3.3.3 RES-HC use obligation on buildings

This option is aiming at reinforcing the current RES minimum requirements of Art. 13(4) RED. According to Art. 13(4) RED RES minimum requirements apply for new buildings and buildings under-going major renovation. While this obligation was due by the end of 2014 only few Member States had implemented such use obligations by the end of 2013 (Atanasiu et al. 2014). The analysis of non-economic barriers in the course of project 688 showed that several Member States' building codes are still not compliant with Art. 13(4). Reinforcing the impact of Art. 13(4) by full implementation of the RES minimum requirements by all Member States would therefore deliver additional RES-HC. In order to estimate the impact of Art. 13(4) for the period 2020-2030 the following assumptions have been made:

- Based on data provided by the Entranze project (TU Wien et al. 2014) the total floor space of residential buildings is in the range of 18 000 mio. square meters while non-residential buildings provide a floor area of about 5 500 square meters.
- According to (BPIE 2016) in the period 2000-2012 the annual average new construction rate for residential buildings was in the range of 0.25-1.5% referring to the entire floor area in domestic buildings. Referring to the number of dwellings the EU-28 average new construction rate in the period 2000-2010 was about 1.2% per year in the residential sector according to (TU Wien et al. 2014). For estimating the impact of reinforcing Art. 13(4) we assume that the new construction rate in the residential sector will be 1.5% per year in the period 2020-2030. For non-residential buildings the same construction rate is assumed.
- According to the EPBD all new buildings need to meet the nearly zero energy standard (nZEB) from 2019/2021 onwards. While the EPBD is providing a definition for this standard Member States apply different approaches and indicators in their building codes to implement the nZEB standard. Apart from differing methodologies also the ambition level differs significantly be-tween Member States (e.g. BPIE 2015). For our estimate we assume that for residential buildings the specific final energy demand for heating and cooling will be 50 kWh per square meter and year while in non-residential buildings the demand will be double.
- We further assume that the RES minimum standard that will be achieved in new buildings will on average be 15% referring to the final energy demand for heating and cooling (which for instance is the minimum share applying for new buildings in Germany according to the German Renewable Heat Law[148]).
- For the existing building stock the use obligation applies when a building is undergoing a major renovation. According to Art. 2 EPBD a major renovation is given when "the total cost of the renovation relating to the building envelope or the technical building systems is higher than 25 % of the value of the building (excluding the value of the land upon which the building is situated) or more than 25 % of the surface of the building envelope undergoes renovation" (Member States may choose which option to apply). No data is available on the major renovation rate in the Member States. However it can be assumed that the rate is rather low as often renovations are done step by step (which means that the RES-HC requirement does not apply). For our estimate we assume a major renovation rate of 0.25% per year.
- For existing buildings that are subject to a major renovation a RES minimum standard of 15% referring to the final energy demand for heating

[148] Act on the Promotion of Renewable Energies in the Heat Sector (Erneuerbare-Energien-Wärmegesetz – EEWärmeG)

and cooling is assumed (which for instance is the minimum standard for renovations applied by the Heat Law in the state of Baden-Württemberg[149]).

If all Member States will fully implement Art. 13(4) and if the requirements will be extended to 2030, new buildings (residential and non-residential) constructed between 2020 and 2030 would deliver additional 28.5 TWh (= 2.45 Mtoe) RES-HC in the end year. Existing buildings that are subject to a major renovation would contribute additional 9.9 TWh (= 0.85 Mtoe).

2.3.4 Outline for a consistent policy package

Based on the partly isolated assessment of the different instrument approaches in the previous sections Table 75 provides an outline of how a policy package could look like combining instruments or instrument elements in a consistent way.

Table 75 Outline for a consistent policy package

Instrument	Design
RES-HC obligation	Scheme design as outlined in the guidance on how to implement a RES-HC obligation in Table 69.
Provisions on DHC	Although DHC would not be directly affected by the RES-HC obligation (as not being subject to the quota) there would be an indirect impact as the non-RES fuels that are used in DHC plants to produce heat and cold would underlie the obligation. The price signal of the obligation would therefore be reflected by the price for the obligated fuels. Accordingly, this would already provide an incentive for integrating RES in DHC. The analysed options to improve the conditions for RES-HC in DHC could be implemented in parallel to the RES-HC obligation. However there might be some interactions that need to be considered. For instance, in order to fulfil the RES-HC obligation an obliged gas supplier might provide financial support to a large heat pump that is claiming access rights to an existing DHC grid (which is mainly supplied by gas-fired heat or CHP plants). In such a case the RES-HC obligation would trigger additional RES-HC while the preferential third-party grid access would ensure that also the DHC infrastructure would be open for integrating these additional volumes. However, the DHC supplier involved would be impacted twice, by a higher purchase price for the gas used in his conversion plants (since the obliged gas supplier would pass his support costs for the large heat pump on his customers) as well as by potentially losing customers to the heat-pump operator.
RES-HC use obligations for buildings	Regarding the requirements from Art 13 (4) RED it must be decided whether RES-HC devices that are installed on new buildings or those buildings being subject to a major renovation should be accountable towards the RES-HC obligation. Such a case would e.g. be given if an obliged gas supplier was providing an investment subsidy to a building owner for installing a solar collector on his new building. If accountability should be excluded rules need to be implemented to avoid that certificates

[149] Gesetz zur Nutzung erneuerbarer Wärmeenergie in Baden-Württemberg (Erneuerbare-Wärme-Gesetz – EWärmeG)

	are issued for RES-HC installations that fall under Art 13 (4) RED.[150] If the effectiveness of Art 13 (4) RED was extended by including more buildings (e.g. by applying a use obligation in case of a boiler replacement) similar questions concerning the accountability would occur.
Energy Efficiency Obligations	Regarding the question which market actors to oblige some alignment might be possible in the case of gas suppliers for which both obligations (EEO and RES-HC) could address the same companies. However, since suppliers of heating oil as well as solid fossil fuels are not covered by any of the existing energy efficiency schemes while the recommended design of the RES-HC obligation would not address electricity suppliers no further overlap is given regarding the obligated party. Regarding the administration of the RES-HC obligation similar procedures need to be established as for an EEO. In particular this includes the issue, trade, submission and redemption of certificates, verification, monitoring, control etc. The administrative and institutional set-up that needs to be implemented in order to facilitate these processes could be aligned to the EEO set-up. In order to avoid double counting it has to be ensured that the investment in a RES-HC installation is accountable towards the target of only one of the two obligations. For that reason we suggest that Member States exclude all RES-HC measures from being eligible to Art. 7 EED.

Source: Öko-Institut e.V.

2.3.4.1 Identification of additional/supportive instruments

There might be several other options to promote RES-HC that are mainly dealt with in other Directives, especially EBPD and EED. Examples include

- Strengthening the definition of "nearly zero energy standard" by ensuring 100% RES (replacing current provision "The nearly zero or very low amount of energy required should be covered to a very significant extent…" by "The nearly zero or very low amount of energy required shall be covered by energy from renewable energy sources…")
- Provisions for onsite RES-HC production
- Development of long-term strategies to decarbonise Member States' heating/cooling sectors and/or building sectors
- Measures aiming at soft cost reductions for RES-HC (IEA-RETD 2015)
- Taxation of fossil fuels

2.4 Increasing power sector flexibility

An increasing share of RES-E results in a change of flexibility demand. Today flexibility is mainly provided by conventional power plants as well as pumped hydro storage plants. Their flexibility is mainly used to meet demand and optimize the use of the conventional power plant fleet. Along with the increasing share of

[150] Regarding the relationship to Art 13 (4) RED it should be considered that from 2019/2021 onwards all new buildings need to comply with the nearly zero energy (nZEB) standard that in most Member States should include heat/cold production from RES-HC. For that reason Art 13 (4) will lose its effectiveness for new buildings. However, this does not apply to existing buildings that are subject to a major renovation as for those buildings no mandatory nZEB requirement does apply.

variable RES-E from wind and solar, additional flexibility is needed to integrate the electricity produced by those technologies.

In general we have to distinguish the following options that can either provide flexibility or reduce the demand for flexibility:

- Demand side flexibility
- Storing electricity (this option has been excluded from the assessment as there is no direct link to the RES-Directive)
- Using excess RES-E production
- Making production from VRE less variable
- Making other RES-E electricity production more flexible

Many measures to increase system flexibility e.g. via storage, demand side management or flexibility of conventional plants are located outside the RED. Measures to increase flexibility would be most appropriate within the RED if they directly address the flexibility of RES plants. Besides providing additional flexibility options, it is also important to reduce the flexibility demand in the first place.

In terms of system contexts, the demand for additional flexibility depends on:

- the share of RES-E (Kondziella & Bruckner 2016). Many studies show that the demand for additional flexibility increases substantially not before RES-E have reached a share above 50%, (Bauknecht 2014; Bauknecht et al. 2014; DIW 2013; VDE 2012).
- the kind of flexibility that is already available in the system (including conventional power plants) and that can be exploited, before new flexibility options and new technologies are set up.

We propose to link this action area more to task 3 and discuss measures to increase flexibility with member states and within the flexibility roadmap.

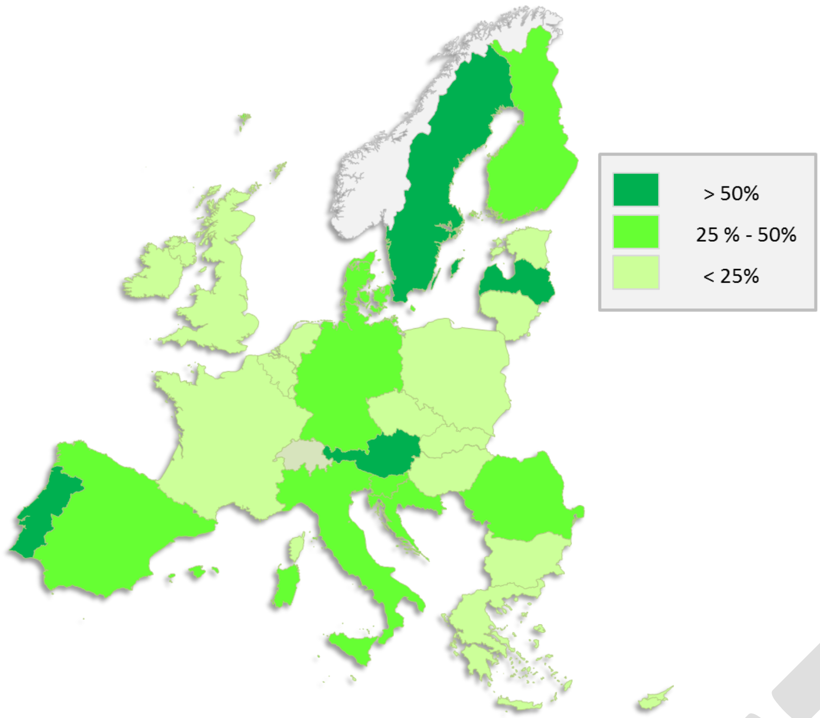
<u>One key question for the assessment of these options is which ones are relevant at which level of RES-E penetration and which ones in the long-term or in systems with higher RES-E penetration.</u>

We define three phases of different RES-E penetration:

- Phase I: <25% RES-E
- Phase II: <50% RES-E
- Phase III: >50% RES-E.

As will be discussed in more detail in the following sections, some measures can be expected to be implemented and having a positive impact even with low shares of RES-E within the system while others can only be expected to have a positive impact in systems with high shares of RES-E. The impact of adding flexibility also depends on the structure of the remaining fossil power plant fleet (Agora Energiewende 2015).

It important to stress that most of the European MS have RES-E shares of around 30% (see Figure 31). Electricity production from run-off water power plants are very relevant for MS with high shares of RES-E. However, flexibility is mainly needed in systems with a high penetration of variable renewable energy sources (VRE) (IEA 2011).



Source: http://ec.europa.eu/eurostat/web/energy/data/shares

Figure 31 RES-E shares 2014 of the European Member States

2.4.1 Demand side flexibility

Demand side flexibility can be triggered by providing incentives to consumers to shift loads according to the system needs. If there is plenty of RES-E production, demand should increase, while it should decrease in times of low RES-E production. The following Table 76 shows the major pros and cons of demand side management providing flexibility.

Table 76 Demand side flexibility

Field of action / measure	Triggering flexibility of end customers by time dependent components of the price for electricity
Suitable for: Phase II	In general, additional flexibility is not necessarily needed in systems with a share of less than 25% RES-E.
Pro	▪ The investment needed to make demand more flexible is relatively low. ▪ This is especially true for larger industries.
Contra	▪ If the incentives to shift loads are based on variable prices of electricity, smart meters are needed in order to track the contribution of each customer.

	▪ While some larger consumers have meters that can track the usage per time, especially households would need an upgrade to smart meters. ▪ In some MS with high shares of lignite production, linking demand side management to an amplified market price can lead to even higher production from lignite because the marginal production costs of lignite power plants are relatively low.
Discussion	▪ The general question is, whether this issue can be addressed in the RES-Directive.

Source: Öko-Institut e.V.

2.4.1.1 Time dependent taxes on energy & Time dependent RES-levies

One option to vary the overall price for electricity would be to vary the taxes on energy. If there is plenty of RES-E energy production taxes could be low in order to reduce the overall price for electricity at this time. There is a chance that this way, customers are incentivised to reduce demand in times of low RES production.

Table 77 Triggering demand side flexibility | Time dependent taxes on energy

Field of action / measure	Triggering flexibility of end customers by time dependent components of the price for electricity Time dependent taxes on energy
Pro	▪ Amplified price signal making it more profitable for consumers to shift loads into times of plenty RES-E production
Contra	▪ This measure might shift costs to consumers that are for different reasons not flexible. ▪ The taxes on energy vary from MS to MS (see Figure 32). Therefore the effectiveness of the measure can differ throughout Europe.

Source: Öko-Institut e.V.

If there is plenty of RES-E energy production also the RES levies could be low in order to reduce the overall price for electricity at this time. The option discussed for example in (Nabe & Bons 2014) suggest to link the RES-levy to the market price.

Table 78 Triggering demand side flexibility | Time dependent RES-levies

Field of action / measure	Triggering flexibility of end customers by time dependent components of the price for electricity Time dependent RES-levies
Pro	▪ Amplified price signal making it more profitable for consumers to shift loads into times of plenty RES-E production ▪ There is a direct linkage to the RES-share per hour. ▪ This measure can incentivize an integration of self-production strategies into the general system demands. In times of high RES-production the RES-levy is low which results in a reduced self-production.
Contra	▪ This measure might shift costs to consumers that are for different reasons not flexible. ▪ RES-levies are not harmonized regarding its share of the overall price for electricity, therefore the effectiveness can differ. However there is a correlation between the share of variable RES-E sources and the RES-levy. The higher the share of variable RES-E the more effective is a time dependent RES-levy. ▪ In some MS industries with high electricity consumption are exempted from the RES levy; however some large potential for demand-side-management can be found within those industries.

Source: Öko-Institut e.V.

For both – RES levies and taxes – the issue of diverging shares between the MS arises. The following **Figure 32** shows the significant differences between the MS. This results in diverging incentives to shift loads according to the overall electricity price.

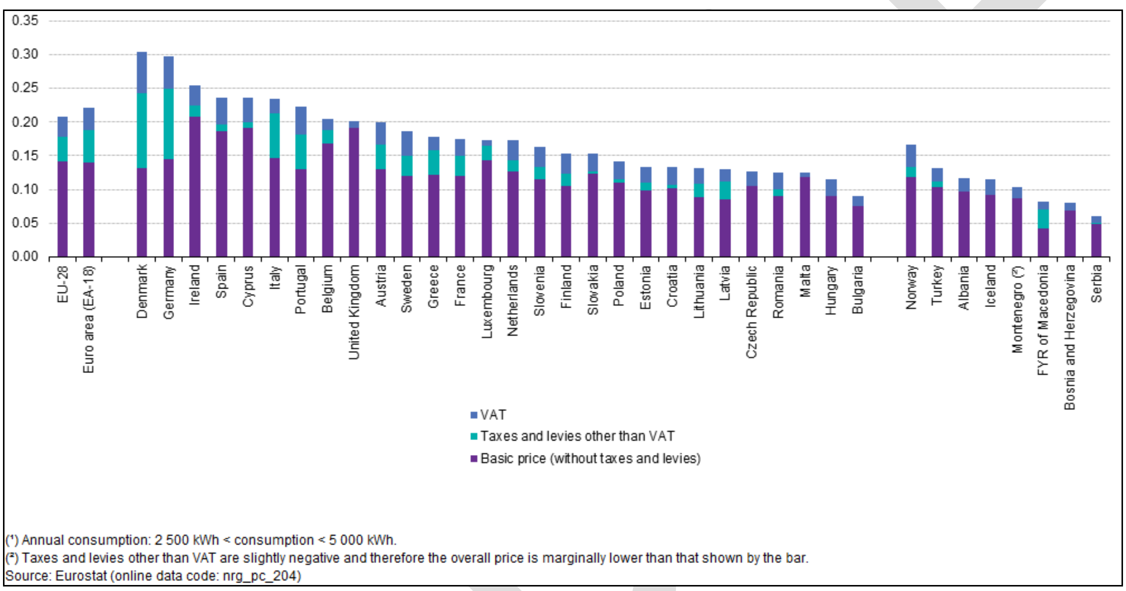


Figure 32 Differences in taxes and RES levies in between MS

Source:http://ec.europa.eu/eurostat/statistics-explained/index.php/Energy_price_statistics#Electricity_prices_for_household_consumers

In general both components (RES levy and tax) only account for a small share of the overall electricity price. One further option could be to combine several price components in order to increase the economic incentive to shift loads.

2.4.1.2 Time dependent grid tariffs

If there is plenty of RES-E energy production grid tariffs could be low in order to reduce the overall price for electricity at this time. There is a chance that this way, customers are incentivised to reduce demand in times of low RES production.

Table 79 Triggering demand side flexibility | Time dependent grid tariffs

Field of action / measure	Triggering flexibility of end customers by time dependent components of the price for electricity Time dependent grid tariffs
Pro	▪ Amplified price signal making it more profitable for consumers to shift loads into times of plenty RES-E production
Contra	▪ It is difficult to find a theoretical rationale for why the payment of grid-costs should be indexed with whole-sale prices. ▪ This price component could stay reserved for triggering flexibility used for grid constraints.

Source: Öko-Institut e.V.

2.4.2 Making production from VRE less variable and more flexible

There are several options to make production from VRE plans less variable and if possible even more flexible in production.

2.4.2.1 Enable RES-E plants to participate in balancing markets

Measures could be introduced in order to enable RES-E plants to participate in balancing markets. In Germany for example plants that receive support under the feed-in-tariff are not eligible to participate in the balancing markets. However, under the feed-in-premium participation is possible (Hirth & Ziegenhagen 2014).

If participation of RES-E plants in balancing markets leads to a reduced provision of balancing services by conventional plants with their minimum load, this can significantly contribute to increased RES-E shares.

This measure is different from an increased balancing responsibility for RES-E as required by state-aid guidelines.

2.4.2.2 Reduce variability of production from VRE

One measure to reduce the flexibility demand that results from VRE is to design the plants in a way so that they do not maximize overall generation, but rather provide a less variable production curve. This can be achieved for example by weak-wind turbines and to some minor by level east-west oriented PV plants. RES-E support schemes can be designed in such a way that they incentivize such plants and production profiles rather than maximum output. In general, market integration of RES-E plants, i.e. plants have to sell their output on the market, is a good way to provide such incentives (Öko-Institut e.V. 2014b) bearing in mind that the measures have to take the technology inherent possibilities into account. Also the effect from this measure is limited. Nevertheless, the question is whether and how such incentives could and should be further strengthened, i.e. through a specific design of the market integration approach.

Table 80 Reduce variability of production from VRE

Field of action / measure	Reduce variability of production from VRE by adapting technologies Linking support schemes to the market price
Suitable for: Phase II	As long as most of the RES-E production can be used directly to cover demand, there is no strong need for reducing variability of production from VRE.
Pro	• Overall demand for flexibility can be reduced.
Contra	• More space for wind turbines and PV-Modules would be required to generate the same amount of production. This is especially relevant for wind turbines while east-west orientated PV plants can be deployed on additional suitable rooftops.
Discussion	• Agora Energiewende suggested (Öko-Institut e.V. 2014b) a premium on top of the general RES-support which is being paid for VRE production units that are designed to produce most adequately to the system needs (wind turbines can for example be designed to produce less peak-production). This premium is defined as a capacity payment which is higher for technologies that produce according to the system needs with less production peaks.

Source: Öko-Institut e.V.

2.4.2.3 Geographical distribution of RES-E plants

Linked to the previous possible measure is the issue of the geographical distribution of RES-E plants. If RES-E plants are concentrated in a small area so as to exploit best sites in terms of primary energy (e.g. wind in the north of Germany), this can lead to higher peak-production due to synchronized production profiles and therefore to a higher flexibility demand in terms of flexible capacity (Wimmer 2014). One option to incentivize a more distributed deployment of RES-E would be diversified support by regions.

Table 81 Intensified geographical distribution of RES-E plants | Regional diversified support

Field of action / measure	Incentivize greater geographical distribution of RES-E plants (especially wind turbines) in order to exploit different generation profiles in different regions Regional diversified support for RES-E
Suitable for: Phase II	As long as most of the RES-E production can be used directly to cover demand, there is no strong need for reducing variability of production from VRE.
Pro	• The variability and ramps of the overall production can be reduced. • Also this approach might also put less stress on the transmission grid.

Contra	• Leads to development of sites with lower wind speeds which again results in the need for more wind turbines in total. This can again result in acceptance issues in the public.
Discussion	• If plants are more distributed and are also located at lower quality sites, this may increase the overall number of plants required to generate a certain amount of electricity, which can also lead to higher peaks (this effect has been described in Wimmer 2014). A support scheme design that aims at – amongst others – reduced flexibility demand should take these issues into account.

Source: Öko-Institut e.V.

2.4.2.4 Using flexibility from decentralized storages

There is also a link to self-consumption (see section 2.6). If flexibility (i.e. batteries) is used to increase self-consumption, the overall system demand for flexibility will typically increase because the electricity grid is not being used to its full potential (Öko-Institut e.V. & Offis 2016; Peter 2013) and the question therefore is when flexibility should be used for self-consumption or rather on a system level.

Table 82 Using flexibility from decentralized storages | Requirement

Field of action / measure	Use the flexibility provided through self-consumption incentives to optimize the overall electricity system Requirement: It should be possible to use decentralized flexibility for system and grid needs
Suitable for: Phase I	Storing electricity with higher losses compared to average grid losses is always less efficient from the system perspective (Agora Energiewende 2013). This rationale should be taken into account from the very beginning of RES deployment.
Pro	• Flexibility could be used in an optimal way to integrate RES-E into the system and replacing fossil generation.
Contra	• A to adjust operation of decentralized storage systems by requirement might reduce the will of consumers to invest in and operate decentralized flexibility (i.e. batteries). • Using decentralized storages for system operation would require further incentives for the customer or automatic management systems of those storages.
Discussion	• Please see the chapter on self-consumption, Chapter 2.6

Source: Öko-Institut

2.4.2.5 Optimizing the wind-PV mix

The flexibility demand also depends on the RES-E mix, namely the PV-wind-mix (Heide et al. 2010). This should be taken into account when designing and calibrating support schemes. Feed-in tariffs or quota systems could be designed in a way so that an optimal mix of wind-PV is created.

Table 83 Incentivize an optimal wind-PV mix in order to reduce variability of production

Field of action / measure	Incentivize an optimal wind-PV mix in order to reduce variability of production Adjust technology specific support schemes according to an predefined optimal mix of wind an PV
Suitable for: Phase III	This measure is especially important as soon as PV and Wind are a major source of electricity production.
Pro	• The variability and ramps of the overall production can be reduced.
Contra	• This measure might not be useful for all MS with high potentials of just one technology. In those situations there might be regions with more than one MS for which an optimal mix of technologies is beneficial. (Link to Task 3)
Discussion	• The optimal mix can differ from MS to MS (or region). • Various definitions about potentials etc. would be necessary in order to implement technology specific support schemes in MS.

Source: Öko-Institut

2.4.2.6 Making electricity production from RES-E other than wind and PV more flexible

Flexibility can be provided by plants fueled by biomass, landfill gas, sewage treatment plant gas and biogases. Support schemes can be designed so as to incentivize increased storage capacities. This can include gas and heat storages or additional CHP units that can help to make production out of those plants more flexible. In the following tables two options are discussed: linking RES-E support to the market price and oblige RES-E plants to install measures in order to provide flexible production.

Table 84 Trigger flexibility provided by plants | Link RES-E support to market price

Field of action / measure	Trigger flexibility provided by plants fueled by biomass, landfill gas, sewage treatment plant gas and biogases (these are mostly based on CHP technologies) Support schemes: Part of the support could be linked to the market price
Suitable for: Phase II	As soon as production from VRE increase within the overall production, it is necessary to increase the flexibility of other power plants in the system to accompany the VRE.
Pro	• RES-E plants are incentivized to produce more energy in times of scarcity and less in times of plenty
Contra	• For some RES-E technologies the linkage to the market price does not make as much sense as for others. Therefore this measure would have to be technology specific which makes the development of this measure more complicated.
Discussion	• Linking the support to the market price gives strong incentives to invest in flexibility. • However, the technology inherent possibilities of flexible production have to be taken into account.

Source: Öko-Institut e.V.

Table 85 Trigger flexibility provided by plants | Obligation

Field of action / measure	Trigger flexibility provided by plants fueled by biomass, landfill gas, sewage treatment plant gas and biogases (these are mostly based on CHP technologies) Obligation: Oblige plants to install measures (e.g. gas-storage or additional CHP unit) which make it possible to provide flexible production.
Suitable for Phase: II	• As soon as production from VRE increase within the overall production, it is necessary to increase the flexibility of other power plants in the system to accompany the VRE.
Pro	• Guaranteed investment in flexibility measures.
Contra	• Defining a certain measure to provide flexibility in form of a certain technology might hold back possible innovation. • Defining a certain output of flexibility is not straight forward to implement. Flexibility could be measured for example by the variation of production in relation to the plants possibilities. However, this will be hard to quantify and monitor. • If the plants have the possibility to produce in a more flexible manner, the RES-E support scheme still has to incentivize flexible production.
Discussion	• This obligation could be linked to an explicit support for investments enabling flexible generation • In Germany the EEG support scheme introduced such a flexibility bonus for biogas plants in 2012.

Source: Öko-Institut e.V.

2.4.2.7 Using excess electricity

Measures could be introduced to use RES electricity in situations where RES plants would otherwise have to be curtailed by the network operator due to network constraints. This can include a reduction of taxes and levies at certain times. The otherwise curtailed production could be used in storages, by demand side management or by other sectors (i.e. Power-to-Heat).

Table 86 Alternative use of curtailed RES-E production due to network constraints

Field of action / measure	RES electricity should be used (for example in other sectors) in situations where RES plants would otherwise have to be curtailed due to network constraints Reduction of taxes and levies at certain times of surplus RES-E in areas of grid bottlenecks
Suitable for: Phase: I	Network constraints can occur from the very beginning of RES-E deployment especially if VRE are being deployed. In the first phase, network constraints mostly occur within the distribution grid in relation to PV generation, later also the transmission grid is being affected mostly due to the peaks of wind generation.

Pro	• Less overall production losses from RES-E due to network constraints. • Use of renewable energy in other sectors.
Contra	• This measure might lead to reduced grid development in early stages of RES-E deployment.
Discussion	• Can be used as an alternative to full-scale grid development or as a preliminary measure while the grid is being developed. • In order to pinpoint the surplus RES-E production due to network constraints the reduction of taxes or levies has to address the network bottleneck. Therefore a regional differentiation is needed which is very hard to define and put in place.

Source: Öko-Institut e.V.

2.4.3 Cost-Benefit-Analysis

The main costs and benefits are economic or environmental ones. Nonetheless, there are some options that have to be discussed that relate to social costs and benefits.

2.4.3.1 Environmental and Economic costs and benefits

The following cost-benefit analysis differentiates between cost and benefits that arise from the general increase of flexibility within a power system and the cost and benefits that can be attributed to specific measures and flexibility options.

The following Table 87 describes the economic and environmental costs and benefits of the general increase of flexibility within a power system. For the economic assessment generation costs as well as investment costs are being considered. Environmental costs and benefits are being discussed for the topics CO_2-emissions and the need of grid infrastructure as well as the need for RES-E power plants. The latter two issues have a significant impact on the required space and therefore also on acceptance issues with the local public.

The costs and benefits of additional flexibility differ from phase I (with low shares of RES-E) to phase III (high shares of RES-E) (Papaefthymiou et al. 2014). This change is being addressed as well in Table 87.

The following Table 88 looks at the costs and benefits that can be attributed to specific measures and flexibility options. The table addresses the main arguments for positive or negative impact of the options on the economics as well as the environment. If available, quantitative data is provided for selected issues.

Table 87 Costs and benefits attributable to a general increase of flexibility within a power system[151]

Phase	Economic [Generation costs] [Investment costs]	Environmental [CO_2-Emissions] [Grid expansion] [required space for RES-E plants]
I	**For Phase I**: Negative economic effects result from investments being made into flexibility during an early phase where additional flexibility is not needed for integrating RES-E. **In general for all phases:** Flexibility results in lower generation costs as generation is being shifted from plants with high costs to plants with lower costs due to the existing economic incentives. Flexibility also enables integration of surplus RES-E generation which then substitutes more expansive fossil generation. The extent of the economic impact is highly dependent on the structure of the fossil power plant fleet. The higher the difference in marginal costs between the plants the higher the economic benefit from flexibility. **Beginning of Phase II**: Flexibility can result in avoiding negative prices at the spot markets.	One function of flexibility is to integrate surplus RES-E. In the first phase there is hardly any RES-E surplus that could be integrated by flexibility options. However, a lack of grid capacity in the distribution system can result in grid related RES-E surpluses. Existing flexibility options or new options can integrate this surplus. In this first phase with still high shares of fossil power plant production, flexibility results mainly in an optimization within the fossil power plant fleet which generally results in a shift from gas fired plants to coal fired plants. The consequence is higher CO_2 emissions.
II		In the second phase, integration of surplus is becoming more and more relevant. Surpluses occur in a fair amount of times and can be stored and shifted to times of fossil production, hence replacing fossil production. This leads to reduced CO_2 emissions. Flexibility still results in optimization of the existing fossil power system. In case of high shares of cheap coal power plants with high specific CO_2 emissions, flexibility can result in increased production from coal plants and hence higher CO_2 emissions. A lack of grid capacity in the distribution system – as in phase one - and now also in the transmission system can result in grid related RES-E surpluses. Flexibility measures can integrate this surplus and replace fossil fuels.
III		The function of integrating surplus RES-E production is very relevant in this phase. Therefore the environmental effect of substituting fossil generation by RES-E generation becomes more relevant. However, as long as cheap coal power plants are in the system flexibility can still lead to increasing CO_2-emissions. Grid constraints will become also more relevant. As it is not economical feasible to invest in grids that can handle every single MWh produced by RES-E plants it might become attractive to invest in flexibility options that are able to use the electricity in other sectors (heat, transport). This can reduce the need for grid expansion which again leads to less required space for grid infrastructure. In general RES-E production has to be used to the fullest as possible in this phase in order to keep the required space for RES-E power plants at a minimum.

Source: Öko-Institut e.V.

[151] This table is based on results from (Bauknecht 2016).

Table 88 Costs and benefits attributable to specific measures and flexibility options

positive assessment	no clear positive or negative assessment	negative assessment

Options for providing flexibility	Earliest Phase	Economic		Environmental		Measure triggering the options
		(Investment) Costs	Effects	Costs	Effects	
Demand side flexibility - Industry	I	Smart meters are generally already in place and no other large investments are needed compared to conventional storage options. Investment costs range from €1 to €18 per kW of flexible capacity.[152]	High efficiency factors of DSM make it possible to reduce generation costs by shifting loads into times of cheap generation.	No significant amount of resources or space needed	High efficiency factors of DSM options can help replacing fossil fuelled plants with low efficiency factors (i.e. old lignite plants) and result in low storage losses. However, shifting loads to times of cheaper generation can result in higher CO_2-emissions.	Variable RES levy Variable taxes Variable grid tariffs
Demand side flexibility - Trade and services	I	Investment in infrastructure incl. smart meter needed Investment costs range from 16 to 360 €/kW of flexible capacity[153]	High efficiency factors of DSM make it possible to reduce generation costs by shifting loads into times of cheap generation.	No significant amount of resources or space needed	High efficiency factors of DSM options can help replacing fossil fuelled plants with low efficiency factors (i.e. old lignite plants) and result in low storage losses. However, shifting loads to cheaper times can result in higher CO_2-emissions.	Variable RES levy Variable taxes Variable grid tariffs
Demand side flexibility - Households	II	The costs are assumed to be €223 per metering point[154] which results in high costs per kW of flexible capacity[155].	High efficiency factors of DSM make it possible to reduce generation costs by shifting loads into times of cheap generation.	No significant amount of resources or space needed	High efficiency factors of DSM options can help replacing fossil fuelled plants with low efficiency factors (i.e. old lignite plants) and result in low storage losses.	Variable RES levy Variable taxes Variable grid tariffs

[152] (Hartkopf et al. 2012)
[153] (Klobasa & Focken 2011)
[154] (European Commission 2014a)
[155] (Papaefthymiou et al. 2014)

					However, shifting loads to cheaper times can result in higher CO_2-emissions.	
Flexible RES-E power plants (biomass, landfill gas, sewage treatment plant gas, biogas)	II	Costs for gas storage and additional CHP unit (ca. 1000€/kw) are fairly high[156].	Flexible production of those plants can substitute fossil production and therefore reduce the overall costs of meeting demand. No significant losses occur in gas storages.	No significant amount of resources or space needed	Flexible production of flexible plants can substitute fossil production and therefore reduce CO_2-emissions. No significant losses occur in gas storages.	Making electricity production from RES-E other than wind and PV more flexible by: linking support schemes to the market price Oblige plants to install measures (e.g. gas-storage or additional CHP unit) which make it possible to provide flexible production
Enable RES-E plants to participate in balancing markets	II (negative balancing) III (positive balancing)	No significant investment is needed in order to provide balancing power even from VRE.	Very much depending on the support scheme for RES-E. In the case of providing positive balancing power constant losses in production from RES-E result in increased overall generation costs.	No significant amount of resources or space needed	In the case of providing positive balancing power constant losses in production from RES-E might result in increased CO_2-emissions if the gap has to be filled by fossil power plants.	Smaller units and plants with higher forecasting uncertainty should be allowed in the balancing market Allow RES-E plants which are supported by some kind of support scheme access to the balancing market (double marketing provisions)

156 (ASUE 2011)

Reduce variability of production from VRE (by triggering adapted technologies)	II	Compared to the deployment of standard i.e. wind turbines the costs of i.e. weak wind turbines are assumed to be slightly higher.[157]	Less investment costs needed for backup capacities and other storage options in systems with high shares of VRE[158]	Slightly higher use of space due to i.e. the larger rotor of weak wind turbines, but also less need for storage within the system	As less storages are needed for meeting demand at all times, storage losses are reduced which can result either in less RES-E deployment needed or less fossil generation and therefore less CO_2-emissions.	Linking support schemes to the market price
Using RES-E surplus triggered by grid bottlenecks (To address grid related RES-E surplus, flexibility options need to be deployed at the location of the bottleneck)	I	Especially for Power to heat the investment costs are relatively low. Other options like Power to gas or batteries have much higher investment costs.	As long as other generation can be substituted by RES-E generation that would otherwise have been curtailed, costs of meeting demand can be reduced. If RES-E is being used in other sectors, no direct benefits for the electricity sector can be derived.	No significant amount of resources or space needed	In the case of using the surplus in other sectors, fossil fuels are replaced in those sectors, resulting in higher CO_2-emissions. If surplus is stored i.e. in batteries, the general positive effects of substituting fossil generation in later times occur.	Reduction of taxes and levies at certain times of surplus RES-E
Optimizing the wind-PV mix in order to minimize flexibility demand.[159]	III	The resulting mix might differ from the optimal cost effective mix for RES-E deployment.	Less investment costs needed for backup capacities and other storage options in systems with high shares of VRE.	Reduced need for storage within the system etc.	As less storages are needed for meeting demand at all times, storage losses are reduced which can result either in less RES-E deployment needed or less fossil generation and therefore less CO_2-emissions.	Adjust technology specific support schemes according to an predefined optimal mix of wind an PV
Using flexibility from decentralized storages	I	If decentralized storage options are deployed already for other reasons (self-consumption), only	Decentralized flexibility can be used to optimize the overall power system with the benefits described for	No significant amount of resources or	The times in which decentralized storages are being use in a way which does not suit the system	Requirement: It should be possible to use decentralized flexibility for system

[157] (Prognos AG 2013)
[158] This connection has also been made in (Öko-Institut e.V. 2014a)
[159] (Heide et al. 2010)

		some additional costs to integrate those storages into the power system processes need to be considered.	general flexibility deployment (Table 87).	space needed.	needs are being reduced. This again leads to better overall integration of RES-E production and reduces CO_2-emissions.	and grid needs
Geographical distribution of RES-E plants	II	More plants have to be deployed in order to generate the same amount of electricity while not focusing on the locations with the highest potentials. This results in higher deployment costs.[160]	Due to higher minimum overall generation from VRE (i.e. weak wind turbines) less investment costs are needed for backup capacities and other storage options in systems with high shares of VRE.	Reduced need for storage within the system etc. but increased use of space for increased number of plants.	As less storages are needed for meeting demand at all times, storage losses are reduced which can result either in less RES-E deployment needed or less fossil generation and therefore less CO_2-emissions.	Regional diversified support for RES-E

160 (Wimmer 2014)

2.4.3.2 *Social costs and benefits*

Most of the measures and flexibility options discussed in this paper are large scale options or strategic options that do not affect social groups as such. However, small scale flexibility options like batteries used in combination with a PV-system or demand side flexibility of households have a direct impact on certain social groups. On the one hand, these small scale flexibility options make direct participation of households in the energy market possible. On the other hand, it has to be taken into account that only some social groups can afford to invest in flexibility options. This occurs mainly in combination with an already or newly installed PV power plant in the case of batteries. In contrast to the case of batteries, most social groups would in general be able to participate in DSM schemes. Yet, also this option needs in most cases investment in smart metering and consumers with a high proportion of inflexible loads would face high costs in case of variable price components. DSM also calls for a high activity of the consumers if the main loads are not controlled automatically.

2.5 Participation of consumers, citizens and communities

2.5.1 Introduction

The Energy Union strategy places citizens at the core of the EU energy policy. This action area analyzes how adequate support for active participation of citizens can be provided in the new RED.

Options in two different fields have been analyzed:

- Instruments that support and strengthen the role of community energy projects and especially energy cooperatives, where citizens can collaborate with others to perform collective action.
- Instruments that enable and incentivize self-production and self-consumption of energy. Individual citizens can produce energy on their own premises and either self-consume it or export it to the distribution system they are connected to. These instruments are currently discussed in a separate report.

In many cases, these instruments will consist in creating exemption rules or safeguards for regional cooperatives or individual citizens. Therefore, a proper definition of terms is of high importance (e.g. how to differentiate between small-scale and large-scale and how to assess the degree of community participation in RES projects?). The consortium will provide recommendations on how these distinctions can be made.

A comment on definition and wording: Citizens that join in cooperative action usually form some sort of legal entity. These can be very diverse, which makes it difficult to find a definition that encompasses all of them. They are often small, but not necessarily so (e.g. large wind parks in Denmark and Germany). They often have a regional context, but not necessarily so (e.g. crowdfunding projects). We suggest to use the term 'community energy projects' (rather than 'regional cooperatives') as this term does not imply a regional context, and, more importantly, is not limited to a certain legal or organizational form. The term is widely used in literature and also in some national legislation.

2.5.2 Overview of various dimensions to involve local citizens, consumers and communities

The involvement of local citizens, consumers and communities in renewable energy projects can take different forms. The following roles can be distinguished:

- Consumer
- Investor
- Political Actor

These dimensions are interrelated. For example, if the consumer and the investor role converge, consumers turn into prosumers. And both the consumer and the investor role can have an influence on the political actor role and the acceptance of both individual projects and renewable deployment as a whole.

In the consumer dimension, besides the development towards prosumers, consumers can become more active by providing more demand side flexibility, either to increase self-consumption or to provide this flexibility to the system. While this is often presented as a way of empowering consumers to make better informed decisions[161], it also requires consumers to relinquish some of their flexibility (in terms of the flexibility to use electricity irrespective of the market situation). It can expose them to a higher market risk, if they are exposed to market prices.

Another important aspect in the consumer dimension is the consumption of green electricity. As an alternative to investing in RES projects, consumers can explicitly buy energy from such projects. The voluntary green power market is a case in point. In terms of community energy projects, there is some evidence that there is a slightly higher willingness-to-pay for electricity produced by such projects (Sagebiel et al. 2014). However, the green power market is still relatively small, even in member states like Germany. It could be increased to some extent if consumers could buy green electricity directly and outside the regular support mechanisms, if a suitable mechanism is put in place. Such a mechanism can enable consumers not just to buy green electricity, but also specifically buy regional electricity.

In the dimension of political actors a key question is how participation in project planning can be improved. There is a potential trade-off between increasing acceptance through more participatory planning procedures and the objective to make these procedures shorter and less costly. Besides that, there can also be compensation payments for the local community or affected citizens. In general, it is important to distinguish between 'community ownership' which generally entails a higher degree of active participation, responsibility and involvement, and 'community benefit', where local municipalities or individual citizens participate in economic benefits.

Finally, the investor dimension is the focus of the following sections, especially with regard to community energy projects that are primarily based on financial community

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[161] See for example https://setis.ec.europa.eu/publications/setis-magazine/smart-grids/demand-response-empowering-european-consumer, last accessed on 7 April 2016.

and citizen participation, and to self-production and self-consumption, where citizens also turn into investors.

In contrast to projects which are defined by a pivotal role and participation of citizens in terms of development and implementation, there are also investment models where their role is reduced to a minority financial participation. This can be done voluntarily by project developers, but there are also schemes that stipulate a mandatory community involvement in renewable energy projects: Examples are Wallonia, Denmark (Bauwens et al. 2016) and the federal state of Mecklenburg-Vorpommern in Germany that plans to put in place such a scheme. These regulations ensure a certain level of economic participation, but do not necessarily encourage active participation in decision processes.

2.5.3 Community energy: Status quo

There are a significant number of renewable energy cooperatives in the European Union. However, it is also important to note that these are mainly concentrated in quite a small number of countries.

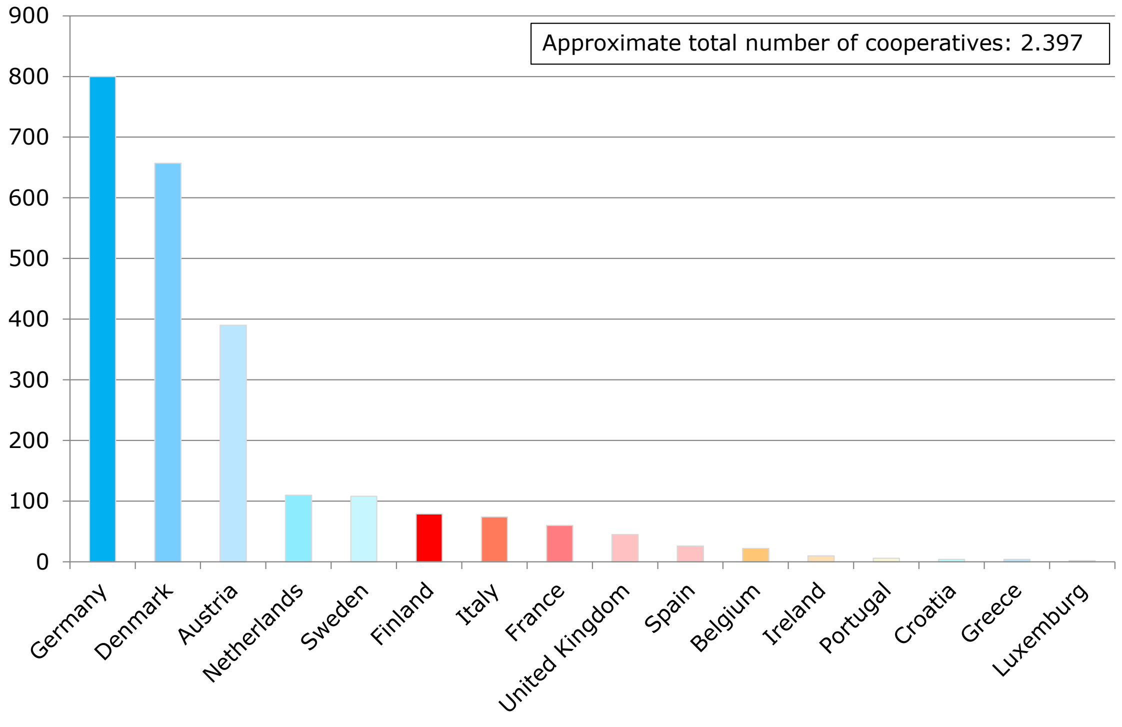

Figure 33 Approximate number of renewable energy cooperatives in seventeen European countries

Source: Based on figures by (RESCoop 2016), own illustration

The fact that energy cooperatives play only a minor role or are not relevant at all in many member states cannot only be explained by the regulatory design (which could be changed to remove barriers). Rather, it also depends on the capital that can be made available by citizens and cultural factors like the general attitude towards cooperatives and the cultures of local energy activism (Bauwens et al. 2016; Magnani

& Osti 2016; RES-Report: Interviews with Stakeholders in the Renewable Energy Sector in Europe 2016; Schreuer 2012). This leads to the question of whether – from a European perspective – the primary objective should be to promote cooperatives all across Europe, or whether the focus should be on removing barriers so that cooperatives can be set up in those member states where they fit into the cultural landscape.

2.5.4 Rationale and specific characteristics

To design support mechanisms for community energy, one should first establish an understanding of why this should be done, which types of community power projects exist, and how these types of projects are different from established actors.

2.5.4.1 Rationale for supporting community energy

There are several benefits that can result from supporting community energy:

- **Increasing public acceptance:** If citizens participate actively in renewable power projects they benefit in two ways: They participate in economic gains from investing in renewable power (by selling self-generated power or by consuming self-generated energy and thereby reducing their energy bills), and maybe more importantly, they take an active part in shaping their environment, instead of limiting themselves to being passive consumers of energy. This way, public acceptance for single renewable power projects as well as for the general concept of increasing renewables deployment may be increased.
- However, there can also be a trade-off between these two levels of acceptance (individual projects and overall RES deployment). This can be the case especially if measures to increase the acceptance for individual projects are implemented at the expense of efficiency and therefore increase the overall costs of RES deployment, which may in turn increase consumer prices and thus reduce their acceptance.
- Moreover, community energy can certainly increase the acceptance of some people, but the question remains which part of the overall population actually finds this type of involvement attractive and will therefore be affected in their attitude towards renewables.
- In terms of technologies, acceptance problems often occur with wind projects rather than PV projects. It is therefore important that community energy projects are enabled to develop such projects.
- **Energy Transition as democratization:** The development of renewables is often not just seen as a technical project to reduce the environmental impact of energy provision, but is often also related to a more "democratic" or participatory organization of the energy system (100 prozent erneuerbar stiftung 2012; Dunker & Mono 2013; Kunze & Becker 2014), which is often seen as a goal in its own right. Community energy can contribute to this objective.

- **Unlocking capital:** Incentivizing citizens to participate in community energy projects means to introduce actors that would otherwise not invest in this sector, thereby unlocking new sources of capital. This may be another way in which community power may help to reach ambitious renewable energy targets.
- **Increasing actor diversity:** It is debatable, though, whether actor diversity is a benefit in its own right. It can be seen as one way to increase the resilience of the energy sector.

2.5.4.2 Ownership models of community power projects

There exist a large variety of organizational and legal types of community energy projects:[162]

- Cooperatives, partnerships, community trusts and foundations: These legal forms are typical for 'classical' renewable energy cooperatives. They usually feature a strong regional focus and a high degree of active involvement of members.
- Public utility companies: Public utility companies are under municipal ownership.
- There can be both companies/projects that are mainly controlled by regional actors and companies/projects without such a regional focus (Trend:research & Leuphana Universität Lüneburg 2013: 29).

2.5.4.3 Specific characteristics of community power projects, and barriers that result from that

There are some characteristics that set community power projects apart from other actors. This is the reason for implementing dedicated measures to create a level playing field where community power projects can participate in the power market under fair conditions.

- **Low risk tolerance:** In many cases, the capabilities of community power projects to deal with risks are significantly different than those of traditional actors. The main reason for this is that in many cases, community power enterprises plan only a small number of projects at any given time – in fact, often only one single project is planned. This makes it very difficult for these actors to mitigate or distribute risks associated with realizing their projects, e.g. risks associated with support schemes based on competitive bidding processes, delays due to inefficient administrative procedures or uncertainties regarding grid access.
- **Limited know-how:** Community power projects often feature a high share of non-professional, semi-professional or voluntary work. This makes it difficult for them to deal with complex administrative procedures.

[162] Abridged from (ClientEarth 2014)

- **Difficulties to access capital:** Especially in MS where access to support schemes is uncertain or where national support for community energy is not sufficient, community energy projects may have difficulties in accessing capital.
- **Different cost profiles:** For some types of projects where economies of scale are important, community power projects may have difficulties to compete with other actors in terms of costs (e.g. solar PV). However, the evidence suggests that this point is not top priority, and that citizens' cooperatives can even have a cost advantage (Fachagentur Windenergie an Land e.V. & IZES 2015).
- **Low capacity to react to locational signals**: If actors operate locally they are bound to local sites, which can be an advantage in terms of acceptance, but can also be a problematic, e.g. when grid connection charges have a high regional variation (in deep connection charging schemes)
- **Democratic decision making process:** Many community projects (e.g. cooperatives) are characterized by a democratic decision making process (Bohnerth 2015). Therefore it may take longer for a cooperative to make decisions that are necessary in an application process (Bauwens et al. 2016).

2.5.4.4 How to overcome barriers that are specific for community energy

A number of measures could be implemented to overcome these barriers:

- **Guarantee fair access to support schemes:** To establish adequate safeguards in competitive bidding schemes is considered top priority by most stakeholders that have been consulted.
- **Acknowledge importance and assure long-term support of community energy on EU level**: This would encourage MS to implement long term strategies for supporting community energy and reduce uncertainties.
- **Simplify administrative and permitting procedures:** This would benefit all actors that invest in renewable energy, but community energy is especially vulnerable to these barriers.
- **Encourage capacity building and knowledge transfer:** This would enable community energy actors to overcome legal and administrative barriers and to successfully participate in complex market contexts

2.5.5 How to define community energy and small-scale projects

2.5.5.1 Why a definition of community energy is necessary

A definition of community energy can serve different purposes: First, if MS are to be encouraged to support community energy growth via the new RED, a definition of community energy in the RED should be used to create a common understanding of what community energy is, how it can help achieving renewable energy targets, and which types of projects should be supported.

Second, there have also been proposals to introduce certification schemes for community energy projects in order to increase market transparency (LITRES 2015). This would also require a clear definition. Some interviewed stakeholders have been sceptical about the added value of such a certification scheme. The main concern is that – due to the high diversity of community energy projects – it may not be possible to agree on a definition that is precise enough for certification processes without excluding a large number of projects.

Third, if community energy projects are to be supported via dedicated regulatory and legislative provisions, precise definitions are needed to distinguish which actors are eligible for these provisions and which are not (e.g. the rated power limits in the State Aid Guidelines which allow for exemption from competitive bidding support schemes, see further below in this section). These definitions should be as inclusive as possible to prevent excluding actors that should be supported, but as exclusive as necessary to prevent abuse.

If regulation is based on size definitions, one should distinguish between size of individual projects, company size and portfolio size (number of projects that are planned / submitted in overall or in parallel). Another issue is to distinguish between 'small-scale' projects and 'community energy' actors. Both have unique characteristics, and both need special consideration to create a level playing field where they can participate in power markets under fair conditions.

2.5.5.2 Characteristics that can be used for classification

Creating exemption rules makes it necessary to define which actors are eligible for this type of differentiation and which are not. There are different criterial that can be applied:

- **Size of individual projects:** This can be a size limit in terms of rated power, or a limit on the number of wind turbines included. Size limits would need to be technology specific (e.g. size limit of 1MW is very relevant for PV, but irrelevant for Wind)

  Pro:

  - Easy to understand, define & control

  Con:

  - Does not account for the actor type. Not all small-scale projects are community power project in the sense that they are community owned or community controlled. Favouring small-scale projects does not necessarily support citizen participation.
  - Not all community energy projects are small. There is evidence that also larger projects are being developed. According to stakeholder consultations, project size is rather limited by the local availability of sites and the size of the local community which participates in the project than by the ownership or participation model. Restrictive size limits can put larger community energy projects at a disadvantage and create an incentive to keep projects small, thus unnecessarily limiting the scale-up potential of community energy. This is also confirmed by interviews conducted by (FA Wind & IZES 2015). In those cases where community projects can contribute to local acceptance or have a better local network than external project developers, they may even have access to larger sites.

   - A size limit could also create perverse incentives. Statements from consulted stakeholders indicate that limiting exemptions to small projects may create an incentive for community power projects to stay beyond these size limits, although they could develop larger projects as well. If the role of community power is to increase substantially in the longer term, it should not artificially be limited to small niche applications.
   - If the size limits are increased high enough larger community energy projects are not put at a disadvantage, the number of eligible actors may become large enough that in the case of bidding processes the number of participations and the level of competition may be significantly reduced (Tiedemann et al. 2015). Depending on the way projects are exempted from the tendering scheme, the definition of the threshold may also undermine the quantity control that can be established with such schemes.
- **Company size:** Eligibility can be linked to company size (e.g. in terms of number of employees or business volume). The DGRV (an association that represents German cooperatives) proposes to limit exemption rules in the tendering process to small and medium enterprises (SME) as defined in the EU recommendation 2003/361. (DGRV 2015b; European Commission 2003)
   - Pro:
   - Easy to define & control (SME definition is well established)
   - Con:
   - Similar to size of project, company size is not necessarily linked to certain type of actors - being a small company does not necessarily imply a high degree of citizen participation. Also, there may be a significant community power projects that are too large to be SMEs (e.g. municipal utilities).
   - The SME definition excludes many relevant small- and medium-sized actors in the energy sector, namely municipal utilities.
- **Size of project portfolio:** The smaller the number of projects that are planned in parallel, the harder it is to distribute the risk of one project being delayed or failing across other projects. According to a survey conducted by FA Wind and IZES (2015) cooperatives typically bring online a maximum of one project per calendar year, unless in the case of very small projects, which can be up to five or six projects per calendar year. As projects are often developed over several years, there may also be years without a project that start operating. The DGRV proposes a limit of max. one bid per year, if only small cooperatives are to be targeted, or of up to three projects per year, if other actors like small municipal utility companies should be included (DGRV 2015b).
- **Participation of Citizens:** The increase of citizens that actively participate in the integration of renewables has a number of advantages and is one of the main rationales why community energy projects deserve special attention. This is an argument for including this dimension in the definition.

- **Regional context:** A project that is rooted within the local community is likely to experience higher levels of public support – an important argument for supporting regional projects. Additionally, actors that only operate within a small region are often especially vulnerable as they cannot distribute risks across projects in different locations. This makes it difficult for them to deal with non-compliant DSOs or local authorities. The question is if should be made a mandatory requirement and how 'regional' can be defined.
- **Limit to type of organization / degree of participation:** The exemptions can be linked to certain requirements regarding the organizational or legal form of actors. The objective is usually to ensure a minimum degree of direct citizen participation. For example: The German Ministry for Economics and Energy proposes to limit simplified prequalification rules to companies where natural persons hold more than half of the voting rights (Bundesministerium für Wirtschaft und Energie 2016).
    - Pro:
    - Accurate targeting of specific actor group
    - Con:
    - Difficult to implement, especially on EU level, as legal forms and organization types are very diverse

2.5.5.3 How large are community energy projects?

In terms of the relationship between actor type and project size, there is some evidence that these two criteria do not correlate strongly enough so as to use one as the proxy for the other, i.e. the project size as a proxy for the company type. There are two main reasons for this: First of all, community energy projects also invest in larger plants, and second, other, larger market actors also invest in smaller plants.

As for the first point (energy cooperatives' investments in larger plants), there are examples of larger projects carried out by cooperatives, and there is a certain trend towards larger projects, as for example highlighted in the following analysis: "*The growth from low capital rates to comparably high capital rates reveals that a significant number of renewable energy production cooperatives intensified their investment activities by increasing the size or the number of their projects. The observation of higher investments is in line with a rising number of cooperatives that have turned their business focus from smaller photovoltaic projects to more capital intensive wind power projects*" (Debor 2014: 15).

Examples for large renewable power projects that are community owned are the Middelgrunden offshore wind farm in Denmark (20 turbines, 40MW)[163] or the Saterland onshore wind farm in Germany (24 turbines, 72MW)[164].

The following examples show other large wind parks in Germany that are operated by cooperatives with only one project so far.

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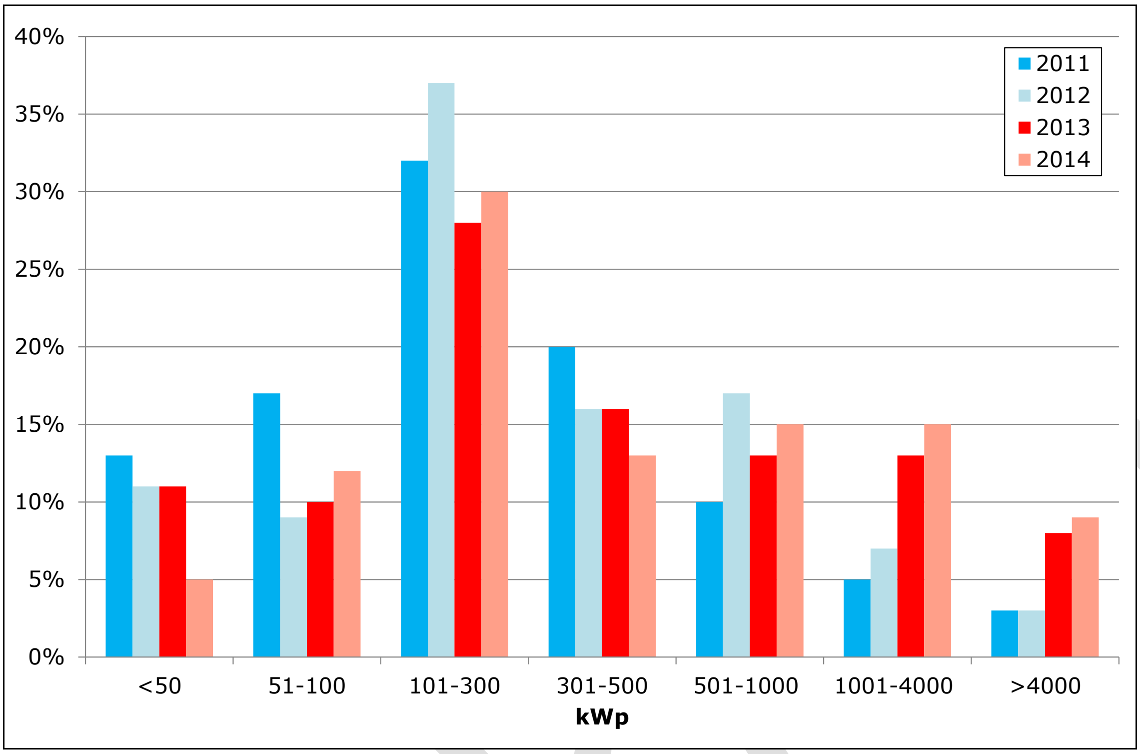
[163] http://www.middelgrunden.dk

[164] FA Wind and IZES (Fachagentur Windenergie an Land e.V. & IZES 2015)

- Bürgerwindpark Eider (69 MW)
- Bürgerwindpark Süderlügum (36 MW)
- Bürgerwindpark Neuenkirchen (35 MW)

Figure 34 shows the development of solar capacities of energy cooperatives in Germany from 2011 to 2014 (portfolios, not individual plants). Different developments of the different capacity categories can be observed over the years. All capacity categories below 500 kWp have decreased between 2011 and 2014, while portfolios with a capacity above 500 kWp have increased since 2011. This is not necessarily due to larger projects, but this is likely to be one reason behind this development.



Source: based on (DGRV 2012, 2013, 2014, 2015a), own illustration

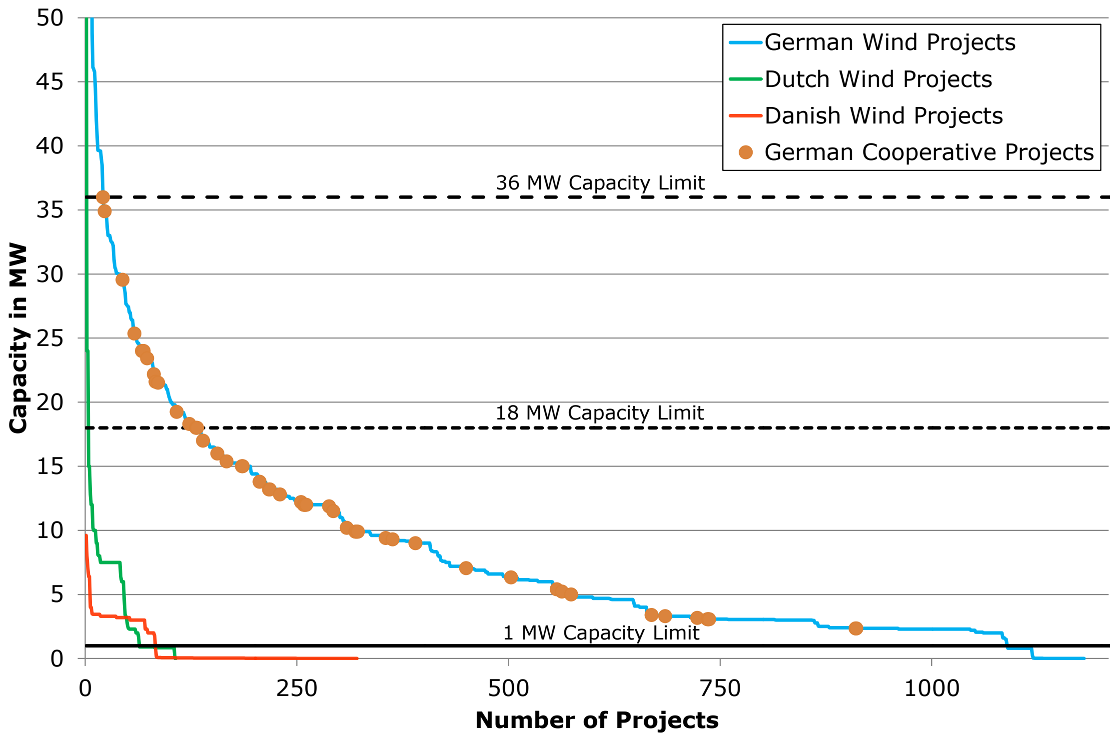
Figure 34 Development of the overall portfolio sizes of solar energy cooperative projects.

Figure 35 shows the size distribution of recent German, Danish and Dutch onshore wind projects. The graph represents 1208 wind projects in Germany and 371 wind projects in Denmark that have come online since August 2014. They are sorted by capacity[165]. In addition, 55 German cooperative projects are highlighted. The capacity of these projects varies significantly between 2.3MW and 36MW.

[165] In addition to the projects shown in the figure there are seven German projects with a capacity of more than 50 MW that are not shown in the figure, the largest one with a capacity of 99 MW. Three of these projects are cooperative projects.

The figure also shows capacity limits that have been proposed in national and European discussions on this topic. In Germany currently a 1 MW capacity limit is suggested by the Federal Ministry of Economic Affairs and Energy. Moreover, the European State aid guidelines from 2014 impose a limit of 36 MW per project (6 turbnies with 6 MW each). However, the European Commissioner for Competition Margrethe Vestager has clarified that this is to be interpreted as a 18 MW limit for a wind park (6 turbines with 2.5-3 MW each) (European Commission 2014b; Fachagentur Windenergie an Land e.V. 2016).

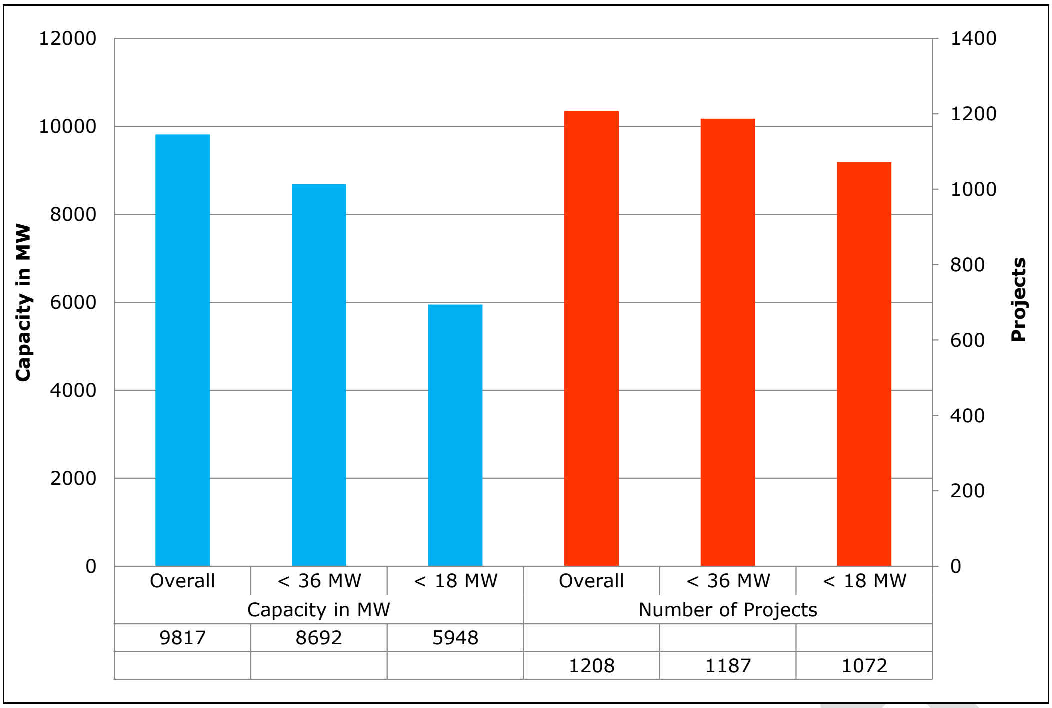
The figure shows that – in the observed group of projects – community energy projects were not limited to a certain size range. Attempting to define community energy projects by applying a fixed capacity limit would either exclude a significant number of community energy projects from the exemption, or include a significant number of other, conventional projects.



Source: Based on (Bundesnetzagentur 2016; Danish Energy Agency 2016), own illustration.

Figure 35 Capacity distribution of onshore wind projects in Germany, Denmark and the Netherlands (grid connection since 2014).

Figure 36 is based on the data for Germany that is depicted in Figure 35. On the left hand side the overall capacity is shown, as well as the sum of capacities for projects with a capacity of up to 18 and 36 MW respectively. The majority of the installed capacity is provided by smaller projects with a capacity smaller than 18 MW with 5948 out of 9817 MW in total. On the right hand side of the figure the number of projects in the same three categories can be seen. It becomes clear that almost all wind projects have a capacity of less than 18 MW. Only 115 projects have a capacity that lies between 18 and 36 MW.



Source: Based on (Bundesnetzagentur 2016; Danish Energy Agency 2016), own illustration.

Figure 36 Capacity and number of German wind projects with a capacity of up to 36 or 18 MW.

The above figures support the following arguments:

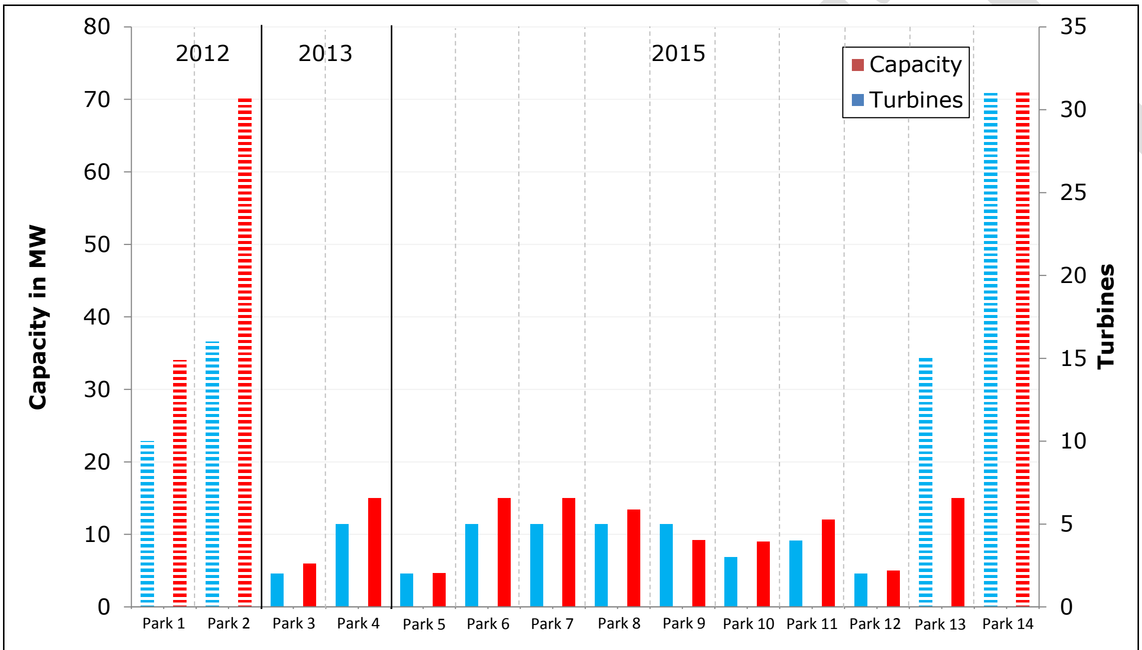
- A 36 MW size limit as originally envisaged in the State Aid Guidelines would exclude the large majority of projects in Germany (1187 out of 1208 in period shown above, i.e. 98% of all projects and 89% of the total capacity), and all the projects in Denmark.
- With a 18 MW size limit more projects would be included in auctions, but this capacity limit would still exclude a majority of projects in Germany (1072 out of 1208 in the period shown above, i.e. still 89% of all projects and 61% of the total capacity). Competition in the auctions would still be significantly redcued. All Danish and almost all Dutch projects would be excluded.
- Despite these limits, which are very "generous" in terms of the number of exempted projects and which have a highly visible effect on the auctioned volume, a significant number of community energy projects in the German example would still have to participate in auctions, at least with the 18 MW capacity limit. Moreover, there are a number of projects that are just below the 18 MW threshold. Therefore, if the limit is decreased in order to increase the number of projects that participate in auctions, the number of community energy projects that are not exempted would increase accordingly.
- A 1 MW size limit as discussed in Germany excludes only a very small number of projects and the large majority of community energy projects is not exempted.

- Finally, the examples of Germany, Denmark and Netherlands show that it is difficult to apply one size limit to different member states, as this makes it even more difficult to find the right balance between excluding some projects, while at the same ensuring that there is still enough volume that participates in the auction.

While Figure 35 shows that there are large community energy projects that exceed the suggested capacity threshholds, the following figure indicates that at the same time large wind developers with a significant portfolio do not only invest in large wind parks according to the above thresholds, but also have a significant number of smaller projects in their portfolio.

Figure 37 shows the different wind projects that were realized by juwi, a major German RES developer, in the years 2012, 2013 and 2015 in Germany. The different parks are displayed with the capacity as well as the number of turbines that are present in each wind park. Only the projects represented by a shaded bar would have to participate in a tender scheme, given the threshold of 18 MW with a maximum of 6 turbines.

If the main rationale for the exemption based on the treshhold is to avoid exposing smaller developers without a portfolio to the volume risk of auctions, the example in the figure below provides another argument for why such an approach is not accurate.



	Park 1	Park 2	Park 3	Park 4	Park 5	Park 6	Park 7	Park 8	Park 9	Park 10	Park 11	Park 12	Park 13	Park 14
Capacity	34	71	6	15	5	15	15	13	9	9	12	5	15	71
Turbines	10	16	2	5	2	5	5	5	5	3	4	2	15	31

Source: Based on (juwi 2016), own illustration.

Figure 37 Wind project portfolio of JUWI (German RES project developer). Only parks with shaded bars would exceed an 18MW/6 turbine threshold.

Overall the presented numbers indicate that it is difficult to set a capacity limit that can deal with the trade-off between on the one hand including as many projects in auctions as possible in order to guarantee a competitive price determination and on the other hand excluding all the projects that may no longer be viable if forced to participate in auctions. It is therefore necessary to discuss alternative criteria.

2.5.5.4 Examples for existing definitions

(Holstenkamp & Degenhart 2013) propose the following list of characteristics that are typical for regional cooperations:

- Providing capital: Citizens provide capital that is invested in RE
- Regional context: Members are part of a locally or regionally confined group
- Openness: Project is open to as many members of this group as possible
- Non-financial objectives: Objective is not only financial gain, but also (to some extent), non-financial objectives like common welfare
- Active participation: Citizens have the right to participate in decisions and control actions
- Majority participation: Citizens control more than 50% of the enterprises' voting rights

The **World Wind Energy Association (WWEA)** also puts a strong focus on participation and local context. According to WWEA, community power projects include *"business models where citizens contribute at least 50% of the equity of the company, the investors come from the region where the plant is located, and the majority of the projects' benefits are distributed locally"* (WWEA 2016).

Greenpeace has commissioned **ClientEarth** to make recommendations on how to support community energy projects in a post-2020 EU legal framework They put a strong focus on project size by joining all small actors under the term "prosumer". This group of actors should encompass *"active energy consumers, such as individuals, non-commercial organizations, public entities and small enterprises that participate in the energy market by producing renewable energy either individually or collectively through organizations, such as cooperatives or associations."* They argue that small actors, regardless of their type, share similar difficulties in accessing the power market and need similar strategies of supporting them (ClientEarth 2016).

In its recent reform proposal for the renewable support scheme[166] (which involves moving from a FiT/FiP scheme to a bidding scheme), the **German Ministry for Economic Affairs and Energy** proposes two safeguards:

- Small projects (installed capacity less than 0,75MW) do not need to participate in the auction and receive a fixed feed-in premium.
- For onshore wind projects, regional cooperatives ("Bürgerenergiegenossen-schaften") are eligible for simplified prequalification requirements (environmental impact assessment results do not need to be obtained prior to submitting the bid). This group of actors has been defined precisely:

[166] (Bundesministerium für Wirtschaft und Energie 2016)

- Active participation: At least ten members of the cooperative need to be natural persons, and these natural persons need to hold the majority of voting rights.
- Regional context: The majority of voting rights needs to be held by persons residing in the same administrative district as the project which is submitted.
- Portfolio size: Only one project may be submitted within a period of one year.

2.5.5.5 Conclusions

Finding suitable definitions for community energy is important – for regulative purposes as well as for establishing the concept of community participation and for incentivizing support for this growing group of actors. Size limits can be useful to distinguish small-scale actors which face specific risks and barriers that justify specific regulations and safeguards. However (as has been shown in section 2.5.5.3), solely using size (in terms of rated power, plant numbers etc) as a distinguishing indicator is not sufficient to take into account all actors that need special consideration.

It highly depends on the area of application which further metrics (in addition to size) should be used. Portfolio size (i.e. the number of projects planned within a certain time period) may be used to identify actors which are especially vulnerable to the risk of losing bids in competitive support schemes. Section 2.5.7.3 provides more details on design options for exemption criteria in support schemes. Minimum requirements on involvement of regional communities may enhance support for projects that enjoy high public support within their local context. However, for maximizing the effect of increasing citizen participation and active involvement of communities, minimum standards for ownership and business models should be applied to ensure a certain degree of participation.

2.5.6 Assure long-term support for community energy on EU level:

The Energy Union strategy places citizens at the core of the EU energy policy, and there are some provisions that provide implicit support (e.g. exemptions for SMEs or requirements to stimulate contributions of individual citizens). But an explicit acknowledgment of the importance of community energy is still missing.

Several of the consulted stakeholders claimed that the importance of community energy for reaching the 2030 targets (and beyond) should be spelled out clearly in the new RED. If the EU would acknowledge its long term support for this emerging group of actors, this would be a strong signal for member states to align their national policies, and it would help overcome investment security issues.

Formulating explicit support could entail:

- An explicit acknowledgment of the role of community energy
- A definition of the EU's understanding of what community energy, and of which types of community energy should be support most

- A call towards MS to define and implement long term strategies on how they intend to support community energy

This could be realized in a dedicated article on community energy (or on citizen participation, if cooperative and individual action of citizens should be addressed in the same section) in the new RED. It should include a definition of the EU's understanding of what community energy is, and why it should be supported.

Although the importance of decentralized, community owned renewable energy production has increased significantly, there is currently no definition of this type of actors that is commonly agreed upon.

2.5.7 Provide access to renewable support schemes

The specific capabilities and requirements of community energy projects need to be taken into account when designing – or modifying – renewable support schemes.

2.5.7.1 Why access to support schemes can be difficult for community power

While FiT schemes are very well suited to create a beneficial environment for supporting community energy projects, auction or tendering schemes that are now being introduced incur high risks of being inaccessible to community energy projects. Based on the characteristics of community energy projects described in section 2.5.4, this is mainly due to the following effects:

- Higher costs of community energy projects: The costs of community energy projects can be higher due to several reasons:
    - For technologies where economies of scale are important (e.g. solar PV installations), small-scale projects are at a disadvantage (this is true for all small-scale projects, whether they are community-owned or not).
    - In countries where community energy projects face high administrative risks or no secure access to financial support, their costs of acquiring capital may be high.
    - However, community energy projects are not necessarily at a cost disadvantage compared to 'traditional' actors. For onshore wind projects in Germany, (Fachagentur Windenergie an Land e.V. & IZES 2015) found no evidence for systematically higher costs of community energy projects. They may even have lower costs due to lower staff overhead costs and a large share of voluntary work.
    - Depending on the country, the price risk resulting from auctions does not necessarily have to be a major barrier for community energy projects.
- Community energy projects usually develop only one project at a time, or at least only a very small number of projects. This makes it difficult for them to mitigate the risk of unsuccessful bidding. The volume risk resulting from auctions is more significant than the price risk.
- Community energy projects do not have enough resources to bear upfront costs for planning and pre-requisition.

- Community energy projects lack capacity and know-how to participate in complex bidding / tendering processes and to optimize their bidding strategy.

According to stakeholder consultations, especially the risk of unsuccessful bidding is highly prohibitive and needs to be mitigated.

In the new RED, new provisions should ensure that either community energy projects receive adequate and sufficient support through FiT or FiP schemes or that auction/tendering schemes are designed in such a way that community power projects have fair access. The State Aid Guidelines already leave room for the MS to protect / support community energy projects. This could be complemented by provisions in the RED that encourage (or even require) MS to implement their support schemes appropriately. MS could be either encouraged / required to develop own strategies, or concrete provisions could be prescribed in the RED itself (e.g. defining minimum standards for auction schemes).

It remains to be discussed how much of this can be dealt with in the RED, and in how far this should rather be implemented in the state aid guidelines.

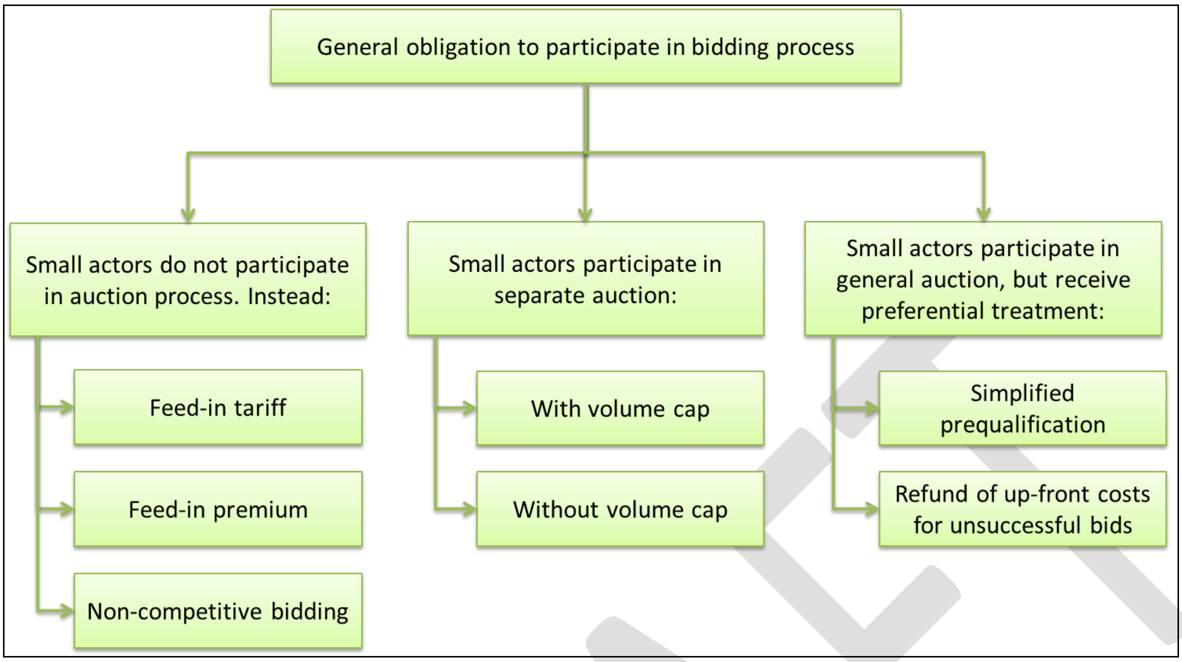
2.5.7.2 Options to secure fair access

There are different options to create a level playing field for community power projects in support schemes that involve competitive bidding processes (Figure 1 gives an overview).

- **Exemption from competitive bidding:** Community power projects are completely exempted from participating in the general bidding process. There are various alternatives:
  - **Feed-in tariffs or Feed-in premiums.** For example: In the proposed German tendering scheme, small projects (installed capacity less than 1MW) do not need to participate in the auction and receive a fixed feed-in tariff (Bundesministerium für Wirtschaft und Energie 2016)
  - **Non-Competitive bidding:** Actors participate in the general bidding process and receive the price that results from the bidding, but their bids are accepted automatically. This leaves the price risk but eliminates the volume risk.
- **Separate bidding process:** A separate, parallel bidding process for community power projects is established. This results in a price that is different (usually higher) than the price from the general bidding process, but still ensures cost effectiveness by creating competition between similar actors. It can be useful to protect small scale actors for technologies where economies of scale lead to high cost differences between small and large installations (e.g. solar PV).
- **Other preferential rules:** Community power projects participate in the general bidding process, but do so under certain preferential conditions. This can involve reduced prequalification requirements or the refunding of up-front costs for bids that have not been accepted. For example: In the proposed German tendering scheme, regional co-operatives may participate in the

auction without environmental impact assessment (Bundesministerium für Wirtschaft und Energie 2016).

A key problem for „small actors" is not so much higher costs, but rather a lower capacity to deal with the volume that results from auctions, i.e. the risk that the capacity cannot be sold. Therefore, approaches that eliminate or at least significantly reduce the volume risk seems most suitable. Many small-scale actors therefore have a preference for non-competitive bidding.



Source: Based on (Fachagentur Windenergie an Land e.V. & IZES 2015), own illustration.

Figure 38 Exemptions for small scale actors in competitive bidding schemes

2.5.7.3 How to define which projects are eligible for exemptions?

According to stakeholder consultations, especially the risk of unsuccessful bidding (volume risk) is highly prohibitive for the majority of community energy projects, and mitigating it should be a top priority. Selection criteria should therefore be designed in such a way that they apply to actors which have difficulties in mitigating this volume risk, and do not apply to all other actors.

Of all proposed selection criteria, size limits are easiest to define, communicate, and control. Size of individual projects (in terms of nameplate capacity, number of turbines etc.) however, is not well suited to distinguish between different types of actors (as shown in section 2.5.5.3) and their exposure to volume risk. Applying limits to the portfolio size (i.e. the number of projects that are planned within a certain time period by one actor) is much more appropriate for this objective. Actors which only plan a small number of projects at any given time (possibly only one) are especially vulnerable to the risk of losing a bid and should be eligible for adequate exemption rules.

This holds not only for community energy projects, but for all actors with small portfolios. If the objective is to specifically support certain types of actors with small portfolios, while exposing other actors to the normal market risks, additional criteria need to be applied. As an example for how this could be implemented, we present a recent proposal of the German Ministry for Economic Affairs and Energy on reforming the renewable support scheme.[167]

First, the proposal contains provisions to allow preferential treatment for actors that submit bids for no more than one project within a time frame of 12 months. This type of definition captures all actors that manage small portfolios – regardless of other characteristics.

In addition to that, the proposal aims at specifically supporting regional cooperatives ("Bürgerenergiegenossenschaften"), a legal form that is characterized by a high degree of direct citizen participation. Therefore, exemptions are only granted to actors where – on top of the portfolio criterion described above – at least ten shareholders are individuals, the majority of voting rights lies with individuals and each shareholder is holding no more than 10% of voting rights. In addition to that, the majority of shareholders needs to reside within the administrative district the project is to be realized in.

These types of requirements can be very effective in selecting very specific types of actors. It becomes apparent, though, that they only work in a specific national regulatory context. On the EU level (e.g. in the RED) a common objective can be stated (e.g. the objective to support actors with a degree of citizen participation). However, it should be left to the individual member states to implement selection criteria which are suitable to reach this objective within their specific national contexts.

2.5.8 Simplify administrative and permitting procedures

Community energy projects often face tedious administrative and permitting procedures (see RES report interviews (RES-Report: Interviews with Stakeholders in the Renewable Energy Sector in Europe 2016)). All stakeholders that have been consulted for this section claim that inefficient, time consuming and complex administrative procedures represent significant growth barriers for community power projects. This entails permitting, licensing, and grid access procedures. The proposed measures encompass the simplification of permitting processes, possibly down to pre-approval or simple notification schemes for small-scale projects, as well as to reduce the number of authorities involved in the permitting process (one stop shop approach).

Removing administrative barriers is generally an important measure to support investments in renewable power generation (see RES report project – task 2). This is the case for all actors and projects, and administrative procedures should be harmonized, simplified, and streamlined for all actors.

But nonetheless, some of these barriers are especially relevant for small scale operations, community power projects and individual citizens, as these often do not

[167] (Bundesministerium für Wirtschaft und Energie 2016)

have the capacities or resources to mitigate administrative risks or to deal with delays that result from long and overly complex permitting procedures. This is especially the case for actors that operate in a local context and only realize a small number of projects at any given time, as these actors have little options to deal with risks that arise from delayed grid access or uncooperative local authorities. Community energy project can therefore be put at a disadvantage compared to other developers. Bauwens et al. (2016: 25) have observed that there is - in terms of planning policies - a tendency towards a more hostile environment for community energy projects.

Besides removing general barriers for all project developers, there is therefore an argument that special rules or exemptions could be put in place for community energy projects, with a focus on streamlining of the planning and permitting process (LITRES 2015). This would create specific incentives for community energy projects.

Two reasons for complicated administrative procedures should be distinguished:

Administrative procedures may be organized in an inefficient way. If this is the case, there is a strong case for making them more efficient in general, so that all projects and actors can benefit. There is no point in differentiating between efficient procedures for certain project types and less efficient procedures for other project types.

Administrative procedures can be difficult and time-consuming even if they are organized as efficiently as possible. This can be due to various conflicts that emerge and issues that need to be resolved, e.g. in the context of the environmental impact assessment. In this case, it is difficult to argue why these conflicts and issues should not be addressed in the case of community energy projects even though these projects can have the same negative impacts as other projects. Especially if community energy projects are to be promoted on the grounds that they can achieve a higher level of public acceptance, it seems counterproductive to put that acceptance at risk by thinning out or downsizing the thoroughness of the permitting process.

2.5.9 Encourage capacity building and knowledge transfer

Both small-scale companies and especially cooperatives run by citizens can entail a lower level of expertise. Know-how is often built up by individuals and is not easily transferred to others. Therefore, one way to promote community energy is to facilitate knowledge exchange between various organizations and to organize training. Moreover there are organizations like Bürgerwerke[168] in Germany that combine various community energy organizations under one roof, which also has the function to organize knowledge transfer.

2.5.10 Financial regulation

Besides the "regulation" of the energy market, energy cooperatives can also face financial regulation that can make them unattractive. A main objective of such regulation is investor protection. However, such regulation, especially if they follow

[168] www.buergerwerke.de

rules for larger investments, may also threaten the very existence of community energy projects. For example in Germany, there were plans to tighten regulations on prospectus requirements and to make community projects subject to financial regulation by the Federal Financial Supervisory Authority (BAFIN).

Although the regulation was not put in place in the end, the discussion created significant uncertainty among community energy projects. According to the German cooperative organization (DGRV), an investment volume of EUR 290 million was blocked to the threat and the uncertainty resulting from these plans (DGRV 2015a).

2.5.11 Overview of measures

The following table lists pros and cons of measures that are available to promote community energy projects.

Table 89 Overview of measures to support community energy projects

Objective	instrument	pro	con
Encourage long-term support	include explicit acknowledgment and definition of community energy in RED	- increases incentive and willingness of MS to develop national strategies and to address barriers - provides long term safety for investments, helps unlocking financing	- some MS are opposed to community energy and may oppose an explicit formulation - difficulties on agreeing on definition - a too restrictive definition may exclude actors - a too broad definition may be ineffective
	Encourage/require MS to develop long term strategy for supporting community energy	- MS can decide on their own which strategy fits best to their conditions	MS strategies may not be ambitious enough
	Encourage/require MS to establish local, regional or national community energy targets	- quantitative targets increase measurability of progress - incentivizes action on national and sub-national level	- some MS may oppose explicit targets -In some MS, citizens may not be prepared (yet) to invest in RES. If citizens want to invest they should have the opportunity and not face unnecessary barriers, but citizens should not be forced to invest in RES. - non-binding targets may be ineffective
	require MS to report on which measures they implemented to meet the objectives of these strategies, and on the progress being made	- increases incentive to comply with requirements - increases transparency - measures can be adapted and improved based on reported data	excessive reporting duties may lead to high administrative costs
	Encourage/require MS to prioritize community energy projects in spatial planning frameworks		
	Encourage/require MS to prioritize community energy projects in public procurement procedures		

Provide access to support schemes	require MS to guarantee FiT /FiP scheme for community power projects	- providing concrete regulations improves chances of MS compliance	- neglecting specific conditions in MS states may lead to ineffective / inefficient implementation - difficulties to define which projects are eligible
	define mandatory minimum standards for auction/tendering schemes	- providing concrete regulations improves chances of MS compliance	- neglecting specific conditions in MS states may lead to ineffective / inefficient implementation - difficulties to define which projects are eligible - difficulties to agree on common minimum standards
	require MS to report on which measures they implemented to meet these requirements, and on the progress being made	- increases to comply with requirements - increases transparency - measures can be adapted and improved based on reported data	excessive reporting duties may lead to high administrative costs
Reduce regulatory burdens	Reduce the requirements for small-scale projects with regards to Environmental Impact Assessments	- significantly reduces upfront costs, permitting time and insecurity	- It is difficult to justify exemptions for community energy projects - not meeting environmental impact regulations may reduce public acceptance of projects - may also reduce the legal security of projects, which can be particularly problematic in auction schemes with penalty payments if plants are not built
	Simplify the permitting process for small-scale projects, possibly down to pre-approval or simple notification schemes		
	Reduce the number of authorities involved in the permitting process (one stop shop approach)	Should apply to all projects	But no specific rules for community energy projects

2.5.12 List of interview partners

A series of interviews has been performed gather information on stakeholder positions. The following stakeholders have participated in the interview process:

- Deutscher Genossenschafts- und Raiffeisenverband e.V. (DGRV)
- Bureau Euopéen des Unions de Consommateurs (BEUC)
- ClientEarth
- Greenpeace
- Leuphana University of Lüneburg
- World Future Council
- Energycities
- Greenpeace Energy
- SCENE

2.5.13 Policies options for energy communities within the energy system

For the revision of the RES directive the Commission presented four options for policies for energy communities, which are described in this chapter and assessed in chapter 2.5.14.

Disclaimer: The analysis of the following options has been performed reflecting the considerations on June 8 2016. This analysis reflects solely the views of the author of the report and does not necessarily reflect the opinion of the European Commission.

Figure 39: Options for policies on energy communities

Option 0	Option 1	Option 2	Option 3
•BAU : no EU intervention	•Guidance on energy communities	•Definition of energy communities + specific provisions on support schemes and market integration	•Option 2 + facilitation of the participation of communities in local projects through opening of project's capital

Source: Draft paper European Commission

We first discuss all options in textual form. In addition to that, we perform a more formal impact assessment along the criteria effectiveness, efficiency, legal feasibility as well as social and environmental impacts (see Table 90). It is to be noted that, as implementation specifics of the options are not detailed in the proposal, the assessment at this stage remains indicative and qualitative in nature.

2.5.13.1 Option 0: BAU (no EU intervention)

No specific action on EU level is taken. As there is currently almost no EU level regulation on energy communities, each member state will develop its own approach on this topic. As energy community projects are so far relevant only in a small number of Member States, it can be expected that this will not change. Especially the trend in renewable support schemes towards market-based mechanisms is most likely to create an increasingly difficult economic environment for community energy projects. This will most likely lead to conditions where development of energy communities is severely hampered. Above that, the continuation of already existing community energy projects may also be put at risk. Bauwens et al. 2016 have observed that there is a tendency towards a more hostile environment for community energy projects.

2.5.13.2 Option 1: Guidance on energy communities

Within this option, the EU offers guidance on how to treat energy communities, but implements no legally binding regulations.

The effect of this option depends very much on (a) the content of the guidance provided and (b) on the degree to which member states can be expected to comply with the provided recommendations.

How much compliance can be expected? Community energy is not a new phenomenon. In some Member States, energy communities have played a very important role (e.g. Germany, Denmark) since before 2000. If MS would have sufficient incentives to support community energy, they could have done so before. But as of today, the vast majority of community energy projects is concentrated in a small number of member states, while being virtually non-existent in others (RESCoop 2016).[169]

If the content of the guidance would be identical to what is proposed in option 2 (the only difference following it would be voluntary), its impacts could be identical to that of option 2. Realistically, it will be much lower in every term.

2.5.13.3 Option 2: definition of energy communities + specific provisions

In contrast to Option 1, Option 2 contains the establishment of binding EU legislation that requires member states to support energy communities in a certain fashion. It contains several actions that – if implemented – would lead to different impacts:

2.5.13.3.1 A definition of energy communities in the revised RED, following a set of criteria

Most Member States have implemented regulations to support or protect small-scale actors in electricity markets. BEUC 2016 states that "almost all Member States assessed have developed dedicated categories for small-scale selfgeneration in their support schemes, at least formally." Dedicated support for community energy projects, however, is much less common. An exhaustive assessment of practises in all Member States is not available, but existing studies (e.g. ClientEarth 2014, Bauwens et al. 2016) almost exclusively focus on a very limited number of Member States where community energy has been actively supported (the most prominent ones are Germany, Denmark, and UK). In this context, a definition at EU level could provide opportunities for improvement in many Member States.

A well-designed definition of energy communities in the revised RED would increase visibility and public awareness, help create a common understanding of how citizen participation in energy systems can be realized, and would significantly strengthen the position of energy communities in public and political debates on EU as well as on national level. To achieve this positive effect, however, the definition would need to be accompanied by a clear declaration of

[169] See also section Community energy: Status quo

the EU to support energy communities, and a call towards MS to implement strategies for achieving this objective.

Energy communities are highly diverse. It is not an easy task to find an EU-wide definition of energy communities that is open enough to include all relevant actors and, at the same time, strict enough to still be meaningful. The criteria used to define energy communities should be chosen carefully.

It is unlikely to find a single definition that includes all relevant actors. It might be necessary to define several categories of actors that all fall under the category of energy communities but have different characteristics and, subsequently, require different approaches for effective and efficient support (e.g. municipal utilities, regional cooperatives, "traditional" companies with some degree of economic participation of citizens).

Defining multiple categories of actors becomes especially important as the Commission proposes to include local authorities in the definition of energy communities. Municipal utilities differ greatly in company size, degree of professionalism and project portfolio. When designing support schemes for energy communities large municipal utilities should be treated differently than for example small regional cooperatives.

The Commission proposes a list of criteria. These are useful, although most of them do not aim at distinguishing community energy actors from other types of actors, but to assess the size of either the actor or the project. These are different dimensions that should be carefully distinguished. Actors face different barriers depending on their size (as determined by e.g. number of employees and turnover), which may warrant to create different regulations for large and small actors. It can also be assumed that the environmental impact of small projects is less severe than that of larger projects, which may warrant facilitated administrative procedures. But to determine whether an actor falls under the category of energy communities, it will be necessary to assess its ownership structure.[170]

Especially the proposed criterion "project size" (in terms of nameplate capacity, number of wind turbines etc.) is not strongly correlated with the degree of public participation. It should not be used to distinguish energy communities from other types of actors.

Other criteria should not be compulsory (i.e. an actor would not have to meet them to be considered as an energy community), but rather be used to distinguish between different categories of energy communities. An example is the local participation of shareholders – energy communities do not necessarily have a regional focus, but it may make sense to distinguish between energy communities with and without regional focus when designing support policies for them.

2.5.13.3.2 Require MS to simplify administrative procedures and facilitate grid access (Art 13(1), Art 16)[171]

The simplification of administrative processes could significantly support energy communities. However, all types of actors would benefit from streamlining administrative procedures. If specific support is given to energy communities in this area, this should be restricted to areas

[170] (ClientEarth 2016) recommends "defining community energy based on the characteristics that separate it from other commercial market participants, namely its governance arrangements."

[171] See section Simplify administrative and permitting procedures

where energy communities have larger difficulties in risk mitigation and costs than other actors.

Simplification of administrative procedures and permitting processes should also not come at the cost of lowering standards, as this could – in the long run – lead to decreasing public acceptance of projects. Special care should be taken when applying automatic approval or simple notification schemes, as these imply that an installation does not violate any standards and requirements without performing an assessment. If at all, this should only be assumed for small projects with low environmental and societal impacts. Even then, no difference should be made between community energy projects and projects with traditional governance schemes, as the degree of environmental impact is related rather to project size than to ownership structure.

2.5.13.3.3 Require MS to help energy communities participate in market-based support schemes

Energy communities face a number of challenges when participating in market based support schemes. Given the fact that more and more countries move their support schemes away from fixed tariffs towards market-based approaches, it is crucial to ensure that energy communities still have access to financial support. Specific provisions in the forthcoming RED to this effect are of high importance.

The success of these provisions depends very much on their specific design – mainly on which actors are to be eligible for exemptions, and in which way they benefit from these regulations.

There are a number of barriers / risks that should be addressed, and there are various measures that can be applied to protect vulnerable actors:

- Instead of having to participate in the bidding process, actors can be provided with an alternative source of funding (e.g. an fixed feed-in tariff or premium)
- Actors can be eligible to "non-competitive bidding", i.e. they are awarded guaranteed access to a funding source with the amount being determined in the bidding process
- Vulnerable actors can be allowed to participate in a separate auction, where they only compete with similar actors.
- Actors can be eligible for various procedural, administrative and financial exemptions (e.g. prolonged realization times, reduced participation requirements, simplified administrative procedures)

The Commission paper states only one measure as an example, which falls into the last category (simplification of administrative procedures) and which is already addressed under the previous heading. While this option may play a certain role, it should not be the first priority, and it cannot be expected to act as a "game-changer" for vulnerable actors.

Mitigating the risk of unsuccessful bidding (volume risk) should be treated with highest priority. Actors with small portfolios (i.e. only a small number, maybe only one, project within a certain period) cannot distribute the volume risk across different projects and face the risk of total loss if their bid is unsuccessful. It requires measures beyond the streamlining of administrative procedures to support these actors (e.g. providing access to guaranteed feed-in tariffs or non-competitive bidding).

2.5.13.4 Option 3: option 2 + provisions to open project capital to public

This option builds upon Option 2. It contains the same measures (but in a 'reinforced' implementation'), and adds the obligation to open project capital to citizens.

2.5.13.4.1 Reinforced measures from Option 2

From how the option is formulated in the Commission's proposal, it is not clear if in option 3, the measures provided in option 2 are to be implemented in a reinforced manner. If this is the intention, it is not possible to assess the effects of this, as no details are provided in the Commission's document. The impacts of all measures discussed depend greatly on the manner in which they are implemented.

2.5.13.4.2 Obligation for project developers to partially open capital to public

This additional measure requires MS to obligate project developers to open a certain share of the each project's capital to (local) citizens or energy communities. Such a provision would guarantee a minimum of public participation for each project – or, at least, it would guarantee this option to be available in case there should be public interest in participating in a project.

Similar provisions have been implemented in several countries at national or sub-national level. For example, national legislation in Denmark requires for all wind turbine projects that 20 % of project capital is to be offered for purchase to local citizens (Danish Government 2008). A "right-to-purchase" legislation can have several beneficial effects: By making public participation a 'standard procedure', they may help to change the perception of energy communities away from being a 'niche application'. Mandatory opening a share of each project's capital may also unlock financing sources that would otherwise remain untapped. On top of that, public acceptance of projects may increase if local citizens have the option to co-invest and to share economic benefits of the projects.

There is, however, a risk that an obligation to open a share of the project's capital will discourage traditional investors, thus reducing overall investments.

Above all, it should be noted that economic shareholdership is only one of many ways citizens can participate in energy systems. (ClientEarth 2014) recommends distinguishing "community ownership and participation" from "community benefit". Economic participation does not necessary imply active involvement, taking and sharing of responsibilities, and participation in decision-making processes.

2.5.14 Impact assessment

2.5.14.1 Indicators

2.5.14.1.1 Economic impact

From a system point of view, the most relevant economic impact indicators are **effectiveness** and **efficiency**.

Other suitable indicators address the distributional effect of establishing community energy projects – e.g. the **economic benefit of shareholders** or the degree by which **financial benefits and resources remain in local communities**. They can be equally associated with economic and social impacts.

2.5.14.1.2 Social impact

Empowering citizens and enabling them to participate in power markets is the primary objective of supporting energy communities. Social impact indicators should assess the degree by which participation of citizens is improved due to implementing the proposed measures. Quantitative indicators that may be used are the **number of community energy projects that are established**, or, preferably, because more precise and because the size of community energy projects can vary significantly, the **number of citizens that participate in community energy projects.**

Other social impacts of energy communities are highly relevant, but are more difficult to quantify: Community participation can lead to higher acceptance of RES projects, can foster cohesion among community members, and increases a communities confidence, interest and capacity to take positive collective action (Tarhan 2015).

2.5.14.1.3 Environmental impact

The main objective of supporting energy communities, in terms of environmental impact, is to support RES expansion – which can be quantified in terms of capacity deployment and power generated by community owned installations. Based on assumptions regarding which power mix will be replaced, these can be used to estimate CO_2 emissions mitigated by increasing the output of community owned installations.

For these assessments, it is important to agree on the baseline, e.g. on which technologies would be used to generate power if community energy projects would not be established. If one assumes that energy communities would result in additional RES installations (e.g. because community participation unlocks new capital, or because it leads to less public opposition against RES projects), they displace conventional generation, which results in significant positive environmental impacts. If one assumes that community owned RES installations replace RES installation with traditional ownership (e.g. because MS have RES targets that they intend to meet one way or another), the environmental impact of energy communities would be small.

2.5.15 Assessment of policy options

Table 90 shows a qualitative assessment of economic, social, legal and environmental impacts of the proposed options.

Beyond this, a quantitative assessment is problematic, as empiric data on community energy projects is very scarce. Quantitative evaluations of policy measures directed at energy communities are also very unusual, due to scarce empirical data and little past experience with dedicated policies on energy communities.

In the UK, an Impact Assessment has been performed to assess various measures for supporting community energy projects under the existing FiT support scheme (Department of Energy and Climate Change 2014). Its central estimate is that implementing the proposed measures will have no net impact on deployment, generation, the net present value or support cost to consumers (as it assumes that the measures do not incentivise additional RES installations); although it is expected to bring about a shift in ownership from household and commercial to community. The authors also perform a sensitivity analysis and state that additional RES installations triggered by the proposed measures would lead to additional support costs in the order of 80EUR/MWh. These results, of course, are highly depending on the assessed measures, the specific frame conditions, and on the support policies in place.

Other studies mostly present case studies of single projects or apply purely qualitative methods.

To our knowledge, scenario analyses for future expansion of community energy do not exist. Many studies assess the current situation of community energies in different countries and point out that in most cases, the existing potential remains largely untapped due to a number of barriers, but none of these studies assesses how far community energy could go if these barriers would be removed. It is possible, however, to examine countries where conditions have been stable and in favour of community energy over a long time period and where community energy has been expanding as a result. These national cases can be used as benchmarks to illustrate the potential of community energy, and the role it could play if the social, economic and legislative environment in an optimal way.

In the EU, Germany and Denmark are leading countries in supporting community energy. Both countries have an ambitious renewable energy policy, a long-standing cooperative tradition, and both have maintained FiT/FiP support schemes over a long time period that guarantee low-risk revenues for small actors. In 2002, in Denmark cooperatives owned slightly less than 40 percent of the total number of 6,300 turbines installed, and over 150,000 households owned shares in wind power cooperatives. The remaining turbines were owned by single owners (approx. 40 percent) – mostly farmers – and utilities (approx. 20 percent) (Danish Wind Industry Association 2002). After 2003, the Danish support scheme was changed to a fixed FiP, which lead to a significant decrease of community engagement in following years (Bauwens et al. 2016). In Germany in 2012, 46% of installed renewable energy capacity was owned by citizens in a broader sense (Trend:research & Leuphana Universität Lüneburg 2013).

These examples show that, under favourable circumstances, community energy has the potential to cover a significant share – even the majority – of renewable power generation. It needs to be stressed, however, that regulatory design (which could be changed to remove barriers) is not the only factor that affects the success of community energy. Rather, it also depends on the capital that can be made available by citizens and cultural factors like the general attitude towards cooperatives and the cultures of local energy activism (Bauwens et al. 2016; Magnani & Osti 2016; RES-Report: Interviews with Stakeholders in the Renewable Energy Sector in Europe 2016; Schreuer 2012). Subsequently, removing barriers and establishing minimum standards at EU level will not yield the same results in all Member States.

Table 90 Impact assessment of policy options

	Option 0	Option 1	Option 2			
			Option 3			
	No action	EU provides guidance	EU provides definition of EC	Require MS to simplify admin. Procedures and to facilitate grid access for EC	Require MS to facilitate participation of EC in market-based support schemes	Require MS to open project capital to local communities
Economic impacts (effectiveness)	-- Without action on EU level, EC support by individual MS is likely to very ineffective (with possible exception of some MS that have supported EC in the past)	- Compliance of MS is questionable if EU guidance is not binding	+ Definition on EU level would raise awareness, create common understanding of targets, and improve standing of EC actors in debates on MS level Definition needs to be accompanied by commitment to support EC If definition is too narrow, important actors may be excluded	+ General streamlining of procedures with additional simplifications for small-scale plants would be an important first step. Additional simplification for EC would be a second and more problematic step. There is evidence that the main issue for energy communities are not higher costs, but rather a lower capacity to deal with risks, especially those resulting from auctions (see report). Lowering costs through specific administrative simplifications should therefore not be a priority option.	++ Access to market based support schemes is a crucial barrier to EC growth, facilitating it would have a large effect	+ An obligation to open project capital may discourage traditional actors to invest
			Effectiveness does not just depend on these policy measures, but also on Member State specific aspects like capital that can be made available by citizens and cultural factors like the general attitude towards cooperatives and the cultures of local energy activism			
Economic impacts	-- No direct costs, but	- Little direct costs,	+ Depends on how	+ Simplified administrative	- Excluding some	+ May unlock

(efficiency)	overall costs for RE expansion would increase as EC potential would largely remain unused	but overall costs for RE expansion would increase as EC potential would largely remain unused	definition is applied Common definition may lead to harmonization of MS approaches, which would increase efficiency	procedures would reduce costs for ECs Simplified procedures, if applied for everyone, could lower costs for all actors Overall efficiency may not increase, e.g. if it leads to increasing court cases.	actors from market based scheme will tend to reduce efficiency	additional capital
Social impacts	-- Existing ECs will face increasingly difficult conditions, EC growth will be seriously hampered, opportunities for citizens to participate will remain unsused	- Low compliance if EU guidance is not binding; most likely little improvements compared to option 0 (BAU)	++	+ Removing significant barriers will support ECs and increase citizen participation If simplified procedures and requirements leads to lower (e.g. environmental) standards, public acceptance may suffer in the long run	++ Guaranteeing access to support schemes strongly supports actors with small portfolios	+ Economic participation may increase public acceptance Economic participation does not necessarily lead to active participation. It should not replace support for CEPs with a higher degree of community involvement
Environmental impacts	-- Further expansion of EC will be severely set back (restricted to some countries that already support EC)	-- Compliance of MS is very questionable if EU guidance is not binding	All these options – if efficiently implemented – will support expansion of community energy, which will help expand renewable generation shares and reduce environmental impacts. The size of the effect depends on the specific implementation. If simplified administrative procedures lead to reduced standards or non-compliance with standards, they may lead to negative environmental impacts			

2.6 Self-consumption

2.6.1 Self-generation and self-consumption: Costs and benefits and policy principles

2.6.1.1 Introduction

In the following chapter the different forms of on-site generation and consumption of electricity shall be reviewed in the context of integration of renewable energies. In practice other forms of on-site generation and consumption are also common as for example gas cogeneration plants that are applied in the scope of industrial processes. These are not further taken into account in the following analysis.

In the scope of renewable energies mainly PV plants are applied to generate electricity for the purpose of self-consumption. This will be the focus of this analysis. Also other technologies can serve this purpose, such as wind or biomass/gas, which differ mainly in their generation profile, but are not applied as frequently.

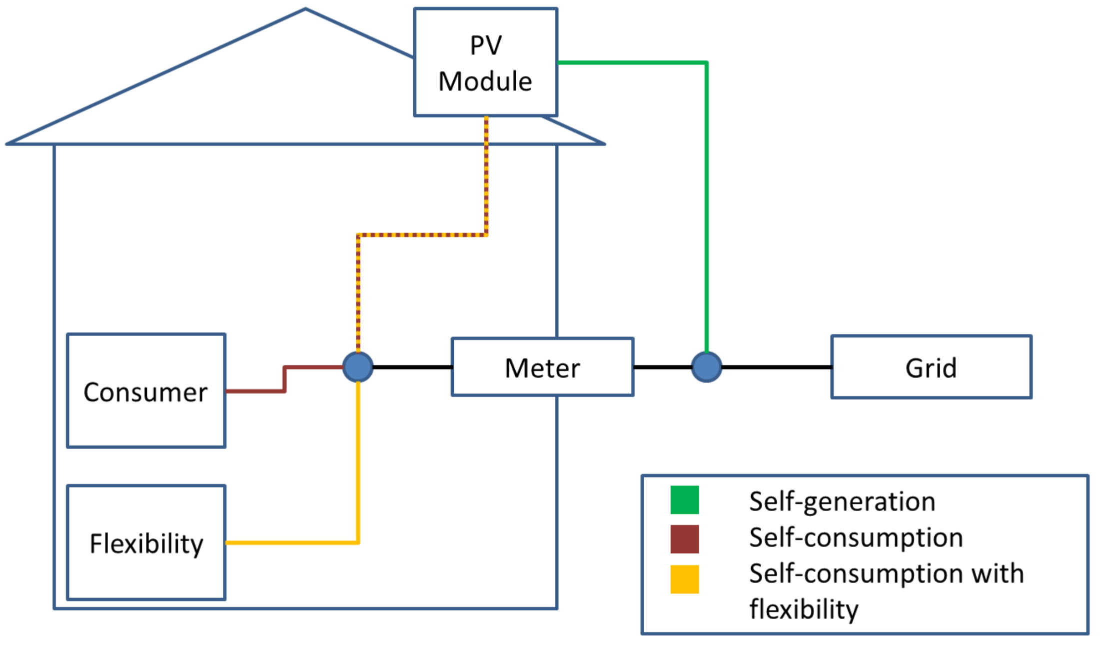
First, a (non-legal) definition of self-generation and self-consumption is provided in the next section. This serves as a basis for discussing various potential costs and benefits that self-consumption can have both for the individual consumer and the overall system. This includes economic effects, effects on the electricity grid and system services as well as the acceptance of the ongoing energy system transition. Based on the overview of costs and benefits, the third section derives key policy principles and policy options that can be applied for self-consumption.

2.6.1.2 Different types of on-site generation of electricity

On-site generation in general can be defined as electricity generation close to/on the premises of the consumer. It comprises three different sub-concepts: Self-generation, self-consumption and self-consumption that makes use of flexibility. Self-generation implies that a generation unit (e.g. a PV module) produces electricity on-site, which is fed into the grid. When this electricity is (partly) consumed on-site it is considered as self-consumption. Additionally some kind of flexibility (e.g. batteries or Demand Side Management (DSM)) can be applied to increase the share of self-consumption of the overall electricity consumption.

For each of these concepts different cash and electricity flows can be observed. To clearly describe the impacts of policies on each of the different concepts it needs these flows need to be analysed.

Figure 40 shows a schematic picture of the structure of self-generation and self-consumption without and with flexibility.



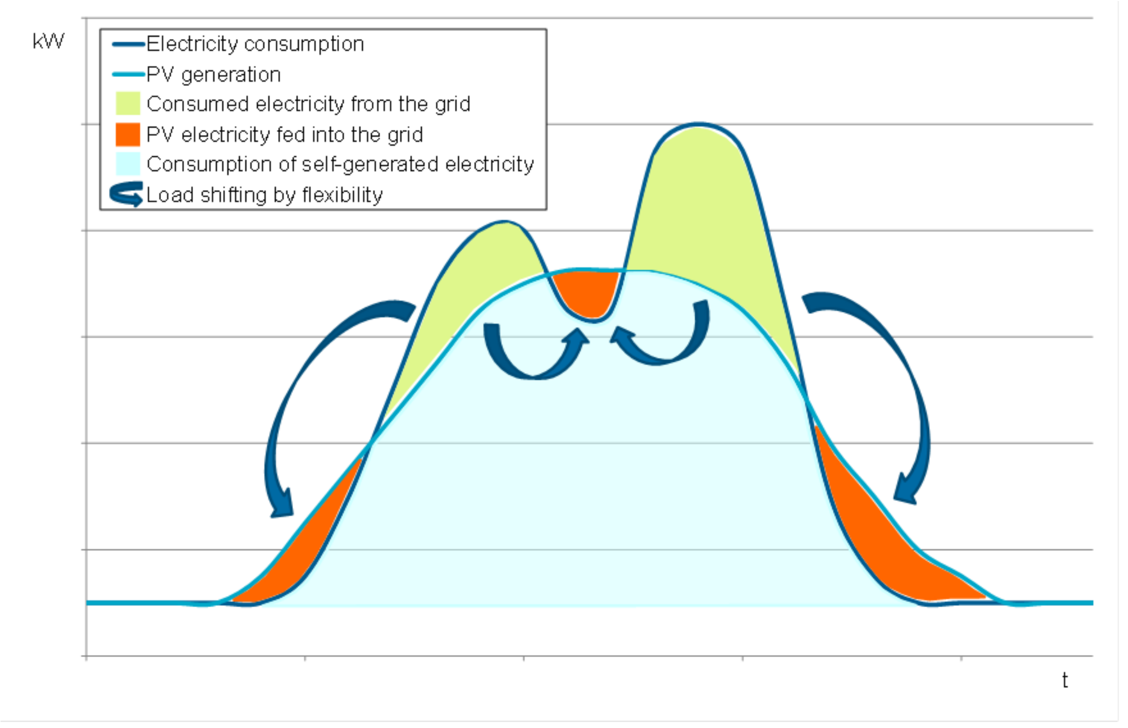
Source: Authors' own illustration.

Figure 40 Illustration of different on-site generation and consumption setups

For the **electricity flow** it is not relevant if the PV module is connected in front of or behind the meter. The electricity always flows to the next consumer. As shown in the following Figure 39 three cases can be distinguished.

If the local consumption exceeds the local production additional electricity has to be "imported" from the grid (green area). The second case is that consumption is below production and the surplus production is fed into the grid (orange area). In some situation consumption can be equal to production and the grid is not needed. The light blue area shows the electricity demand that can be covered by on-site generated electricity. As shown in Table 91 from a physical flow perspective self-generation and self-consumption exhibit the same behaviour. If flexibility is used[172] consumption can be shifted from situations with demand excess to situations with RES-E surplus. In this case the on-site consumption is increased and the grid use is reduced.

[172] Common examples for options that are applicable are battery storages or demand-side flexibility, e.g. through heat pumps. In this case generated electricity that exceeds the consumption is either stored or consumption is shifted towards times in which on-site generation exceeds consumption.



Source: Authors' own illustration.

Figure 41 Consumption and generation profile for a single household with PV and flexibility

Table 91 Physical electricity flow of self-generation and self-consumption

	Self-generation	Self-consumption	Self-consumption with flexibility
Consumption > production	Grid supply	Grid supply	Reducing grid drawing by flexibility
Consumption < production	Grid feed-in	Grid feed-in	Reducing grid feed-in by flexibility
Consumption = production	Balanced	Balanced	Balanced

Source: Authors' own compilation

Another relevant feature of the different models is the **cash flow** that occurs. The difference between self-consumption and self-generation in this case is the way the generated electricity is accounted for. In the case of self-generation the PV module is located "in front of the electricity meter" (see Figure 40). Therefore all electricity consumed on-site is treated as electricity taken from the grid and the regular electricity price has to be paid. At the same time, the electricity that is generated on-site is sold either under a support scheme or on the market. The net benefit of self-generation for the generator therefore is the difference between electricity revenues and the costs of production. If the PV module is located "behind the electricity meter" the consumption of on-site generated electricity can reduce the net demand of electricity that needs to be purchased via the grid. In contrast to self-generation only the electricity that is not consumed onsite is sold. Therefore the net benefits of self-consumption are the avoided costs of electricity purchases reduced by the costs of self-consumption. This is summarized in Table 92.

Table 92 Cash flow of self-generation and self-consumption

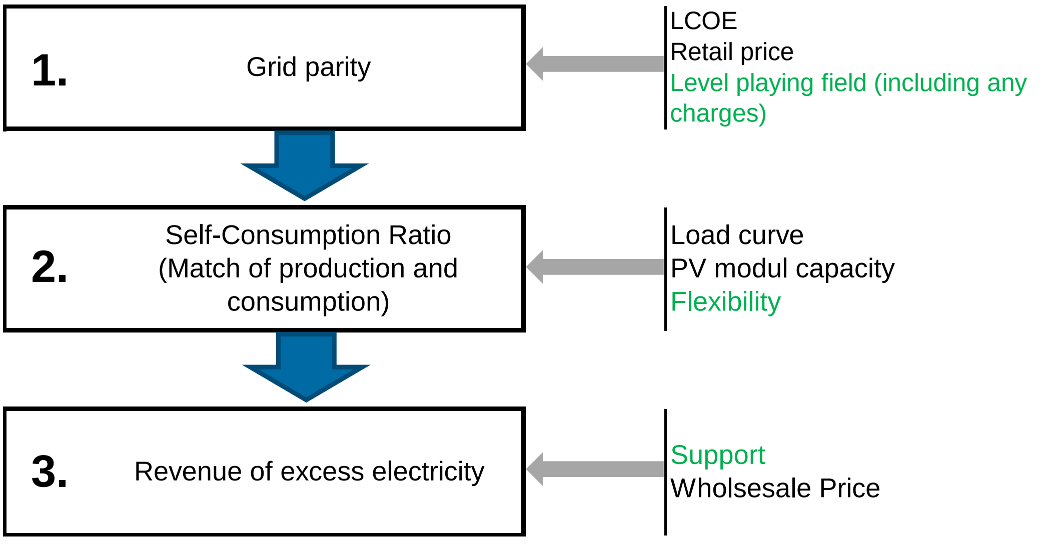
	Self-generation	Self-consumption	Self-consumption with flexibility
Consumption > production	Costs for consumption and revenue for production	Production reduces the consumption costs	Production reduces the consumption costs (stronger)
Consumption < production	Costs for consumption and revenue for production	Excess production is sold	(Less) excess production is sold
Consumption = production	Costs for consumption and revenue for production	Only levy occurs (if relevant)	Only levy occur (if relevant)

Source: Authors' own compilation

2.6.1.3 Profitability of Self-Consumption

With the decrease of PV system costs the self-consumption of electricity from PV becomes more and more attractive. When and if SC gets profitable and can thus be the basis for financing PV systems support schemes can be phased out.

There are three relevant elements that can make SC profitable. Figure 42 shows these elements and the factors that influence them. The factors shown in green can be addressed by MS or (depending on the policy option) EU policy.



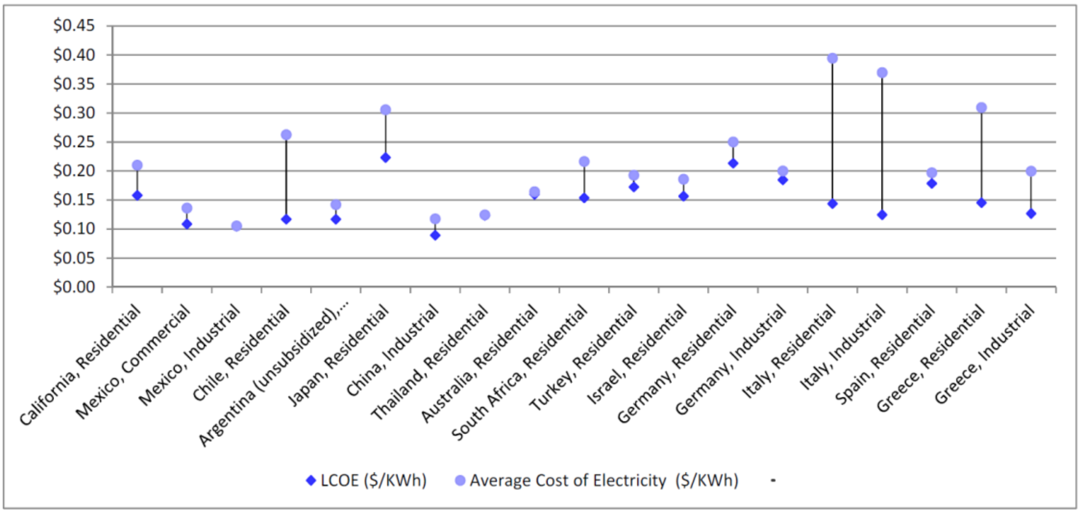
Source: Authors' own illustration.

Figure 42 The three steps to profitable SC

1. Step:

When Levelized Costs of Electricity (LCOE) are below the retail prices, it is cheaper to use the own PV electricity than consume electricity from the grid. Depending on the implemented SC scheme, charges may be in place so that the LCOE would need to be lower accordingly for self-consumption to be profitable. Figure 43 shows that some markets, also in Europe, already achieved grid parity (Effective 2014). The key issue for grid parity to actually result in SC deployment is that a level playing-field[173] (LPF) is implemented.

[173] Level playing-field means that self-consumption is not prohibited or not discriminated against. It includes the distribution of economic effects, so that self-consumers should only incur the costs that they have caused.



Source: DB, BLS, Ontario Energy Board, Mexican Ministry of Energy, Chile Energy Group, Argentinean Secretary of Energy, NASA, Tepco, Chinese Economic Observer, Beijing International, Indian Central Regulatory Commission, Australia Power and Gas, Saudi Electric Company, Eksom, EuroStat

Source: (Deutsche Bank Markets Research 2014)

Figure 43 Markets at grid parity

2. Step:

The SC ratio determines the part of the PV production that can be self-consumed. This match depends on the load curve and the PV capacity. Rasmus Luthander, Joakim Widén, Daniel Nilsson and Jenny Palm (2015) show that the local climate can have an influence on the load curve. While the electricity demand of heat applications like heat pumps does not correlate very well with solar radiation, the "demand of cooling correlates with the daily and yearly irradiation pattern, the self-consumption can be increased if air-conditioning is used." Non-residential consumers can typically achieve higher SC ratios than residential. PV Parity 2012 assumes that households can achieve SC ratio of around 30% and commercial or industrial consumers above 75%. Flexibility such as Demand Side Management or batteries can increase the ratio. Huld et al. 2016 show that the SC ratio "depends strongly on the PV system production fraction." That means that smaller PV systems can typically achieve a higher SC ratio.[174]

3. Step:

The excess electricity that cannot be self-consumed can be sold on the power market, potentially with an additional support payment. Hirth 2013 shows that the market value that PV electricity can achieve on the wholesale market is influenced by the PV market share. For example at a market share of 15% the value factor of PV is below 50%. That means PV obtains only 50% of the average price on the wholesale market.

[174] See also United Nations Industrial Development Organization 2015 "In areas where there is no policy or regulatory framework governing the sale of excess power generation to the grid, industrial prosumers will tend to scale systems down in size to ensure that onsite generation is not wasted."

The described parameters can be implemented in the following equation to deduce the profitability of SC:

$$(Retail\ Price - SC\ Charges) * SC\ Ratio + (1 - SC\ ratio) * (Wholsesale\ Price + Support) \overset{!}{\geq} LCOE$$

The left-hand side of the equation shows the two revenue parts, the first for the self-consumed electricity and the second for the excess electricity. The right-hand side shows the costs that are relevant for the PV system, namely the LCOE. The PV system is profitable when the revenues exceed the costs.

As mentioned above, the two main influence factors are supporting the excess electricity or increasing the SC ratio by flexibility.

The necessary SC ratio without additional support results from:

$$SC\ Ratio \overset{!}{\geq} \frac{LCOE - Wholsesale\ Price}{Retail\ Price - Wholsesale\ Price - Charges}$$

The necessary support with a given SC ratio results from:

$$Support \overset{!}{\geq} \frac{LCOE - SC\ Ratio\ (Retail\ Price - Charges)}{1 - SC\ Ratio} - Wholsesale\ Price$$

2.6.1.4 Potential benefits and disadvantages of self-consumption

The potential benefits and disadvantages of self-consumption can be divided into the categories **system effects** and **supporting the transition of the electricity sector**. In the following the effects of self-consumption will mainly be compared to the effects that can result from self-generation. This is because, as showed in chapter 2.6.1.2, self-consumption always implies self-generation. General effects that occur due to RES-E installations, like reducing GHG emissions or job creation are not considered in the following.

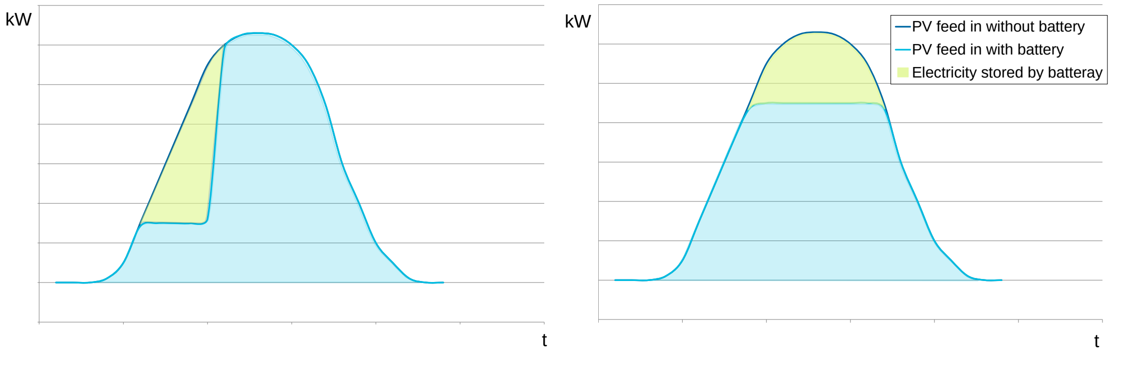
2.6.1.4.1 System effects

In terms of system effects, the impact of self-consumption both on the grid and on flexibility options is relevant. In both cases, there are potential impacts on the operation and on the overall capacity demand. As for the grid, self-consumption can have a positive impact both in operational and investment terms (lower grid usage and lower peak capacity), and the question is how this impact can be maximized. As for flexibility, the local balancing of supply and demand within self-consumption units tends to increase both the usage and the overall demand for flexibility.

For the overall assessment, a key question is how the potential benefits of self-consumption compare to the potential costs, i.e. how operational flexibility losses compare to grid losses and how large grid capacity savings are compared to additional capacity requirements for flexibility options.

The concrete effects depend on the concrete empirical case. Yet it is important to keep in mind that there can be both costs and benefits and the design of instruments for self-consumption should aim at increasing benefits and reducing costs. These effects will be discussed in more detail in the following.

First, one potential benefit of self-consumption that is often discussed is that self-consumption can reduce the **demand for grid expansion**. However, a positive impact can only be achieved if self-consumption reduces the peak of the excess production and consumption reliably (where the excess production is more relevant). This needs to be supported by the regulatory framework. As the demand for grid expansion results mainly from peak hours and not from the sum of the electricity transported over the grid, it is very relevant at what time of the day electricity is self-consumed and when it is exported. PV self-consumption with batteries that only maximize the self-consumption rate, would store the electricity in the battery in the morning (see picture on the left-hand side in **Error! Reference source not found.**). Once the battery is full further PV generation is fed into the grid. The peak PV production fed into the grid is not reduced with this approach and therefore no relief for the grid can be expected. If batteries are used to store peak production (see picture on the right-hand side in **Error! Reference source not found.**) a reduction of the grid load can be expected. This effect can also be observed for other flexibility options (e.g. DSM). How incentives for grid-friendly self-consumption can be implemented will be discussed in chapter 2.6.1.5.



Source: Authors' own illustration.

Figure 44 Effects of an uncontrolled and grid friendly PV-battery use

Second, electricity that is produced close to the point of consumption can **reduce grid losses**, as less electricity needs to be transported over the grid. As shown in section 2.6.1.2 self-generation and self-consumption that do not use flexibility have the same impact on grid usage and thus grid losses. If flexibility is used to increase the self-consumption rate more electricity can be used on-site and does not have to be transported over the grid. The most relevant flexibilities in this context are Demand Side Management (DSM) and battery storage.

Third, if flexibility is used this entails flexibility losses. These have to be compared to the reduction of grid losses. For example due to the efficiency of batteries battery losses are typically much higher than grid losses (see Table 93). Most DSM applications have almost no losses. When using for example Power-to-heat, electricity is converted to the lower energy type heat without having the possibility to reconvert it (exergy losses)

Table 93 Flexibility vs. grid losses

Flexibility type	Storage losses	Voltage Level	Transmission losses
Lead-Acid	~ 20%	110 kV	~ 6%/100km
Lithium-Ion	~ 10%	220 kV	~ 4.5%/100km
DSM	~ 0%	380 kV	~ 3%/100km

Source: Agora Energiewende 2014 and authors' own calculations

Fourth, if flexibility (DSM or battery storage) is used self-consumption can **balance demand and production on a local level**. Besides the resulting operational losses described above, balancing demand and production in smaller areas is typically also less efficient in terms of the overall demand for flexible capacity. Self-consumption can increase the overall demand for flexibility, just as local electricity supply can increase the overall demand for generation capacity. If individual consumers try to balance their demand and production themselves a larger amount of flexible capacities is necessary than in a supra-regional balancing case[175]. Additionally if flexibility is needed for system services further capacities have to be provided.

Adjusting demand and production for example on a household or regional level can lead to the situation that electricity is stored while the neighbour/neighbouring region has a need for electricity. Two problems can result from this. First, electricity is stored with losses while the grid losses, due to the short distance, would have been close to zero. Second, flexibility can be blocked (e.g. the storage is full) and is not available for more efficient use such as supra-regional balancing or system services.

The storage of electricity in an overall scarcity situation can also increase the necessity for additional generation. This can imply two different effects. Either additional RES-E capacity has to be provided or the generation of power plants that are not dependent on volatile energy sources is increased.

Self-consumption can thus lead to a situation where RES-E is stored with losses, while at the same time power is generated from fossil fuels with environmental impact. This example also can be adopted for national (or even ENTSO-E) level as far as no grid congestions occur and grid losses are below flexibility losses (see Table 93).

Another potential advantage of self-consumption that is discussed (e.g. EC 2015) is that load adjustments as a consequence of self-consumption can lead to a **reduction of electricity consumption**, because the overall awareness of consumers for their electricity consumption increases. However, field tests that applied flexible tariffs showed that there may also be the opposite effect – a result

[175] Peter 2013 shows that the need for storage can increase significantly if supply and demand are balanced locally. Moreover, VDE 2007 shows that also the need for production capacity increases.

that can be transferrable to self-consumption: Electricity consumption was increased in hours with low tariffs (similar to times with own production) but it was not reduced in the same amount in hours with high tariffs (similar to times with grid supply) (Agsten et al. 2012, p. 14). In terms of self-consumption that means that people increase their consumption when they know that they produce their own electricity and do not reduce the consumption accordingly afterwards. This can lead to an overall increase of electricity consumption.

2.6.1.4.2 Societal support for the transition towards RES

Besides the system effects described in the previous section, self-consumption can also contribute to the public acceptance and the financing of RES deployment.

Enabling consumers to participate in and **profit from RES deployment** can increase support for and acceptance of the transition in the general public.[176]

This can be achieved if citizens are generally enabled to invest in RES generation. This can be either on-site generation, including self-generation, or investments like energy cooperatives described in a separate section. The financial participation in RES deployment thus does not necessarily depend on self-consumption.

When consumers can produce a share of their electricity consumption themselves they may additionally be able to reduce their electricity bill and thereby further benefit from their participation in the energy transition. The amount of profit depends on the economic framework and is influenced by generation costs and fees and surcharges that have to be paid for self-consumed electricity.

It depends on the design of the self-consumption policy whether many people can profit from it or even have disadvantages. Self-consumption may also reduce the acceptance of the energy transition. If for example only single-family houses can realise a PV system and implement self-consumption a **significant part of the population is excluded**. Two potential approaches to mitigate this disadvantage are multi-consumer and distance self-consumption policies. These are discussed in chapter 2.6.1.5. One question is whether and to what extent self-consumption should be burdened with charges. These are mainly RES-E surcharges, energy taxes and (volumetric) grid charges. The argument for a reduction or exemption from these charges is that self-consumption can reduce the amount of RES-E that needs to be covered via a support scheme or the need for grid development. If the overall exemptions for self-consumers exceed the total system benefits of self-consumption the **bills of consumers that do not use self-consumption will increase**. For example, IÖW & Greenpeace Energy e.G. 2011 shows on p.54 (based on Podewils & Rutschmann 2010) that the German self-consumption framework, which was implemented in 2010, leads to an additional burden for other consumers. This results mainly from the reduction of the electricity volume that finances grid charges, concession levy and CHP surcharges, so that the charges for the remaining volume increases. This increase cannot be compensated by reduced RES-E surcharges. In fact, even if just looking at the RES-E

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[176] See Musall & Kuik 2011; Müller-Kraenner & Langsdorf 2012. Trend:research 2013 shows that the implementation of the Erneuerbare Energien Gesetz led to an increasing participation and financing of private actors of the generation capacity in Germany. In 2012 35% of renewable capacity was owned by private persons. Smaller enterprises such as farmers or project developers owned a share of 11 and 14%.

surcharges, the effect of self-consumption may not be neutral. Self-consumption reduces the amount of electricity consumption that finances the RES-E deployment but also the amount of RES-E that has to be financed by support schemes (if self-consumption is exempted from the support scheme). However, due to a stock of older and more expensive RES-E plants[177] it is not necessarily cost neutral to free self-consumption from RES-E surcharges.

Another related potential benefit of self-consumption is that it could enable additional **funding of RES-E and facilitate more access to rooftop areas for PV**. For example house owners might get incentives from self-consumption to invest in a PV module on their roof. However, also self-generation can give such incentives (e.g. by support schemes). Whether self-consumption is more attractive from a citizen's perspective and thus increases the funding of RES-E and the access to rooftop areas depends mainly on two points. The first one is if a consumer can generate additional economic benefits, compared to self-generation. This should not be based on economic redistribution from the overall system and its users to self-consumers, but should result from additional benefits of self-consumption.

Second, and this relevant both in terms of acceptance and fund-raising, for some people there may be an additional non-financial value to produce and consume their own electricity (in contrast to solely self-generating electricity), thus increasing their acceptance and willingness to invest. The remaining open question that has to be considered is how relevant this group is.

2.6.1.5 Policy framework for self-consumption

2.6.1.5.1 Types of self-consumption

In the following different models to implement self-consumption are discussed against the background of the previous analysis.

The **classical form of self-consumption** as it is described in chapter 2.6.1.2 means that electricity from a production unit is consumed without using the public grid. Producer and consumer are identical. Production and consumption happen simultaneously. Flexibility (Batteries or Demand Side Management) can be used to increase the simultaneous production and consumption. Typically PV systems on single household roofs are used for self-consumption. As mentioned in chapter 2.6.1.4 a significant number of consumers is excluded if via this model only single households are allowed to self-consume their electricity.

One solution to mitigate this discrimination can be multi-consumer self-consumption models (for example Switzerland implemented such a model, see ANNEX L). In this model residents of multi-family houses can consume the on-site produced electricity (without using the public grid), so that the number of consumers that can participate increases. Other system and social effects discussed in chapter 2.6.1.4 are not affected.

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[177] As a consequence of cost reduction for RES-E systems in the last years electricity from new systems has lower electricity generation costs than older ones. This led to the reduction of support rates for RES-E systems.

Another option to enable more consumer access to self-consumption can be distance self-consumption. This concept softens the geographical proximity and allows using the grid between production and consumption. The distance between producer and consumer can be very short (e.g. supply the neighbour with electricity "over the fence") or it can be expended to bigger areas (like the post code based system in the Netherlands, see 2.3.6. and Annex I). By increasing the distance the potential benefits of self-consumption for grid demand and grid losses diminish, especially when the consumer is supplied via different grid levels. From a system view the differences between self-consumption and self-generation disappear and parallel structures for self-generation are established.

Depending on the situation in MS it can be appropriate to support excess electricity that is not self-consumed even if there is no general support scheme in place, in order to cover a small profitability gap. This can help to make SC profitable and it also gives incentives to build a bigger PV system. Different literature sources point out that PV systems that are built under a SC scheme are not only limited by the rooftop capacity but also by the fact that the SC ratio (and thereby the profitability) decrease the larger the ratio between annual PV production and overall electricity consumption becomes (step 2 in chapter 2.6.1.3)178. If one does not want to limit the exploitation of rooftop space by developing SC, two policy options result from this: a) implementing SC support schemes for excess electricity or b) keeping general support schemes (incl. small scale PV) until SC gets profitable (either by cheap batteries, low LCOE or increasing retail prices). However, in this case it seems more appropriate to improve the support schemes and provide general and transparent support, rather than promoting self-consumption. General support schemes can incentive all types of RES-E plant while self-consumption schemes are typically only relevant for a limited number of plants. Bloomberg 2016 argues that most MS will phase out support schemes and that the driver for installing small-scale PV will be SC. The remaining question is, whether in a situation where MS are not motivated to support RES-E in general they are inclined to implement specific support for SC.

A self-consumption model that removes the principle that self-consumed electricity is produced simultaneously is net metering. In this case every on-site produced kWh is counted as self-consumption without considering if the production exceeds the consumption and is actually fed into the grid. The grid is used as a virtual storage without paying for its usage. From a physical and system view no difference exists between net metering and self-generation. Part of the margin for the consumer that results from the difference between electricity generation costs and costs for electricity purchase has to be interpreted as a support scheme.

2.6.1.5.2 General principles for a self-consumption framework

The effects that were discussed in chapter 2.6.1.4 show that compared to self-generation no clear additional benefits can be expected from self-consumption. Depending on the way self-consumption is implemented even disadvantages may occur (e.g. inefficient use of flexibility, financial disadvantage of non-self-consumption consumers). At the same time, self-consumption should be enabled for those cases where real overall benefits can be realised.

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[178] Cf.: United Nations Industrial Development Organization 2015 and Huld et al. 2016

As a consequence, the EC should establish a framework that enables a level playing field for self-consumption. Level playing field means that self-consumption is not prohibited or not discriminated against. This includes the distribution of economic effects, so that self-consumers should only incur the costs that they have caused. At the same time an implicit or explicit support for self-consumption is not appropriate, and self-consumers should contribute to the overall system costs to the extent they make use of it.

As shown in the following, it is a thin line between implementing a level playing field for self-consumption and supporting it. This also depends on the overall framework in a specific country.

Against this background, self-consumption should be considered in an EU legal framework based on the following principles:

- Grant the right to consumer to **use and store** their self-generated renewable electricity
- Grant the right to consumer to **sell** excess electricity.
- The framework conditions for self-consumption of renewable electricity should not be worse than the ones for **self-consumption of conventional** electricity that will still be in place for some time to come.
- **Self-consumed electricity** should **not** be **supported** via RES support schemes.
- If a support scheme is in place, excess electricity from self-consumption should also be covered. Depending on the situation in Member States it can be appropriate to **support excess electricity** that is not self-consumed even if there is no general support scheme is in place, e.g. if there is only a small profitability gap.
- **No specific incentives or support** for batteries or Power-to-Heat should be provided as a way to increase self-consumption. Load shifting is, due to low losses, the preferable flexibility.
- Self-consumption should be implemented in a **grid–friendly** way. That means there should be incentives to reduce peak excess production. One option is that the maximum feed-in power is limited as it is for example implemented in Germany (see Weniger et al. 2015, pp. 50 ff.). Another option are capacity based network tariffs where a reduction of grid peak-use is incentivised (different types of grid tariffs are for example discussed in Jansen et al. 2014). An alternative to capacity based network tariffs are time variable network tariffs which provide incentives to reduce the demand in hours with high grid use. However, there is evidence that this approach has only limited impact on grid requirements, e.g. dena et al. 2012.
- If the network tariff is volumetric based there is no incentive for self-consumers to reduce the peak capacity taken from the grid. In this case, it should be left up to the Member States to levy **network charges** on self-consumed electricity, so that self-consumers would still contribute to the financing of the network. The amount of these charges could be reduced if self-consumption is implemented in a way that reduces the demand for grid

infrastructure. However, if self-consumption is not implemented as an island solution that is decoupled completely from the grid it will still use the grid for excess energy or uncovered demand. Therefore, costs for maintenance and extension have to be covered also by self-consuming customers via their network charges (cf. BEUC 2015, p. 29 and Eurelectric 2015, p. 7).

- Self-consumption reduces the amount of RES-E that has to be financed by support schemes but also the amount of electricity consumption that is the basis for financing RES-E deployment. Depending on the Member State an exemption from **RES-E surcharges on self-consumed electricity** can lead to a higher burden for the other consumers. For this reason RES-E surcharges on self-consumption should be allowed in Member States.

2.6.1.6 Summary

On-site generation in general can be defined as electricity generation close to/on the premises of the consumer. It comprises three different sub-concepts: Self-generation, self-consumption and self-consumption that makes use of flexibility. Self-generation implies that a generation unit (e.g. a PV module) produces electricity on-site, which is fed into the grid. When this electricity is (partly) consumed on-site it is considered as self-consumption. Additionally some kind of flexibility (e.g. batteries or Demand Side Management (DSM)) can be applied to increase the share of self-consumption of the overall electricity consumption. For each of these concepts different cash and electricity flows can be observed. (cf. chapter 2.6.1.3)

Chapter 2.6.1.3 shows that besides grid parity as such other elements can influence the profitability of SC. The relevant parameters are listed and an equation to calculate the profitability of SC is deduced from these parameters, in order to show which factors are relevant and which ones can be influenced by policy.

Potential benefits of self-consumption have to be compared to the ones resulting from self-generation. Whether the system benefits from self-consumption or not depends on the way self-consumption is implemented (e.g. grid-friendly). Self-consumption is not a no-regret measure, but can also entail disadvantages, both in terms of overall costs (e.g. additional demand for flexibility) and distribution of costs (e.g. additional burden for customers that do not use self-consumption). (cf. chapter 2.6.1.4)

As a consequence of the discussed advantages and disadvantages of self-consumption, the EC should establish a framework that enables a level playing field for self-consumption. Level playing field means that self-consumption is not prohibited or not discriminated against. This includes the distribution of economic effects, so that self-consumers should only incur the costs that they have caused. At the same time an implicit or explicit support for self-consumed electricity is not appropriate, and self-consumers should contribute to the overall system costs to the extent they make use of the system. If a support scheme is in place, excess electricity from self-consumption should also be covered. Depending on the situation in Member States it can be appropriate to support excess electricity that is not self-consumed even if there is no general support scheme is in place, e.g. if there is only a small profitability gap (cf. chapter 2.6.1.5).

2.6.2 Overview of existing regulations on self-generation and self-consumption schemes in the EU and its Member States

2.6.2.1 Introduction

The Energy Union strategy of the European Commission places consumers at the core of the EU energy policy.179 In its Staff Working Document "Best practices on Renewable Energy Self-Consumption", published in July 2015 and accompanying the Commission's communication entitled "Delivering a New Deal for Energy Consumers"180, the European Commission illustrates best practice in the area of self-generation and self-consumption, based on the experience of national schemes (see Annex of the SWD). In May 2016, the European Parliament adopted the report of the ITRE committee (2015/2323(INI)), which welcomes the communication from the Commission.181

Based on the assumptions in the SWD mentioned above,. the following chapter concentrates on different options of the background note, which would include the following provisions:

- Introduce a EU-wide definition of renewable energy prosumers;
- Enabling consumers (below a certain capacity threshold) to generate and store renewable electricity for their own use, without requiring the supplier's permission, and limit the administrative burden by requiring a simple notification to the DSO;
- Enabling consumers to sell excess renewable electricity, at least at the wholesale market price, and to participate in all relevant energy markets either directly or through market aggregators;
- Define principles for cost-effective support schemes for renewable prosumers, including net-metering;
- Require Member States to establish simplified authorisation procedures for small-scale renewable energy projects, including through simple notification.
- As a further option: Member States would be required to guarantee the possibility of small prosumers (below a certain capacity threshold) to sell their own renewable electricity 'over-the-fence' to nearby consumers *e.g.* within multi-apartment blocks or shopping centres.

To develop concrete proposals for future regulations on this issue, it is necessary to get a better understanding of the existing regulations in the EU and its

179 COM, Best practices on Renewable Energy Self-Consumption, COM(2015) 339 final, p. 2.
180 COM, Best practices on Renewable Energy Self-Consumption, COM(2015) 339 final, p. 2.
181 EP, Report on delivering a new deal for energy consumers (2015/2323(INI)), p. 4/no. 1.

Members States for assessing the regulative possibilities. This chapter summarizes the present legal frameworks for self-generation and self-consumption in the EU and its Member States with a focus on micro and small-scale renewable energy systems (installed electricity capacity below 500 kW). Overviews were made of the different national situations in the following eight Member States:

Austria, Belgium, Denmark, Germany, Italy, The Netherlands, Spain, and the United Kingdom.182

The description of the national schemes is mainly based on the following sources:

- RES legal, Assignment 2014-1 RES-E Self-Consumption and net-metering, 09/2014
- BEUC, Current practices in consumer-driven renewable electricity markets, BEUC mapping report, January 2016
- IEA, PVPS Annual Report 2015
- IEA, PVPS, Review and analysis of PV self-consumption policies, 2016
- EPIA, Overview of PV Support Schemes in Europe, December 2014 (not published)

At the end of the chapter, an analysis of the different issues and conclusions are made.

[182] The national regulations of other Member States, esp. France and Portugal, will be reflected when discussing the individual topics.

2.6.2.2 *Country reports*

Matrix for overview of existing regulations in some of the Member States

		Self-supply			
Self-generation		**Use of self-generated electricity**			
		Self-consumption		**Use of excess electricity**	
Right to self-generate?		**Right to self-consume?**		**Right to sell excess electricity?**	
System size limitation		**Support?**		**Priority dispatch?**	
Suppliers` permission?		**Burden**		**Support?**	
DSO´s permission?		Levies		FiT	
Grid connection issues		Taxes		Wholesale market	
		Grid tariffs		Others	
		Right to store?		**Burden?**	

Definition of „Prosumer"

Net metering

„Over the fence"
- Distance
- Multi-consumers

2.6.2.2.1 Austria

AUSTRIA							
Self-generation		**Use of self-generated electricity**					
		Self-consumption			**Use of excess electricity**		
Right to self-generate?	Yes	**Right to self-consume?**	Yes		**Right to sell excess electricity?**	Yes	
System size limitation[183]		**Direct support?**	A subsidy of 275 euro per kW installed capacity is granted by the Federal Climate and Energy Fund to private households and companies that install a roof-top or ground-mounted solar PV systems with a maximum installed capacity of 5 kW (375 euro for building integrated installations)[184].		**Priority dispatch?**		
Suppliers` permission?		**Burden**			**Support?**		
DSO´s permission?	Grid operators have to answer renewable power plants' applications for connection within two weeks. After a technical text, a connection agreement is concluded between the plant	Levies			FiT	In 2015, solar PV systems with an installed capacity of more than 5 kW up to 200 kW (2014: 350 kW) are entitled to a FiT of 11.5 ct/kWh (12.5 ct/kWh in 2014).Additionally, 30% of investment costs are granted as a direct subsidy, but capped	

[183] Only for large installations over 200 kwp

[184] BEUC, mapping report, January 2016, p. 45; IEA, PVPS, Annual report 2015, p. 40.

	operator and the grid operator.[185]				at 200 euro per kW.[186]
Grid connection issues	Self-generators have to pay a grid-access fee covering the costs of the connection and additional charges related to metering. If reinforcement of the grid is necessary to secure sufficient feed-in capacity, another contract between the plant operator and the grid operator needs to be established, clarifying the cost allocation. No legal provisions define these procedure. Only in the case of insufficient grid capacities, priority grid access is given to renewable power plants[187].	Taxes		Wholesale market	No support scheme for excess electricity for solar PV units below 5 kW; self-generators have to sell excess electricity to supplier (or third party) via PPA.[188]
		Grid tariffs	>25 MWh/y pay 1.5 € cent/kWh on SC electricity[189]	Others	
		Right to store?	Yes; in 2015, support schemes for battery-storage systems in combination with PV systems were offered by several provinces. This scheme is dedicated for small, mainly private	**Burden?**	

[185] BEUC, mapping report, January 2016, p. 44.
[186] BEUC, mapping report, January 2016, p. 45.
[187] BEUC, mapping report, January 2016, p. 44.
[188] COM, SWD(2015) 141 final, p. 13.
[189] COM, SWD(2015) 141 final, p. 13.

		systems, the support schemes are very different, typically ranging up to storage capacities of up to a maximum of 10 kWh.[190]		
	Net metering			
	A net-metering policy does not exist.			

[190] IEA, PVPS, Annual report 2015, p. 41.

2.6.2.2.2 Belgium

BELGIUM					
Self-generation		**Use of self-generated electricity**			
		Self-consumption		**Use of excess electricity**	
Right to self-generate?	Yes	**Right to self-consume?**	Yes	**Right to sell excess electricity?**	Yes
System size limitation	Up to 10kW (residential)	**Direct support?**	PV production eligible for Green Certificates (Flanders, Brussels); Net metering (see below)	**Priority dispatch?**	Yes
Suppliers` permission?		**Burden**		**Support?**	
DSO´s permission?	A technical acceptance has to be emitted by an accredited controller than transferred to the distribution grid operator.[191]	Levies		FiT	No
Grid connection issues	Flanders and Wallonia both guarantee priority access as well as priority grid use to renewable power plants. In Flanders, the grid operator is obliged to adapt the consumer's meter in order to enable him/her to participate in the net metering scheme. In Wallonia, the consumer	Taxes		Wholesale market	

[191] BEUC, mapping report, January 2016, p. 55.

	just has to inform his/her grid operator that he/she will start net metering. For low voltage connections on the distribution grid level, simplified access procedures apply.[192]				
		Grid tariffs	In Flanders, the "prosumer fee" of around 85 EUR/KW depending on the Distribution System Operator (DSO) was introduced in July 2015 for all the small PV systems (<10 kW). This fixed fee enables DSOs to charge for the cost of grid use by PV owners, without changing the system of net metering.[193]	Others	Retail Electricity prices via net-metering (see below)
		Right to store?	The right to store is given in Brussels. In Wallonia and Flanders, the right to store is only guaranteed for systems above 10 kW[194].	**Burden?**	
		Net metering			
		• Brussels: small auto-producers of green electricity are entitled to benefit from a compensation mechanism for the difference between the amount of electricity taken from the grid and the amount of electricity fed into the grid (net-metering). Renewable energy plants with a capacity of maximum 5kW are eligible for net-metering. In order to benefit from net-metering, the installation shall be equipped with two different meters: a bi-directional meter (A+/A-) installed by Sibelga and a "green meter", certified by Brugel, measuring the electricity produced by the renewable energy plant.[195] To be removed at the start of 2018.[196]			

[192] BEUC, mapping report, January 2016, p. 55.
[193] IEA, PVPS Annual Report 2015, p. 43.
[194] IEA, PVPS Annual Report 2015, p. 43.
[195] RES legal, RES-E self-consumption and net metering, p. 18.
[196] IEA, PVPS Annual Report 2015, p. 43.

	• Flanders: All renewable technologies with a maximum capacity of 10 kW are eligible to the net-metering scheme. Excess electricity produced by installations with a maximum capacity of 10 kW is injected into the grid and automatically deducted from the electricity consumed from the grid. However, if an installation injects more electricity than it has taken from the grid during a billing period, this amount is not financially reimbursed.[197] • Wallonia: Auto-producers producing electricity through a renewable energy plant with a capacity of ≤ 10 kVA and connected to the distribution grid are eligible for net-metering, provided their installation has been certified and registered as a green electricity production plant by the CWaPE. The metering balance is calculated on an annual basis.[198]

[197] RES legal, RES-E self-consumption and net metering, p. 18.
[198] RES legal, RES-E self-consumption and net metering, p. 18.

2.6.2.2.3 Denmark

DENMARK					
Self-generation		**Use of self-generated electricity**			
		Self-consumption		**Use of excess electricity**	
Right to self-generate?	Yes	**Right to self-consume?**	Yes	**Right to sell excess electricity?**	Yes
System size limitation	6 kW (for the high tariff)[199]	**Direct support?**	There is no support for self-consumed electricity in Denmark. RES-E support only applies to electricity delivered to the grid.[200]	**Priority dispatch?**	
Suppliers` permission?		**Burden**		**Support?**	
DSO´s permission?	Application at the national transmission system operator Energienet.dk one month before the start[201]	Levies		FiT	No, but purchase by utility (see below)
Grid connection issues	Plant operators are not granted priority but non-discriminatory grid access.[202]	Taxes	Self-consumption of renewable energy is exempted from the energy tax and the PSO-tariff (public service obligation).[203]	Wholesale market	No
		Grid tariffs	Self-consumption is exempted from grid fees.[204]	Others	Net-metering regulation with energy compensation on an

199 IEA, PVPS Review and Analysis of PV Self-Consumption Policies, March 2016, p. 18.
200 RES Legal, RES-E self-consumption and net metering, p. 22.
201 BEUC, mapping report, January 2016, p. 73.
202 BEUC, mapping report, January 2016, p. 73.
203 RES Legal, RES-E self-consumption and net metering, p. 22.
204 RES Legal, RES-E self-consumption and net metering, p. 22.

				hourly basis only. - The excess generation is bought by the utility at a price that is significantly lower than the price of electricity from the grid. - Some 80 MW can receive a tariff of 1.03 DKK/kWh for 10 years, probably reduced. - Outside of these 80 MW, a reduced tariff (0.6 DKK/kWh paid for 10 years and 0.4 DKK/kWh for the 10 following years) is paid for the excess electricity. After 20 years, the tariff paid will be equal to the spot market price.[205]
	Right to store?	Yes, but no support for in-house storage[206].	**Burden?**	
	Net metering			
	In Denmark, net-metering is in place for non-commercial small scale PV systems. It is possible on an hourly basis. Older systems, which were connected to the grid not later than 31th December 2013, conduct net-metering on an annual basis.[207]			

205 IEA, PVPS, IEA, PVPS Review and Analysis of PV Self-Consumption Policies, March 2016, p. 18.
206 RES legal, Assignment 2014-1 RES-E Self-Consumption and net-metering, 09/2014, p. 22.
207 RES legal, RES-E self-consumption and net metering, p. 22.

2.6.2.2.4

Germany **GERMANY**					
Self-generation		**Use of self-generated electricity**			
		Self-consumption		**Use of excess electricity**	
Right to self-generate?	Yes	**Right to self-consume?**	Yes	**Right to sell excess electricity?**	Yes
System size limitation		**Direct support?**	No	**Priority dispatch?**	Yes
Suppliers` permission?	No	**Burden**		**Support?**	
DSO´s permission?	Consumers inform the local grid operator who is obliged to provide a timetable for connection. No formal contract between the self-generator and the grid operator has to be concluded.[208]	Levies	Surcharge on the electricity bill that finances feed-in tariffs has to be paid for the self-consumed electricity from new PV systems. Installations below 10 kW are exempted while other installations have to pay 30% of the surcharge, increasing to 40% in 2017. The exemption is valid during 20 years, after which the full surcharge will have to be paid.	FiT	Excess PV electricity is paid either with a defined feed-in tariff or through the so-called "market integration model": a feed-in premium on top of electricity market prices. For installations between 10 kW and 1 MW, only 90% of the yearly-generated electricity is allowed to receive the tariff, which can be translated into a minimum requirement of 10% of self-consumption.[209]
Grid connection issues	Grid operators are obliged to connect renewable power plants with priority. To these ends, it is the grid operator's duty to	Taxes	None	Wholesale market	

[208] BEUC, mapping report, January 2016, p. 81.
[209] IEA, PVPS Review and Analysis of PV Self-Consumption Policies, March 2016, p. 21; RES Legal, RES-E self-consumption and net metering, p. 24.

	optimise and expand the grid. No charges related to grid connection and expansion occur.[210]				
		Grid tariffs	Self-generators are not burdened with grid-related costs.	Others	
		Right to store?	Germany has introduced an energy storage incentive program that provides owners of systems up to 30 kW with a 30% rebate and low interest loans from KfW (German development bank).[211]	**Burden?**	
		Other incentives			
		Net metering			
		There is no net-metering policy in place in Germany.[212]			

[210] BEUC, mapping report, January 2016, p. 81.
[211] IEA, PVPS Review and Analysis of PV Self-Consumption Policies, March 2016, p. 21.
[212] RES Legal, RES-E self-consumption and net metering, p. 24.

2.6.2.2.5 *Italy*

ITALY					
Self-generation		**Use of self-generated electricity**			
		Self-consumption		**Use of excess electricity**	
Right to self-generate?	Yes	**Right to self-consume?**	Yes	**Right to sell excess electricity?**	Yes
System size limitation	None	**Direct support?**	Prosumers can opt for Indirect energy sale (Ritiro Dedicato) and for net billing (Scambio sul posto,). A prosumer can be eligible for both incentives, depending on the specific circumstances.[213]	**Priority dispatch?**	
Suppliers` permission?		**Burden**		**Support?**	
DSO´s permission?	A simple standard application process obliges the grid operator to conclude a contract for grid connection with the applicant within a limited period of time.[214]	Levies		FiT	
Grid connection issues	Grid operators are obliged to connect renewable power plants with priority.[215]	Taxes	Generally, solar PV benefits from a reduced VAT rate (10% instead of 20%).[216]	Wholesale market	Electricity sales, indirectly by entering into a "Ritiro Dedicato" (RID), through which GSE retires the electricity according

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213 RES Legal, RES-E self-consumption and net metering, p. 26.
214 BEUC, mapping report, January 2016, p. 96.
215 BEUC, mapping report, January 2016, p. 96.
216 BEUC, mapping report, January 2016, p. 96.

					to a dedicated withdrawal agreement, or directly, through sales of electricity on the power exchange or to a wholesaler.[217]
		Grid tariffs	Self-generators pay an annual fee per connection point to cover the grid operator's administrative costs. The underlying fee ranges between 15 and 45 euro depending on the installed capacity.[218] Self-consumed electricity is gradually exempted from grid and system costs: < 20kW, exempted from grid and system costs; 20-200kW partially exempted[219]	Others	Scambio sul posto (net-billing)
		Right to store?		**Burden?**	
		Net metering			
		Applicable: the Scambio sul posto measure. This entails: - All RES installations up to 20 kW - RES installations from 20 to 200 kW active from after 31st Dec 2007 (and high efficiency cogeneration plants up to 200 kW) Scambio sul posto is an incentive based on the net amount of energy input into the grid on a certain time-period. It works as follows: The Scambio sul posto regulation allows a form of self-consumption by which the energy produced and input into the grid can be "taken back" and used at a later time.[220]			

[217] IEA, PVPS, Annual report 2015, p. 68.
[218] BEUC, mapping report, January 2016, p. 96.
[219] COM, SWD(2015) 141 final, p. 13.
[220] RES Legal, RES-E self-consumption and net metering, p. 26.

	Distance and multi-consumers
	Another indirect support is granted through the exemption of self-consumption systems, uniting one or several modules with up to 20 MW (Sistemi Efficienti di Utenza, SEU) from grid and system costs equal to around 40% of retail electricity prices. One or more renewable power plants or (fossil) cogeneration units directly feed a unique final user through a private connection. Producer and consumer share the same connection point to the grid but they do not necessarily have to be identic.[221]

[221] BEUC, mapping report, January 2016, p. 97.

2.6.2.2.6 *The Netherlands*

THE NETHERLANDS					
Self-generation		**Use of self-generated electricity**			
		Self-consumption		**Use of excess electricity**	
Right to self-generate?	Yes	**Right to self-consume?**	Yes	**Right to sell excess electricity?**	Yes
System size limitation	15 kW	**Direct support?**	For small systems net metering (prosumers with in-house PV system). This indirectly favours self-consumption. Net billing for prosumers participating in shared renewable energy programmes (members of energy cooperation, apartment owners associations). It could be argued that this favours virtual self-consumption.[222]	**Priority dispatch?**	Yes
Suppliers` permission?	N/A	**Burden**		**Support?**	
DSO´s permission?	Grid operators obliged to enter into a contract with future renewable power plant operators (right to use the grid and to claim eventually an extension of the grid). Before start of project under net metering scheme: need for prior application for an	Levies	None	FiT	

[222] RES legal, RES-E self-consumption and net metering, p. 29.

	offer from local grid operator to feed electricity into grid.[223]				
Grid connection issues	No priority grid access is secured, only a discrimination-free connection.[224]	Taxes	Energy taxes only apply to the net consumption of electricity, i.e. the consumed electricity reduced by the amount of electricity fed into the grid.[225]	Wholesale market	
		Grid tariffs	Grid operators do not explicitly charge self-generators for grid connection and grid use. However, households that participate in the net metering scheme continue to pay the capacity based network fee. Imposed networks fees do not depend upon actual consumption but as a fixed capacity based standing charge.[226]	Others	Retail electricity pricing through full Net metering (see below)
		Right to store?		**Burden?**	
		Net metering			
		As per 1 January 2014, applicable without limitation for residential customers with an individual roof-top PV system and 3 x 80A circuit breakers. Any annual total generation exceeding annual total consumption goes beyond the remit of net metering. For surplus generation the buy-back rate offered by the prosumer's supplier obtains. Customers member of an energy cooperation or apartment owners association may be eligible under certain conditions to net billing which means that they may be eligible to a discount of 7.5 €ct energy tax on their energy bill.[227] Net metering scheme is guaranteed until 2020.[228]			

[223] BEUC, mapping report, January 2016, p. 107.
[224] BEUC, mapping report, January 2016, p. 107.
[225] BEUC, mapping report, January 2016, p. 107.
[226] BEUC, mapping report, January 2016, p. 107.
[227] RES legal, RES-E self-consumption and net metering, p. 29.

	Distance and multi-consumers
	Energy tax exemption is also granted to tenants who rent a solar PV unit as part of their lease contract in case they self-consume solar electricity or buy electricity from their landlord. The exemption is only granted if no third party is involved and if the solar PV unit is owned by the landlord himself.[229]

[228] IEA, PVPS, Annual report 2015, p. 85.
[229] BEUC, mapping report, January 2016, p. 108.

2.6.2.2.7 Spain

SPAIN					
Self-generation		**Use of self-generated electricity**			
		Self-consumption		**Use of excess electricity**	
Right to self-generate?	Yes	**Right to self-consume?**	Yes	**Right to sell excess electricity?**	Yes
System size limitation	No	**Direct support?**	Three categories of self-consumption: (1) Solar PV units up to 100 kW may self-consume electricity if producer and consumer are the same. Installed capacity is limited to contracted power capacity. (2) Solar PV units up to 100 kW without power capacity-related limits. Installation has to be run by one juristic person who is obliged to declare self-generation as a commercial activity, liable to taxation in the trade register. (3) Off-grid solar PV units without any limit of installed capacity that supply electricity through a direct line to a self-consumer who is identic with owner.[230]	**Priority dispatch?**	
Suppliers` permission?		**Burden**		**Support?**	

[230] BEUC, mapping report, January 2016, p. 141.

DSO´s permission?	For small-scale solar PV units with up to 10 kW, a simplified grid connection permit procedure applies. Self-generators have to request authorisation for connection to the distribution grid at the existing point of supply.[231]	Levies		FiT	No
Grid connection issues	Formally, priority grid access is granted. However priority access and dispatch of renewable energy installations limited which is contingent upon undercutting of prices of the other players.[232]	Taxes		Wholesale market	
		Grid tariffs	Solar PV self-generation units that connect to the grid have to pay a charge on the electricity which they generate ('back-up toll'), as well as a charge defined by the size of installed capacity. Installations below 10 kW are exempted from the charge on the electricity generated. In case installed capacity of solar PV unit is below size of household's grid connection, self-generators also can be exempted.[233]	Others	No

[231] BEUC, mapping report, January 2016, p. 141.
[232] BEUC, mapping report, January 2016, p. 141.
[233] BEUC, mapping report, January 2016, p. 141.

	Right to store?	No storage devices are allowed for solar PV units connected to the grid.[234] Adding battery storage implies additional tax.[235]	**Burden?**
	Net metering		
	No net metering policies.[236]		

[234] RES legal, RES-E self-consumption and net metering, p. 32.
[235] IEA, PVPS Review and Analysis of PV Self-Consumption Policies, March 2016, p. 26.
[236] RES legal, RES-E self-consumption and net metering, p. 32.

2.6.2.2.8 United Kingdom

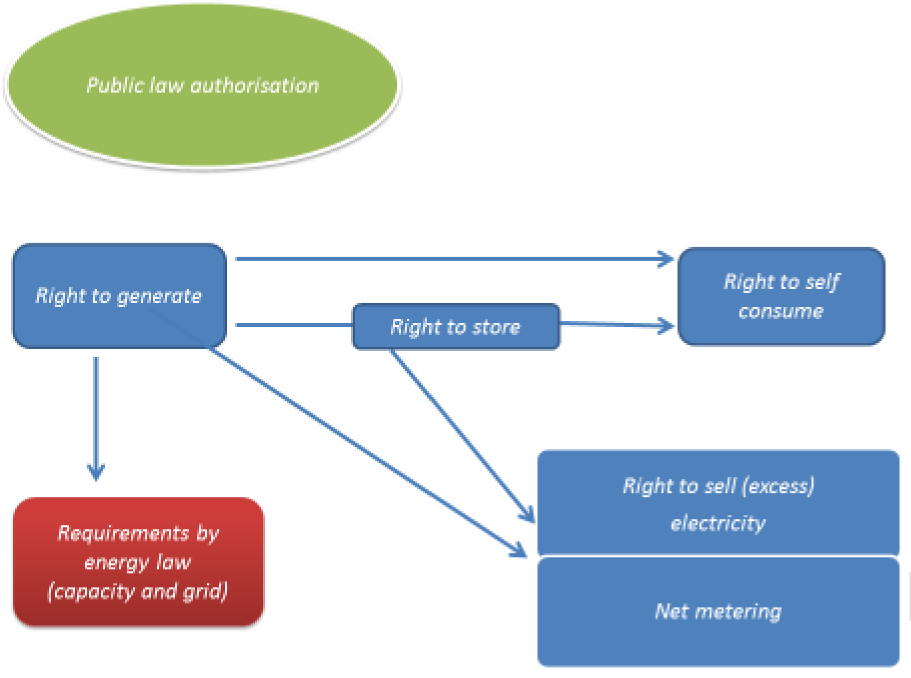
UNITED KINGDOM					
Self-generation		**Use of self-generated electricity**			
		Self-consumption		**Use of excess electricity**	
Right to self-generate?	Yes	**Right to self-consume?**	Yes	**Right to sell excess electricity?**	Yes
System size limitation	30 kW	**Direct support?**	Self-consumption for small systems (<30 kW) is being encouraged through a generation tariff and an export tariff, applicable to the electricity fed into the grid.[237]	**Priority dispatch?**	Yes
Suppliers` permission?		**Burden**		**Support?**	
DSO´s permission?	Grid operators have to conclude a connection agreement with plant operators. Solar PV self-generators are subject to a standardised procedure.[238]	Levies	There are no taxes or levies on self-consumption of electricity in the United Kingdom.[239]	FiT	The FiT payment is made up of two components: There is payment for RES-E generation and one for the export to the grid of this electricity (the export tariff is 4.5 p/kWh). For self-consumed electricity only the generation tariff applies. The generation tariff for PV plants depend on the system capacity.[240]
Grid connection issues	Renewable power plants cannot rely on priority access to the grid.	Taxes		Wholesale market	

[237] IEA, PVPS Review and Analysis of PV Self-Consumption Policies, March 2016, p. 30.
[238] BEUC, mapping report, January 2016, p. 150.
[239] RES legal, RES-E self-consumption and net metering, p. 34.
[240] RES legal, RES-E self-consumption and net metering, p. 34.

	Households that produce renewable electricity and want to feed it into the grid conclude a contract with the grid operator to enter a bilateral connection agreement. In the case of small self-generation units, a FiT licensee, for instance the electricity supplier of the consumer, takes over this procedure. For larger projects above 4 kW of installed capacity, additional costs can apply for grid reinforcement which consumers might not know about until they apply for access.[241]				
		Grid tariffs	None	Others	
		Right to store?	Consumption of electricity stored in-house is considered as self-consumption. There is no support scheme for in-house storage.[242]	**Burden?**	
		Net metering			
		There is no net-metering policy in place in the UK.[243]			

[241] BEUC, mapping report, January 2016, p. 150.
[242] RES legal, RES-E self-consumption and net metering, p. 34.
[243] RES legal, RES-E self-consumption and net metering, p. 34.

2.6.2.3 Analysis



2.6.2.3.1 Right to self-generate and right to self-consume

Overview of the situation in the Member States

The right to self-generate and the right to self-consume are the basis if the active participation of consumers as producers in the energy market is aspired to. Nearly all assessed Member States assume that self-consumption can play an important role for the achievement of the 2020 and 2030 targets.

In all examined Member States, the right to self-generate and the right to self-consume renewable energy are in existence. As far as it can be stated, the assessment of the national regulations in the Member States not show that the right to self-generate has been reduced in general by requiring certain permissions of the suppliers. However, the relation between the future generator and the local distribution grid operator is more complex. The RED declares in recital (60) that the priority access and guaranteed access for electricity from renewable energy sources are important for integrating renewable energy sources into the internal electricity market. The regulation in Art. 16 para. 2 RED (priority or guaranteed grid access) refers to all generated renewable energies, including residential or small-scale self-generated energy. The rights related to grid access issues are not well complied with in each Member State. This is the reason why grid access can become the bottleneck of consumers' self-generation projects. If small-scale solar PV installations on households' rooftops have to compete with multi-megawatt power plants for the use of grid capacity, self-generation will remain a niche market.

Summary of various stakeholder positions

In general, *BEUC* states that a high self-consumption rate does neither serve the consumer nor the system. With regard to solar PV, *BEUC* does not share the Commission's view of a high self-consumption rate being a value in itself (SWD(2015) 141). From the point of view of consumers to be fully integrated in future markets, this might be counterproductive. A household running a micro solar unit for mere self-consumption as an 'isolated system' with as little interaction as possible with the grid would contradict the Commission's vision of an energy producer who is actively involved in market.[244]

When it comes to grid connection, *BEUC* states that prosumers' installations cannot be compared with established power plant operators.[245] For this reason, *BEUC* recommends that in the future legislative framework, grid operators should be obliged to immediately optimise and expand their network in order to guarantee to self-generators the purchase, transmission and distribution of their electricity.[246]

Client Earth recommends adopting the right of fair access to relevant markets including the guarantee access and priority connection for renewable energy production installations to distribution grid infrastructure.[247] Regarding the right to self-consume it its crucial to know how the system is designed and if further rights are granted.

Eurelectric recommends that opting for distribution generation should be a customer choice that does not result from artificial incentives.[248] Furthermore, they remark in the consultation for the RED for the period after 2020 that it is unclear for them what an "EU wide right to generate, self-consume and store renewable electricity" would mean in practice. In their opinion, the EU should rather prepare a concrete list of barriers that should be removed, such as purchasing obligations and designing incentives for efficient investments.[249]

SolarPower Europe proposes the implementation of a right to self-generate and consume renewable energy: it is seen as the first pre-requisite to make sure European consumers can control their energy costs via self-generation and consumption is to make it legally possible everywhere in Europe. A clear right to self-generate, consume and store energy is therefore needed. Specific taxes or other fees on self-consumed electricity as well as economic barriers and discriminatory measures such as the ones implemented in Spain for instance should not be allowed. Further, a definition of renewable self-generators and self-consumers should be introduced, which should be large enough to reflect cases where the production of one on-site generation facility is self-consumed by different consumers (e.g. single building occupied by several different households;

[244] Public Consultation on the RED for the period after 2020, BEUC, p. 22.
[245] BEUC, A welcome culture for consumers' solar self-generation, January 2016, p. 6.
[246] BEUC, A welcome culture for consumers' solar self-generation, January 2016, p. 6, 7.
[247] Client Earth, Prosumer Rights, May 2016, p. 22.
[248] Eurelectric, Prosumers - an integral part of the power system and the market, June 2015, p. 5.
[249] Public Consultation on the RED for the period after 2020, Eurelectric, p. 28.

commercial mall where the electricity is self-consumed by different shops within the same building; cooperatives).[250]

- ➔ The stakeholders widely agree on the need of an EU-wide right to generate and a right to self-consume. *Eurelectric* merely makes the objection that the impact of these guarantees in practice are not clear.

How should the right to self-generate and self-consume be defined?

The basis for a right to self-generate and a right to self-consume is the introduction of clear and understandable definitions. The definitions of a right to generate and self-consume should guarantee the citizens and/or investors that the legal framework for their installations is stable and reliable. The rights should rather be defined in two separate definitions. The right to self-generate is not directly coupled with the right to self-consume, but they correspond to each other. The right to self-consume depends on the right to self-generate, while the right to self-generate does not necessarily depend on the right to self-consume. Hence, the right to self-generate has to be defined as the basis of the right to self-consume.

The right to self-generate has to include the guarantee for citizens and/or organizations of citizens to generate their own electricity with their own installations/power plants. The right to self-generate should give the citizens and affiliation of citizens the opportunity to generate their own electricity without any discrimination. However, the right to self-generate has to be distinguished from the mere financial participation in energy communities/projects (See also 2.3.7 on prosumer definition). Possible definition:

> "Each Member State should ensure that the right of every citizen and/or affiliation of citizens to generate their own electricity is guaranteed."

The right to self-consume can be defined in a wide or narrow sense. A narrow definition would exclusively cover the right to self-consume for the self-generator himself. The self-consumer and the self-generator would be identical. The situation that the self-generator is not identical with the self-consumer could be subsumed under the terms multi-consumers or distance-consumers. The use of the grid would be the point of difference between self-consumption and other forms of consumption of the self-generated electricity. A wide definition would include any kind of consumption of the electricity generated and would also cover multi-consumers or distance-consumers. (See also 2.3.7 on prosumer definition). The disadvantage of the wide definition is that the differentiating elements are not clearly identifiable and could create legal uncertainty. Self-consumption should be seen as an entity of generation and consumption. Because of these aspects, the narrow definition is preferable. Possible definition:

> "Each Member State should ensure that self-generated electricity can be self-consumed by the generator."

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[250] Public Consultation on the RED for the period after 2020, SolarPower Europe, p. 17.

What is the best capacity threshold for small prosumers?

In general, thresholds for small prosumers can play a role in connection with diverse regulatory contexts, such as

- System size limitation for self-generation (see Belgium, Denmark, The Netherlands or the United Kingdom)
- System size limitation for self-consumption (see Spain)
- DSO´s permission, (see Spain)
- Requirement for public authorization, (see United Kingdom)
- Net-metering,(see Belgium, The Netherlands)
- Selling of excess electricity. (see Austria, Denmark, Germany, Italy)

From a legal viewpoint, the assessment of the national regulations in the Member States did not provide any reliable indications that a certain capacity can be qualified as "best" capacity for small prosumers. To define the optimum in this sense is rather a technical and/or economic question. When introducing certain thresholds, it should be ensured that these limits are consistent and without contradiction.

Summary of pros *and cons*

Option	**Pro**	**Con**
Confirmation of a right to self-generate (in general)	Avoidance of retroactive changes; reduction of the application basis of volumetric grid charges[251]; increasing acceptance of the energy transition; facilitated access to roof area for PV[252]; Higher legal certainty for rightholder	Low incentive to reduce the claim on network capacity[253] Rather unclear how robust the legal right will be; MS might introduce certain restrictions to guarantee secure operation of the national electricity system
Confirmation of a right to self-consume (in general)	Avoidance of retroactive changes; reducing demand for grid expansion; increasing acceptance of the energy transition[254] Higher legal certainty	Eurelectric: Unclear what right would mean in practice
Narrow definition of the right to self-consume	Legal certainty as a clear definition can be provided	Less beneficiaries

[251] RES legal, RES-E Self-consumption and net metering, 2014, p. 37.
[252] Öko-Institut, Self-Consumption, 06/2016, slide 3.
[253] RES legal, RES-E Self-consumption and net metering, 2014, p. 37.
[254] Öko-Institut, Self-Consumption, 06/2016, slide 3.

Wide definition of the right to self-consume	More beneficiaries	Legal uncertainty; unclear differentiation between generators and consumers

2.6.2.3.2 Right to store self-generated electricity

Energy storage installed by consumers may help storing excess onsite renewable generation in period of low demand for use in periods when energy demand is high and renewable production is low. It may also reduce the peak power of the decentralized renewable energy installations and the consumers can use their energy systems more efficiently by decoupling time of generation and consumption.[255] As a result, storage can also be seen as an energy efficiency measure. The current RES directive states in Art. 16 para. 1: "Member States shall take the appropriate steps to develop transmission and distribution grid infrastructure, intelligent networks, **storage facilities** and the electricity system, in order to allow the secure operation of the electricity system as it accommodates the further development of electricity production from renewable energy sources, […]". It determines in recital (57) that the Member States have to support the use of energy storage systems for integrated intermittent production of energy from renewable sources. This consideration applies to the entire scope of the RED 2009/28/EC, but does not set concrete legally binding requirements. So the granting of a concrete right to store depends on the national renewable energy policy and the national legal framework. The country reports show that the right to store self-generated energy from RES is not granted in all Member States. In some cases, the right to store self-produced energy depends on the further design of the national support scheme, especially in the case of a net-metering system[256], as there might be a conflict between the two instruments.

2.6.2.3.3 Overview of the situation in the Member States

In some Member States the storage of self-produced energy is desired and subsidized, e.g. in Germany[257], Austria[258] or Portugal[259]. Several federal "Länder" in Austria and Germany offer a support scheme for battery-storage systems in combination with PV systems[260]. In France, the storage of energy for one`s own use is allowed, but not subsidized. At the moment, the storage in France is regarded as uneconomic because of the nationally low retail electricity price[261]. It is said, that an uneconomic environment for storage exists also in Slovenia[262]. The Spanish government raises a tax on batteries for the storage of energy[263] and does not in general allow the storage for PV units connected to the grid[264].

[255] COM, Best practices on Renewable Energy Self-Consumption, COM(2015) 339 final, p. 6.
[256] E.g. in the Netherlands: IEA, PVPS Annual Report 2015, p. 85; See below: chapter „Net-metering".
[257] IEA, PVPS Annual Report 2015, p. 64.
[258] IEA, PVPS Annual Report 2015, p. 40.
[259] APESF, PowerPoint „Self Consumption in Portugal", May 2015, p. 3.
[260] IEA, PVPS Annual Report 2015, p. 40.
[261] IEA, PVPS Review and Analysis of PV Self-Consumption Policies, March 2016, p. 20.
[262] BEUC, mapping report, January 2016, p. 133.
[263] IEA, PVPS Review and Analysis of PV Self-Consumption Policies, March 2016, p. 26.
[264] BEUC, mapping report, January 2016, p. 142.

Summary of various stakeholder positions

Solar Power Europe calls for an incentive of demand response and storage in all forms in order to exploit self-consumption to its full potential.[265]

Eurelectric declares that cost of appliances or enabler for electrical storage onsite aren't regulatory barriers. For *Eurelectric*, it is up to the market to develop cost effective technologies.[266]

➔ The stakeholders agree that storage should be allowed. However, they differ concerning the need of incentives for storage.

Summary of pros and cons

Option	Pro	Con
Confirmation of a right to store	Demand-response-flexibility, reduction of peaks; reduction of every negative cost-boosting grid impacts[267]; reducing demand for grid expansion[268] Legal certainty	Smaller distribution of network charges; storage losses (up to 20 %)[269]; Flexibility in big areas is blocked[270]

2.6.2.3.4 *Right to sell excess electricity*

The situation that all of the produced electricity is self-consumed is usually not the case for residential or commercial consumers. Hereby, consumers producing renewable energy still need to feed the non-consumed electricity into the grid and receive value for it in order for the project to be viable.[271] For this position, the prosumer needs to participate in the energy market as a seller, directly or through market aggregators.

Overview of situation in the Member States

Most of the Member States decided to choose a feed-in tariff/premium approach or a net-metering approach. Within the feed-in tariff (FiT) scheme, the prosumer receives support for non-consumed electricity that is fed into the grid. The value of the FiT can determine the cost effectiveness of self-consumption. The net-metering policies are discussed in a separate chapter.

The right to sell excess renewable energy is allowed in all Member States – in some states under several conditions. A few states are offering feed-in tariffs for

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265 SolarPowerEurope, Renewable Self-Consumption – Policy Paper, June 2015, p.9.
266 Public Consultation on the RED for the period after 2020, Eurelectric, p. 23.
267 RES legal, RES-E Self-consumption and net metering, 2014, p.
268 Öko-Institut, Self-consumption, 06/2016, slide 4.
269 Öko-Institut, Self-consumption, 06/2016, slide 10.
270 Öko-Institut, Self-consumption, 06/2016, slide 5.
271 COM, Best practices on Renewable Energy Self-Consumption, COM(2015) 339 final, p. 9.

excess energy, e.g. Germany ("market integration model"), Austria, Portugal and France. The feed-in tariff can be a measure for incentivizing self-consumption, as in Germany or Denmark where the feed-in tariff is lower than the retail electricity price. However in France the feed-in tariff is above the retail electricity price so that the self-consumption isn't incentivized. France has not reached the grid parity yet[272]. Another system for the guarantee to sell excess renewable energy is the net-metering system[273].

A specialty is the Spanish regulation: since the moratorium in 2012, the feed-in tariff system is not been used. As a result, the PV excesses have not been compensated but have been charged to cover the transmission and distribution costs. For PV installations above 100 kW the wholesale market price minus taxes is counting[274].

Another specialty is the Italian regulation: Italy has a net-billing system with quarterly compensation up to systems with 500 kW, which is based on an Energy Quota and a Service Quota[275]. The net-billing scheme compensates the kWh fed into the grid with the hourly revenues from on-spot trading[276].

The United Kingdom has a composite tariff of a generation tariff and an export tariff[277]. Slovenia switched from a feed-in tariff system to a tender system without positive effects to the national PV sector[278]. As a result, the right to sell excess self-generated renewable energy is assured, but the manner and the economic efficiency depend on the national arrangements.

Summary of various stakeholder positions

Solar Power Europe recommends that the national frameworks ensure that prosumers have access to aggregation services in an open and non-discriminatory manner.[279] Therefore, the excess renewable energy can be remunerated based on market-based pricing mechanisms.[280]

Eurelectric recommends that the regulatory framework should be adapted to ensure cost-effective development of distributed generation and grids, as well as a fair allocation of costs and benefits. Additionally, *Eurelectric* stresses that opting for distributed generation should be a customer choice that does not result from artificial incentives.[281] In addition they declare that in order to better integrate prosumers them in the market and expose them to market signals prosumers should be required to sell their surplus energy, based on a fair market price. Appropriate metering plays an important role to enable market partners to calculate reliably and value properly the energy surplus provided by prosumers.[282]

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[272] Becquerel institute – PV Development as prosumers, October 2015, p. 4.
[273] See below.
[274] Becquerel institute – PV Development as prosumers, October 2015, p. 4; IEA, PVPS Annual Report 2015, p. 93; EPIA, Overview of PV Support Schemes in Europe, December 2014, p. 93.
[275] IEA, PVPS Review and Analysis of PV Self-Consumption Policies, March 2016, p. 23.
[276] BEUC, mapping report, January 2016, p. 93.
[277] IEA, PVPS Review and Analysis of PV Self-Consumption Policies, March 2016, p. 30.
[278] BEUC, mapping report, January 2016, p. 129.
[279] SolarPowerEurope, Renewable Self-Consumption – Policy Paper, June 2015, p.9.
[280] SolarPowerEurope, Renewable Self-Consumption – Policy Paper, June 2015, p.9.
[281] Eurelectric, Prosumers- an integral part of the power system and the market, June 2015, p. 3.
[282] Public Consultation on the RED for the period after 2020, Eurelectric, p. 23.

BEUC stresses that substituting electricity imports from the grid by 'home-grown' electricity alone usually does not allow to pay off an investment in self-generation, regardless of the technology and local potentials. Consumers need to be able to sell their excess electricity at an adequate price. But again, amortization is questioned by a lack of sufficient remuneration schemes for excess electricity fed into the grid.[283]

- ➔ The stakeholders agree on need of a right for prosumers to sell their excess electricity. *BEUC* and *Eurelectric* differ in the treatment of the prosumer in the market. *Eurelectric* wants the prosumer to be on the level with other generators. Whereas *BEUC* takes the prosumer as an active consumer on focus

Summary of pros and cons

Option	Pro	Con
Right to sell excess electricity	Low transmission losses (around 5 %)[284]	High peaks
Wholesale market price	Non-discriminatory; minor state aid problems	Low incentive to self-generate
Incentives for sale	Lower financial risk for prosumers; higher cost-effectiveness for self-generators[285]; equalizing of higher investment risks for prosumers	Risk of distortion of competition[286]; possible state aid problems

2.6.2.3.5 *Authorization for small-scale RE projects*

A cumbersome authorisation procedure for small-scale RE projects presents a high burden for new installations. Prosumers are often no financial or technical experts. Therefore, an absolute minimum of administrative barriers and security of investment should be guaranteed by the national frameworks.

The EP suggests that "the revision of the RED could include specific provisions to remove barriers and promote community/cooperative energy schemes via 'one-stop-shops' dealing with project permits and providing financial and technical expertise, and/or specific information campaigns at local and community level."[287] There are different approaches for the improvement of the authorization for small-scale RE projects. Öko-Institut analysed in specific policy options to remove administrative barriers for the development of renewable energies:

[283] Public Consultation on the RED for the period after 2020, BEUC, p. 21.
[284] Öko-Institut, Self-consumption, 06/2016, slide 4, 10.
[285] BEUC, A welcome culture for consumers' solar self-generation, January 2016, p. 1.
[286] Eurelectric, Prosumers- an integral part of the power system and the market, June 2015, p. 3.
[287] EP, Report on delivering a new deal for energy consumers (2015/2323(INI)), p. 10/no. 30.

- single administrative authority (one-stop shop),
- reducing the required time for permit granting,
- automatic and facilitated notification procedures for self-consumption, small-community based renewables project.[288].

Overview of situation in the Member States

The procedures differ between the states and in some states even between the regions, e.g. the federal states in Austria[289], Belgium[290] and Germany[291] have own regulations in part. In some Member States, the authorisation procedure does not have major problems concerning accessibility and bureaucracy[292]. In other Member States the authorization procedure is not effective because of amongst other reasons high complexity, ponderous natures or high administrative costs[293]. The result of cumbersome and complex authorization procedures are long durations and low economic attractiveness of the PV sector for citizens or investors.

The main sources of information for citizens regarding to PV installations are the national agencies, as e.g. Bundesnetzagentur in Germany, or the national consumers' associations. The authorization could be organized better if one-stop shops and information centers will be installed by the member states[294], e.g. as in Slovenia[295].

Summary of various stakeholder positions

Client Earth wants to ensure an access to transparent and understandable information, including clear and comparable contractual information form third party undertakings, the information that allows the prosumer to understand the risks and opportunities and conditions and requirements for effectively exercising their rights through a one-stop-shop or existing single point of contact.[296] *Greenpeace* supports to simplify administrative procedures, such as the creation of one-stop shops for energy citizens.[297] *Solar Power Europe* supports simplified procedures for the grid connection in order to reduce soft costs for prosumers and purposes that the Member States will encourage practices – such as joint purchasing programmes or leasing models involving third parties guarantee – which make on-site renewable generation accessible to a larger number of citizens.[298] The administrative procedures could be simplified with one-stop-shops for prosumers: building on existing provisions (Article 13 of the Directive), a

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288 Öko-Institut, Options to remove administrative barriers for the development of renewable energy, 06/2016, p. 3.
289 BEUC, mapping report, January 2016, p. 46.
290 IEA, PVPS Annual Report 2015, p. 43; BEUC, mapping report, January 2016, p. 48.
291 www.photovoltaik.org/wissen/baugenehmigung (19.05.2016).
292 E.g. Austria, Denmark, Germany, United Kingdom; BEUC, mapping report, January 2016, p. 46, 74, 82, 151.
293 E.g. Belgium, Italy, Portugal, Slovenia, Spain; BEUC, mapping report, January 2016, p. 58, 97, 125, 134, 142.
294 BEUC, mapping report, January 2016, p. 45, 58.
295 BEUC, mapping report, January 2016, p. 134.
296 Client Earth, Prosumer Rights, May 2016, p. 22.
297 Greenpeace, Putting Energy Citizens at the heart of the Energy Union, 04/2016, p. 3.
298 SolarPowerEurope, Renewable Self-Consumption – Policy Paper, June 2015, p.9.

staggered approach should be introduced, with simple notification procedures for smaller systems (similarly to what we see in Portugal for instance) and simplified authorisation procedures for medium-size systems.[299]

BEUC criticizes that generally, consumers' plans to invest in self-generation are hampered by a lack of reliable and structured information on technological options and potentials. *BEUC* purposes that Member States and regulators have to ensure that a simplified administrative framework responds to the specific needs of consumers who want to invest in a small-scale self-generation project. Therefore, the regional and local authorities should be encouraged and supported to establish one-stop shops for consumers.[300]

- ➔ The stakeholders agree in the need of simplified authorization procedures and easier access to information, e.g. through one-stop shops.

EEAG de minimis projects

The EEAG include two relevant thresholds:

(1) The conditions established in point (Aid is granted as a premium in addition to the market price whereby the generators sell its electricity directly in the market; Beneficiaries are subject to standard balancing responsibilities, unless no liquid intra-day markets exist; Measures are put in place to ensure that generators have no incentive to generate electricity under negative prices.) do not apply to installations with an installed electricity capacity of less than 500 kW and demonstration projects except for electricity from wind energy where an installed electricity capacity of 3 MW or 3 generation units applies.

(2) Aid may be granted without a competitive bidding process to installations with an installed electricity capacity of less than 1 MW, or demonstration projects, except for electricity from wind energy, for installations with an installed electricity capacity of up to 6 MW or 6 generation units.

Both thresholds do not seem to be relevant when it comes to small prosumers.

Summary of pros and cons[301]

Option	Pro	Con
single administrative authority (one-stop-shop)	Improvement of the permitting process, generally effective at reducing required time and costs for permitting processes, building on existing provisions	No implementation yet in the majority of MS, possible conflict with the general MS permitting framework

[299] Public Consultation on the RED for the period after 2020, Solar Power Europe, p. 17.
[300] BEUC, A welcome culture for consumers' solar self-generation, January 2016, p. 5.
[301] Öko-Institut, Options to remove administrative barriers for the development of renewable energy, 06/2016.

	(Article 13 of the Directive) possible[302], increasingly used via electronic or web-based delivery platforms	
Reducing the required time for permit granting	Short and efficient, implementation in the majority of MS, generally effective at reducing required time and costs for permitting processes	Minor flexibility. Different administrative structures in MS (or even within a MS)
Automatic and facilitated notification procedures for small-scale plants	Lower environmental impact of small-scale plants, minor non-economic barrier, reduction of time and cost	Minor flexibility, Different administrative structures in MS (or even within a MS), risk of imprecise assessment of environmental issues

2.6.2.3.6 Principles for cost-effective support schemes for renewable prosumers, including net-metering

As shown above in chapter 1.5.2, several principles for a self-consumption framework can be described, inter alia the implementation of self-consumption in a grid-friendly way and a fair burden sharing regarding network charges and RES-E surcharges on self-consumed electricity. Further, a strict non-discriminatory policy is needed, and the distortion of the market should be as low as possible.

Net metering is a regulatory framework under which the excess electricity injected into the grid can be used later to offset consumption during times when their onsite renewable generation is absent or not sufficient. In this scheme, the grid is used as a backup system for excess power production. The applicable billing period can extend from one hour over long periods of time or one year. Net metering raises concerns when large deployment levels are reached. Due to the concerns, the net-metering approaches have limited the system size to which it is applicable. Under this model, battery storage seems useless as the consumers are using the grid to store artificially electricity produced at one point to consume it at another point of time, without reflecting to the value of electricity.

Overview of the situation in the Member States

Net metering forms the basis of support for solar PV across most US states and Australian states.[303] Net-metering systems are installed by some Member states (Belgium, Denmark and The Netherlands), Italy is using a net-billing system. The

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[302] Public Consultation on the RED for the period after 2020, Solar Power Europe, p. 17.
[303] COM, Best practices on Renewable Energy Self-Consumption, COM(2015) 339 final, p. 10.

Netherlands are guaranteeing the net-metering system until 2020[304]. Denmark limited the net-metering on 1 hour. Above one hour is a lower value of the electricity than the retail price[305]. There is no direct remuneration for excess electricity granted, but the self-generator's meter runs backwards on an hourly basis for every surplus kWh fed into the grid during this period of time[306]. Belgium has partly different regulations in the regions Brussels, Wallonia and Flanders[307]. The introduction of a net-metering system is under discussion in Slovenia and Finland[308].

Summary of various stakeholder positions

The report of the ITRE committee of the EP persists a call for Member States to introduce net-metering schemes in order to support self-generation and cooperative energy production.[309] *Eurelectric* wants to integrate the prosumer in the market and the power system without indirect subsidies and refers to non-market-based net-metering systems, which should be avoided.[310]

Eurelectric recommends that prosumers should be integrated into the market and the power system. Furthermore, Prosumers should contribute to the network cost recovery in the same way as other customers and the use of the electricity bill to collect (non-energy related) taxes and levies should be avoided.[311]

BEUC wants that the new RED provides a dedicated long-term strategy for an adequate support and that the MS should be urged to establish or to improve national self-generation strategies that target private households. Besides, *BEUC* recommends that the grid operators grant priority grid access to small-scale renewable self-generators without setting any caps and in addition, that grid operators should guarantee the purchase, transmission and distribution of self-generators' electricity.[312]

- ➔ The stakeholder positions relating to principles of cost-effective support schemes are differing widely in parts. Especially the point of views of Eurelectric and BEUC aren't coincident. Eurelectric has the market and competition on focus. Whereas BEUC wants to ensure the rights of prosumers also as consumers and their competitive position.

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304 IEA, PVPS Annual Report 2015, p. 83.
305 IEA, PVPS Review and Analysis of PV Self-Consumption Policies, March 2016, p. 18; BEUC, mapping report, January 2016, p. 69.
306 BEUC, mapping report, January 2016, p. 74.
307 IEA, PVPS Review and Analysis of PV Self-Consumption Policies, March 2016, p. 13.
308 IEA, PVPS Review and Analysis of PV Self-Consumption Policies, March 2016, p. 19; BEUC, mapping report, January 2016, p. 134.
309 EP, Report on delivering a new deal for energy consumers (2015/2323(INI)), p. 9.
310 Eurelectric, Prosumers- an integral part of the power system and the market, June 2015, p. 3.
311 Eurelectric, Prosumers- an integral part of the power system and the market, June 2015, p. 3.
312 BEUC, A welcome culture for consumers' solar self-generation, January 2016, p. 7.

Summary of pros and cons

Option	Pro	Con
Net-metering (in general)	Low losses	High peaks, no demand-response flexibility; demand for grid expansion [313]

2.6.2.3.7 Distance self-consumption, especially for local authorities

The term "distance self-consumption" describes the right of small prosumers to sell their own renewable electricity to nearby consumers, e.g. within shopping centers or neighborhoods (see above 2.6.1.5.1). There is an important potential for renewable energy production in apartment buildings that can be realized if self-consumption is allowed also at a multi-dwelling building level, and if cost-efficient procedures are in place for residual electricity needs.[314] The EP adopted in her report the requirement to "highlight the need to develop a favourable, stable and fair framework for tenants and those living in multi-dwelling buildings, in order to enable them to also benefit from co-ownership, self-generation and energy efficiency measures."[315]

Overview of the situation in the Member States

In Germany, the direct delivery of energy to a nearby consumer without using the grid is allowed in Section 20 para. 3 number 2 RES Act 2014. The prosumer can decide if he will use the grid or sell the energy directly (with a bidirectional meter)[316]. The Netherlands have installed the "postcoderoos", i.e. a tax reduction scheme for local energy cooperatives with members living nearby and similar postal codes[317]. The Italian government has established a program named "Sistema Efficiente die Utenza"(SEU), i.e. a configuration of generation systems in which one or more plants operated by a single producer are connected through a private transmission line to a single end user. The SEU can mainly boost the installation of medium and large plants[318]. The delivery of energy "over-the-fence" has not an individual regulation or support scheme in most of the Member States. There is no specific approach regarding distance self-consumption and the involvement of local authorithies in any of the examined Member States.

Summary of various stakeholders

BEUC approaches self-generation mainly from the point of view of households being homeowners while tenants living in multi-storey dwellings could and should be able to adopt self-generation as well. The benefits of solar PV installations should be accessible to all consumers, independent of owning a detached house. In order to enable all households to benefit from renewable self-generation, the

[313] Öko-Institut, Self-consumption, 06/2016, slide 3.
[314] COM, Best practices on Renewable Energy Self-Consumption, COM(2015) 339 final, p. 4.
[315] EP, Report on delivering a new deal for energy consumers (2015/2323(INI)), p. 10/no. 31.
[316] Deutsch-französisches Büro für erneuerbare Energien, Eigenverbrauch und Direktvermarktung, May 2016, p. 6.
[317] IEA, PVPS Annual Report 2015, p. 83; IEA, PVPS Review and Analysis of PV Self-Consumption Policies, March 2016, p. 29.
[318] IEA, PVPS Annual Report 2015, p. 68; BEUC, mapping report, January 2016, p. 96, 97.

future RED should pay attention to the role of tenants and foster the self-generation potential of multi-storey dwellings. In principal, tenants should have the same opportunities to participate in self-generation projects as home owners.[319]

The difficulties to integrate multi-consumer models in the existing frameworks of most of the Member States arise from the fundamental regulatory approach, which is used as basis for incentivising self-consumption: It is often based on granting exemptions of legal requirements which apply to all other generators. In general, these exceptions are linked to certain features, which are related to the person(s) acting and the action taken. Most of the existing frameworks require (1) related to the person(s) acting, that a real identity between the producer and the consumer exist and (2) related to the action taken, that the electricity is consumed in immediate proximity to the installation and/or is not fed through a grid system. But often, as in the German case, there is no consistent system for defining exceptions, i.e. that a certain model might qualify for an exception from a tax burden, but not for an exemption from a surcharge or grid tariffs.

The stakeholders do not address the issue of a specific involvement of local authorities related to distance self-consumption.

2.6.2.3.8 (Introduction of a EU-wide) definition of renewable energy prosumers

The neologism "prosumer" is a rather new concept in the field of energy, which has been introduced in the overall discussion a couple of years ago. It has not been used in EU legislation yet. Consequently, a consistent definition of the "prosumer" does not exist so far on EU or national level. The introduction of a uniform definition of the "prosumer" in EU law is important for the implementation of a consistent approach of the consumers` role in the energy market. It shall guarantee legal certainty and a common understanding for all involved participants. In the documents of the European Commission on this issue, the term "prosumer" is explained with a rather basic approach by stating "prosumers (i.e. producers and consumers of renewable energy)"[320].

The European Parliament (EP) adopted in the report of the ITRE committee the following definition:

> "Prosumers are active energy consumers such as households, institutions and small businesses that participate in the energy market by producing renewable energy either on their own or collectively through cooperatives, other social enterprises or aggregations; prosumers can also contribute to energy efficiency and/or support energy system management and grid integration of fluctuating renewable energy sources through demand side response; prosumers contribute towards reaching the full potential of renewable energy projects in suitable urban areas."[321]

319 BEUC, A welcome culture for consumers' solar self-generation, January 2016, p. 2, 10.
320 COM, SWD(2015) 141 final, p. 2.
321 EP, Report on delivering a new deal for energy consumers (2015/2323(INI)), p. 8/no.

Overview of the situation in the Member States

As far as can be seen, national legislators have not yet defined the term "prosumer" in the national schemes. In case of the German Act on the Development of Renewable Energy Sources (Renewable Energy Sources Act - RES Act 2014 the term "self-supply" ("Eigenversorgung")" is defined in German legislation (Article 5 number 12 RES Act 2014):

> „The consumption of electricity which a natural or legal person consumes himself in the immediate vicinity of the electricity-generating installation if the electricity is not fed through a grid system and this person operates the electricity-generating installation himself".

The German definition focuses on the way how the electricity is consumed. An important aspect for the definition for the "prosumer" is the question whether the consumer and the operator have to be the same person (a restrictive definition[322]) or whether the consumer and the operator have not to be identical (a wide definition).

Summary of various stakeholder positions

The question of a definition for the "Prosumer" is addressed by statements of some of the stakeholders: *Eurelectric* understands prosumers as "customers who produce electricity primarily for their own needs, but can also sell the excess electricity. Prosumers are connected to the distribution network with small to medium installed capacity."[323] *BEUC*, the European Consumer Organisation, states that the "Prosumer is another term for consumers that self-generate and self-consume electricity on the premises."[324] *Greenpeace* characterised the prosumers as an "active energy consumer such as individual households, non-commercial organisations, public entities and small enterprises that participate in the energy market by producing renewable energy, either individually or through collective organisations, such as cooperatives or associations."[325] *Client Earth* relies on the definition of Greenpeace and is proposing the installation of a so called "umbrella definition". Under this approach, a core set of rights with general principles should be set and distinct definitions for individual actors and/or activities to account for specific situation should be additionally adopted.[326]

322 Like in Germany.
323 Eurelectric, Prosumers - an integral part of the power system and the market, June 2015, p. 5.
324 BEUC, A welcome culture for consumers' solar self-generation, January 2016, p. 2.
325 Client Earth, Prosumer Rights, May 2016, p. 10.
326 Client Earth, Prosumer Rights, May 2016, p. 15.

Summary of pros and cons

Option	Pro	Con
Eurelectric	Prosumer as customer and generator	Imprecise due to the capacity threshold
BEUC	Prosumer in consumer position	Short, less expressive
Greenpeace	Various groups of prosumers	Imprecise due to the examples
Client Earth	Legal certainty relating to the core set of rights	Individual actors/activities differ between the MS

Proposal for a working definition

We recommend adopting the definition given by *ClientEarth* as a working definition:[327]

> First, the definition of electricity undertaking should be amended so that it includes prosumers, as follows:
>
> *'Electricity undertaking' means "any natural or legal person carrying out at least one of the following functions: generation, transmission, distribution, supply, or purchase of electricity, which his responsible for the commercial, technical or maintenance tasks related to those functions, but does not include final customers that are not active in the market."*

2.6.2.4 Summary

- Right to self-generate and self-consume

  An EU-wide right to self-generate and self-consume electricity does not exist yet. The confirmation of a right to self-generate and self-consume electricity provides legal certainty and a minimum level playing field in the EU. In general, the right to self-generate and the right to consume the self-generated electricity exist in all the examined Member States. When assessing the right to self-generate, main problems arise related to the grid connection of new installations.

- Right to store

  An EU-wide right to store electricity for own use does not exist yet. The confirmation of a right to store opens up numerous advantages. It is granted in several Member States. The large differences between the Member States depend on the different juridical arrangements of the PV support schemes, mainly whether a national net-metering policy is in place or not.

- Right to sell excess electricity

[327] Client Earth, Prosumer Rights, May 2016, p. 17.

The right to sell excess self-generated renewable electricity is granted in the examined Member States. However, the financial compensation of excess electricity is differing widely between the countries. (e.g. no compensation, PPA, feed-in tariffs or net-metering).

- Authorization for small-scale RE projects

  Specific policy options to remove administrative barriers for the development of renewable energies can be: single administrative authority (one-stop shop), reducing the required time for permit granting as well as automatic and facilitated notification procedures for self-consumption, small-community based renewables project. The authorisation procedures for small-scale RE projects are not uniform in the Member States. In some Member States the procedures are (still) complex and lengthy, although Member States are obliged by the current RED to take appropriate steps to accelerate authorisation procedures.

- Principles for cost-effective support schemes for renewable prosumers, including, net-metering policy

  Several principles for a self-consumption framework can be described, inter alia the implementation of self-consumption in a grid-friendly way and a fair burden sharing regarding network charges and RES-E surcharges on self-consumed electricity. Further, a strict non-discriminatory policy is needed, and the distortion of the market should be as low as possible. Further, the net-metering policy differs in the Member States. The introduction of a full net-metering system is not widely spread within the EU. Additionally, the net-metering schemes are limited in some Member States to small-scale residential PV installations.

- Distance self-consumption, especially for local authorities

  The supply of energy "over-the-fence" is incentivised in some Member States. Most of the examined countries regulate the issue by exempting certain models from general tax, levy and grid tariffs. Consistent systems of rules and exceptions are often missing.

- Introduction of a EU-wide definition of renewable energy prosumers

  The neologism "prosumer" is a rather new concept in the field of energy, which has not been used in EU legislation yet. There is a great variety of possibilities and ways to define the "Prosumer". It depends on the legal status and the rights which should be accorded to the "prosumer" by the new directive. The most important objective should be to ensure legal certainty for all participants.

  We recommend adopting the definition given by ClientEarth as a working definition:328

  First, the definition of electricity undertaking should be amended so that it includes prosumers, as follows:

[328] Client Earth, Prosumer Rights, May 2016, p. 17.

> *'Electricity undertaking' means "any natural or legal person carrying out at least one of the following functions: generation, transmission, distribution, supply, or purchase of electricity, which his responsible for the commercial, technical or maintenance tasks related to those functions, but does not include final customers that are not active in the market."*

Second, the legal definition of prosumers should maintain their status as 'customers' and distinguish them from other undertakings, the main difference being the extent to which they participate professionally in the market. As such, the prosumer should be legally defined as an 'active customer', as follows:

> *'active customer' means "a customer who performs any of the functions of generation, storage and/or supply of energy from renewable sources, or energy efficiency/demand-side management, either individually or through a community energy undertaking over which they exercise control jointly with other active customers, provided that for household customers they are, on an annual average, net consumers, and provided that for non-household customers the activity is insignificant in proportion to the customer's primary economic activities."*

2.6.3 Policies options for self-consumption

For the revision of the RES directive there are four options for policies on self-consumption, which are described in this chapter and assessed in chapter 2.6.4.

Disclaimer: The analysis of the following options has been performed reflecting the considerations on June 8 2016. This analysis reflects solely the views of the author of the report and does not necessarily reflect the opinion of the European Commission.

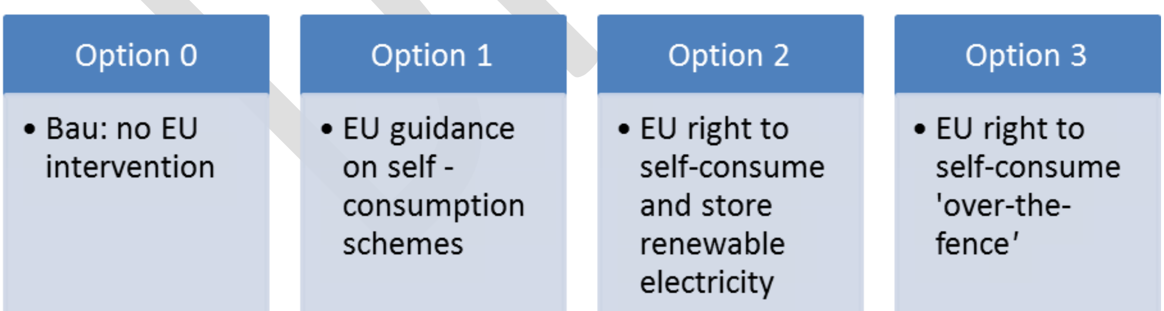

Figure 45: Policies options for self-consumption

2.6.3.1 Option 0: BAU

Under this option, no EU policy framework for self-consumption of renewable energy is developed. Member States decide individually if and how to promote renewable energy self-consumption systems. Support schemes for small scale renewable energy systems will have to comply with the State aid rules. With a lack of common EU rules on renewable energy self-consumption, more Member States will adopt divergent (and sometimes conflicting) national regulations with the risk of distortions of the energy markets, at both distribution and wholesale levels.

This can be seen as the baseline scenario without any additional impact on SC. It is not included in the following assessment (chapter 2.6.4). Generally this option may lead to a situation where barriers remain in place for self-consumption in some Member States. On the other hand, it can also entail the risk that MS implement SC schemes that are inefficient. For example battery use that does not reduce the peak of the residual load, balance supply and demand on a very local level with high storage losses and burden consumers that do/cannot use self-consumption with increasing charges (see chapter 2.6.1.4).

2.6.3.2 Option 1: EU guidance on self-consumption of renewables

Under this option, the Commission would develop a revised non-binding guidance on self-consumption, further building on the recommendations in the Staff Working Document of July 2015 addressing best practices for self-consumption of renewables. However, this option would not provide a harmonised EU policy framework for self-consumption and therefore would not effectively remove the aforementioned administrative and legal obstacles to renewable energy prosumers.

2.6.3.3 Option 2: EU legal right for self-consumption of renewables

The Revised RES Directive would create a legal framework enabling consumers to generate renewable electricity for their own use without their supplier's permission, and would limit the administrative burdens of doing this. More specifically, this option would include the following provisions:

- Introduce a EU-wide definition of renewable energy prosumers;
- Enabling consumers to generate and store renewable electricity for their own use, without requiring the supplier's permission, and limit the administrative burden by requiring a simple notification to the DSO;
- Enabling consumers to sell excess renewable electricity, at least at the wholesale market price, and to participate in all relevant energy markets either directly or through market aggregators;
- Define principles for cost-effective support schemes for renewable prosumers, including net-metering;
- Require Member States to establish simplified authorisation procedures for small-scale renewable energy projects, including through simple notification.

At the same time, there are a number of aspects relevant for self-consumption that will need to be addressed in the Market Design Initiative, such as ensuring that consumers who generate their own renewable energy electricity have access to wholesale and balancing markets through aggregators and that wholesale market rules do not discriminate against renewables, in particular small-scale producers. In addition, grid tariffs should reflect the cost-benefits of self-consumption systems for the electricity network and incentivise cost-effective consumers behaviour from a system point of view.

2.6.3.4 Option 3: EU-wide legal right for self-consumption of renewables 'over-the-fence'

Under this option, Member States would be required to guarantee the right of small prosumers (below a certain capacity threshold) to sell their own renewable electricity 'over-the-fence' to nearby consumers *e.g.* within multi-apartment blocks or shopping centres.

2.6.4 Impact assessment of policy options for self-consumption

In the following we evaluate the options based on the categories economic impact, social impact and environmental impact. It is to be noted that, as implementation details of the options are not set out in the current proposal, the assessment remains indicative and qualitative in nature and it is not based on quantitative modelling. This assessment is based on chapter 2.6.1. The effects and arguments that are listed here are described in more detail in that chapter.

For these assessments, it is important to agree on the baseline, e.g. on which technologies would be used to generate power if SC projects would not be established. If one assumes that SC would result in additional RES installations (e.g. because MS phase out their support schemes and RES plants would therefore not been built without SC), they displace conventional generation, which results in significant positive environmental impacts. If one assumes that RES installations financed by SC replace RES installation which are financed by general support schemes (e.g. because MS have RES targets that they intend to meet one way or another), the environmental impact of SC would be small.

Bloomberg 2016 argues that most MS will phase out support schemes and that the driver for installing small-scale PV will be SC. Assuming that this scenario will materialise, we attempt to quantify the gap that would result from a support phase-out and that would have to be filled by SC.

Based on PRIMES scenarios[329] the increase of PV rooftop capacity from 2015 until 2030 in EU 28 will vary (depending on the scenario) between 39.5 and 74.1 GW, which amounts to app. 50% of the total PV increase. This is the maximum that can be used for SC potentials. These capacities are highly concentrated in Germany and France, depending on the scenario between 46 and 53% of the additional rooftop capacity will be developed in these two countries. As Germany has just confirmed a support scheme for rooftop PV (Bundesregierung 2016) and France is one of the last MS that will reach grid parity (due to low retail prices; Lettner & Auer 2012 - update 2013) it is assumed that only half of the additional rooftop capacity in France and Germany will result from SC. Taking the average of the five PRIMES scenario, this assumption leads to an additional rooftop capacity

[329] REF2015f, D40R27E27c, D40R27E30c, D40R30E30a and D40R27E27CRA

facilitated by SC of app. 39 GW that result in app. 46 TWh of production. These are 31% of the total PV increase until 2030 and 26% of the production increase.

This shows that SC can be a relevant approach to increase the RES-E installation and achieve the EU 2020 and 2030 RES and climate targets.

The relevant general criteria for assessing the impact of RES-E are for example in terms of social impact direct or indirect job creation and the number of participating customers, for economic impacts investment in RES-E and customers' generated revenues and concerning environmental impacts avoided GHG emissions. The benefits that result from the PV increase can be proportionately ascribed to SC schemes. That means that in the case that the above estimate of PV installation that result from SC schemes can be reached, app. 30% of the benefits that result from a PV increase occur due to SC schemes.

Whether this value can be realised heavily depends on the configuration of the SC scheme and the implemented policy option at EU level. Implementing a level playing-field for SC is a key prerequisite for grid parity to feed through to prosumers. But as shown in chapter 2.6.1.3, grid parity is not the only influence factor to facilitate PV installations. Depending on the situation in MS SC is only profitable with support, either for excess electricity or for flexibility like batteries. Different literature sources point out that PV systems that are built under a SC scheme are not only limited by the rooftop capacity but also by the fact that the SC ratio (and thereby the profitability) decrease the larger the ratio between annual PV production and overall electricity consumption becomes (step 2 in chapter 2.6.1.3)[330]. If one does not want to limit the exploitation of rooftop space by SC, two policy options result from this: a) implementing SC support schemes or b) keeping general support schemes (incl. small scale PV) until SC gets profitable (either by cheap batteries, low LCOE or increasing retail prices).

Another point to make is that Member States differ significantly with regard to different dimensions, like profitability of SC without support (due to different LCOE or consumption pattern like air conditioning) and existing general RES-E support schemes. This sets a limit to how detailed European provisions on self-consumption can be, without ignoring these differences.

2.6.4.1 Economic Impact

The first indicator is how **effective** the different options are in realising additional RES-E installations compared to existing or upcoming support schemes. This off course depends on the various framework conditions in Member States. This has to be considered when EU policy options are developed.

As described in the efficiency paragraph below, the SC scheme should establish a level playing-field for SC. If a support scheme is in place, excess electricity from self-consumption should also be covered. Depending on the situation in Member

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[330] Cf.:
United Nations Industrial Development Organization 2015 "In areas where there is no policy or regulatory framework governing the sale of excess power generation to the grid, industrial prosumers will tend to scale systems down in size to ensure that onsite generation is not wasted."
Huld et al. 2016 shows that the SC ratio "depends strongly on the PV system production fraction."

States it can be appropriate to **support excess electricity** that is not self-consumed even if there is no general support scheme is in place, e.g. if there is only a small profitability gap.

Depending on the situation in MS it can be appropriate to support the excess electricity (e.g. if there is only a small gap to independent profitability or if no general support scheme exists). That means the options have to be assessed by their effectivity in implementing a level playing-field for SC and supporting MS to develop a support scheme for excess electricity if necessary. How effective such an approach will then be in developing additional renewables by self-consumption depends on the circumstances in each Member State.

Option 1 can offer a guideline on the principles of a level playing-field. As it is non-binding its impact is off course limited.

Option 2 offers a more effective instrument to guarantee that self-consumption is not prohibited or not discriminated against. This option includes the confirmation that consumers have the right to generate, and store renewable electricity and sell the excess electricity. As mentioned above, support schemes for excess electricity can have to be tailored in every MS due to the different circumstances.

Based on Option 2, **Option 3** enables also distance self-consumption and offers thereby more consumers the chance to participate in SC. This should result in a higher effectivity of this option. But how many additional installation will result from this and how many are built under this SC scheme instead of a RES-E support scheme is difficult to quantify and off course depends on the Member States. The detailed definition of self-consumption should not lead to a situation, where a second market segment is established without additional RES deployment.

The second indicator is how **efficient** the options are in implementing RES-E installations and integrating them into the system.

This should be regarded from a **system efficiency** perspective, not just with regard to the individual SC installation. One important aspect is that SC should be implemented in a grid beneficial way. That means there should be incentives to reduce peak excess production.[331] Another important aspect is that mainly flexibility with low losses (e.g. Demand Side Management) should be used to balance demand and production with SC on a local level. **Flexibility impacts** (capacity demand and losses) have to be compared to **impacts on the grid** (capacity demand and losses).[332]

In a static consideration the options should establish a level playing-field for all options, including SC. Level playing-field means that self-consumption is not prohibited or not discriminated against. This will always be at least as efficient as a situation where self-consumption is prohibited or hampered through unjustified barriers. Level playing-field includes the distribution of economic effects, so that self-consumers should only incur the costs that they have caused. At the same

[331] See also Fraunhofer ISE 2013 and Weniger et al. 2015

[332] Peter 2013 shows that the need for storage can increase significantly if supply and demand are balanced locally. Moreover, VDE 2007 shows that also the need for production capacity increases. More details: see chapter 2.6.1

time an implicit or explicit support for self-consumed electricity is not appropriate, and self-consumers should contribute to the overall system costs to the extent they make use of it. It is a thin line between implementing a level playing field for self-consumption and supporting it. This also depends on the overall framework in a specific country and has to be considered in configuration of the different options. In a dynamic consideration, support for SC beyond the level playing-field could be justified by dynamic efficiency gains through learning curves. This could include innovations related to generation as well as to providing flexibility. However, it is difficult to conceive such innovation potentials triggered by SC that cannot also be achieved by self-generation or providing flexibility (e.g. through demand-side management) directly to the market or the network.

A guidance with best practices as suggested in **Option 1** could establish principles of a level-playing field and how they can be implemented, so that any efficient SC as discussed above can be developed, while at the same time preventing inefficient SC.

Beyond a soft guidance **Option 2** offers the chance to more directly establish a level playing-field for SC. This includes confirming consumers' right to generate, and store renewable electricity and sell the excess electricity. These can certainly be regarded as no-regret measures. Also listed in this option is defining principles for cost-effective support schemes. Again, these should be geared towards the principle of a level playing-field.

Based on the results from chapter 2.6.1 SC schemes should guarantee that SC is not burdened with costs that they do not cause, but should contribute to financing grid and RES development. Implicit or explicit support for self-consumed electricity is not appropriate (whereas support for excess electricity might be reasonable; cf. chapter 2.6.1.3). Net-metering is a support scheme where the grid is used as a virtual storage without paying for its usage. From a physical and system view no difference exists between net metering and self-generation. The support costs of net-metering are relative non-transparent.

In the current description of this option the efficiency resulting from flexibility vs. grid impacts is not yet considered. The configuration of Option 2 should be geared towards system-efficient SC.

Based on Option 2, **Option 3** adds the right for SC 'over-the-fence'. This concept softens the geographical proximity and allows using the grid between production and consumption. The distance between producer and consumer can be very short (e.g. supply the neighbour with electricity "over the fence") or it can be expended to bigger areas (like the post code based system in the Netherlands), both in geographical and network terms. By increasing the distance, potential benefits of self-consumption for grid demand and grid losses diminish, especially when the consumer is supplied via different grid levels. In terms of system efficiency, the differences between self-consumption and self-generation disappear and parallel structures for self-generation are established. But distance SC can increase the SC ration and thereby the profitability of SC. To keep the disadvantages small, it is necessary that production and consumption stay in a short distance (e.g. different properties of municipalities or several locations of SME in one town).

2.6.4.2 Social Impact

One main indicator for evaluating the different options regarding their social impact is if they can prevent an additional **financial burden for non-SC consumers**. This indicator is linked to the efficiency indicator that considers if a level playing-field or financial support is implemented. IÖW & Greenpeace Energy e.G. 2011 shows on p.54 (based on Podewils & Rutschmann 2010) that the German self-consumption framework, which was implemented in 2010, leads to an additional burden for other consumers. This results mainly from the reduction of the electricity volume that finances grid charges, concession levy and CHP surcharges, so that the charges for the remaining volume increases. This increase cannot be compensated by reduced RES-E surcharges. In fact, even if just looking at the RES-E surcharges, the effect of self-consumption may not be neutral. Self-consumption reduces the amount of electricity consumption that finances the RES-E deployment but also the amount of RES-E that has to be financed by support schemes (if self-consumption is exempted from the support scheme). However, due to a stock of older and more expensive RES-E plants[333] it is not necessarily cost neutral to free self-consumption from RES-E surcharges. Dealing with this potential disadvantage of non-SC consumers, it is nevertheless important that SC gets a LPF and (especially in the first years) is not hampered by excessive charges while at the same time support is still necessary.

Another social impact criterion is the influence on the **acceptance for the energy transition**. Depending on the configuration of a SC scheme it can decrease (e.g. financial burden for non-SC consumers) or increase the acceptance. An increase will mainly be caused when consumers can profit from RES deployment. Again, this effect is only relevant if it occurs on top of and not instead of the effects of existing support schemes. Another question in this context is which consumers can participate in SC. If for example only single-family houses can realise a PV system and implement self-consumption a significant part of the population is excluded. Finally, self-consumption may increase acceptance because it has a value in itself for some consumers, over and above self-generation. An open question is for how many people this is a relevant consideration.

Option 1 can give support to the MS on which principles have to be considered to achieve positive social impact from a SC scheme.

Depending on the configuration of **Option 2** it can support the prevention of an additional financial burden for non-SC consumers or it can lead to a financial re-shuffle (e.g. when specific support for SC is introduced).

Option 3 can improve the social impact, as distance self-consumption enables more consumer access to self-consumption.

[333] As a consequence of cost reduction for RES-E systems in the last years electricity from new systems has lower electricity generation costs than older ones. This led to the reduction of support rates for RES-E systems.

2.6.4.3 *Environmental Impact*

For the environmental impact the same key indicators apply as for the economic impact, which are **additional RES-E installations** and **flexibility impacts** (capacity demand and losses) compared to **impacts on the grid** (capacity demand and losses). In this case the result is not measured in Euros but in GHG emissions that can decrease or increase, depending on the efficiency of the SC scheme. Therefore the environmental impact is not assessed separately but the results of the economic impact can be adopted to assess the option regarding their environmental impact. The fact that the efficiency of SC is also essential from an environmental perspective emphasises the importance of choosing a policy option that can achieve this objective.

2.6.4.4 *Summarising valuation of the discussed policy options for self-consumption*

Option 0 can be seen as the baseline scenario without any additional impact on SC. Generally this option may lead to a situation where barriers remain in place for self-consumption in some Member States. On the other hand, it can also entail the risk that MS implement SC schemes that are inefficient.

The discussed criteria for the different impacts show that **Option 1** is a no-regret option that can offer an important contribution to show how sustainable SC should be configured. Additionally, the relevance of SC in achieving the EU targets and the therefor necessary implementation of a level playing-field can be descripted. But as it is non-binding its impact off course is limited and it is not realistic that the self-consumption potential that is required to fill the PV gap can be realized.

To realise the calculated capacities of 39 GW via SC it needs stronger instruments. By confirming consumers' right to generate, and store renewable electricity and sell the excess electricity**, Option 2** offers a real chance to implement a level playing-field for SC in the MS (which is the necessary basis for SC). As far as further provisions are concerned, the option should avoid introducing implicit or explicit support for self-consumed electricity that exceeds a level playing-field. Depending on the situation in MS it can be appropriate to support the excess electricity (e.g. if there is only a small profitability gap or if no general support scheme exists). The EU policy on SC could support MS in assessing the gap towards reaching profitable SC that needs no support. On this basis the MS can conclude which support level would be necessary to reach profitable SC. In the current description of this option the efficiency criterion *flexibility vs. grid impact* is not yet considered. As described in the economic and environmental sections, is it important that the configuration of Option 2 takes into account the system-efficiency of SC. It is assumed that this option can exploit most of the mentioned SC potential.

Option 3 on the one hand allows more consumers to participate in SC schemes. This can result in positive impacts in terms effectiveness and social impact. However, by increasing the distance the potential benefits of self-consumption for grid demand and grid losses diminish, especially when the consumer is supplied via different grid levels. From a system view the differences between self-consumption and self-generation disappear and parallel structures for self-generation are established. This can entail a negative impact on efficiency. This option can, increase the SC ratio and thereby the profitability of SC. Due to this, Option 3 can increase the by Option 2 exploited SC potentials. To keep the disadvantages small, it is necessary that production and consumption stay in a short distance (e.g. different properties of municipalities or several locations of SME in one town).

2.7 Regional cooperation

2.7.1 Introduction

The European Commission, European Council and European Parliament have called for increased regional cooperation between Member States (MS) to deliver on the EU wide 2030 renewable energy (RE) target.

Against this background, the Commission (hereafter COM) is currently considering (new) measures or legal provisions which could be introduced in the REDII proposal to increase the deployment of RE in MS in the absence of national binding targets. This includes measures or legal provisions specific to regional cooperation.

The consortium has been tasked to explore "examples of regional cooperation measures that could be developed into concrete EU legal provisions in the forthcoming REDII", i.e. measures that could specifically promote regional cooperation on RE with a view to increase the deployment of RE.

A broad array of examples of regional cooperation measures will be analysed. In 1.2 (gap filler) it will be elaborated how a regional approach can be adopted to deploy gap filler instruments.

2.7.2 Why do we need regional cooperation?

MS are faced with common challenges with regard to increasing the share of RE in their national energy mix, not only in the current REDI framework but also in the post 2020-timeframe (REDII timeframe). Tackling these challenges jointly across several MS could lead to better solutions, from both an economic, environmental and social perspective, compared to national approaches. For example, there may be situations where policy implementation in individual MS reflect strategies which do not take into account choices made in other MS, despite proximity of their markets, complementarities as well as opportunities for economies of scale[334]. Regional cooperation could in such cases mitigate potential adverse effects through dialogue and processes that allow for joint solutions.

Before assessing possible ways to enhance regional cooperation in the forthcoming REDII, it is first of all important to understand what are the key drivers behind regional cooperation and how MS could benefit from enhanced cooperation. We address these aspects in more detail in section 2.7.5.

2.7.3 What are suitable forms of regional cooperation?

Generally, when we look into existing regional cooperation initiatives we see four different modes of cooperation. These include[335]:

334 http://www.uneca.org/publications/regional-cooperation-policy-development-renewable-energy-north-africa

335 Adapted from (Umpfenbach, 2014) and (Egenhofer, 2015)

1. Dialogue & information-sharing;
2. Joint analysis (of policies and measures) & knowledge creation on selected topics;
3. Common policies in selected areas; and
4. Joint instruments.

The four above-mentioned modes of cooperation are quite different in nature and would require quite different mandates and levels of commitment from MS governments as well as support needed from COM. Which of these modes of cooperation to opt for with regard to future enhancement of cross-border RE cooperation depends of course on the key objectives and needs of the countries/parties involved. In the energy sector, and for RE in particular, an array of different initiatives are emerging. In section 2.7.6 we provide a brief 'state of play' with regard to selected regional cooperation initiatives, highlighting also observed pros and cons of these initiatives with respect to RE deployment. Examples have been selected to highlight pros and cons of different types of cooperation initiatives. Examples of current initiatives also represent an important point of departure for further cooperation across EU MS, noting that new and strengthened initiatives should not to duplicate but rather complement and build on cooperation initiatives that are already in place.

2.7.4 What is needed to enhance RE regional cooperation?

In 2009, the adopted REDI sets a legal framework for the introduction of cooperation mechanisms as a means for MS to achieve their national binding RE targets for 2020 in a more cost-effective manner. The three cooperation mechanisms included statistical transfers, joint projects and joint support schemes. With the exception of the joint Norwegian-Swedish support scheme to promote RE technologies, introduced in 2012, there are at present no additional joint support schemes in place as defined by REDI. However, following COM's approval of Danish and German support schemes under the 2014 EEAG, Denmark and Germany are expected to open their respective support schemes partly for eligible projects in the respective countries. For example, the Danish Energy Agency is expected to reserve up to 2.4 MW of its 20 MW tender for PV for German installations.

There are currently no joint projects implemented between MS. However, concerning statistical transfers, Luxembourg's government cabinet approved in July 2015 a proposed cooperation with Lithuania with a view to achieving the objectives of Luxembourg in 2020 in the field of RE and decided to initiate the necessary procedures. The result is that Luxembourg will commit to apply the cooperation mechanisms in the form of statistical transfers to Lithuania over the period 2016 to 2020. In terms of quantity, it is expected that Luxembourg will retain the flexibility to buy between 100 and 2,500 GWh during the period, as required.

COM has also, through the Multiannual Financial Framework (MFF), a number of funding pipelines which are geared towards enhancing cross-border and regional cooperation. Two important examples include:

- the Connecting Energy Facility (CEF), which supports the development of high performing, sustainable and efficiently interconnected trans-European networks in the fields of transport, energy and digital services[336] and offers financial support to projects through grants and innovative financial instruments such as guarantees and project bonds, and

- the Interreg programme, which is a series of five programmes to stimulate cooperation between regions in the EU, funded by the European Regional Development Fund (ERDF).

Section 2.7.7 assesses different options and approaches to enhance regional cooperation on RE between MS, under the following assumptions:

- It is important to understand what is meant by regional cooperation. A plausible definition of regional cooperation would be[337]:
  - two or more Member States that cooperate within one region (however not necessarily adjacent Member States);
  - cooperation of different actors within one subnational region (which might be a region that crosses Member State borders);
  - cooperation between established regions across Europe (including subnational or nationally organised regions).
- The landscape in which RE will further develop is continuously evolving. Not only is there a significant change in the approach for 2030 (EU-wide RE target) compared to the 2020 approach (national binding RE targets), the European Commission has also recently introduced the concept of the "Energy Union", which suggests that energy and climate policies are put in a more EU-wide and holistic frame. This has implications for how MS will proceed with policies and measures to promote RE as well as for shaping regional cooperation further.
- With respect to RE deployment, there are quite different characteristics and specificities that should be taken into account. For RES-E, market and grid integration aspects play a very important role, also in the context of the generally strong focus on interconnection, market coupling and grid stability issues, driven by internal electricity/gas market regulations aiming at one single market. The existing RES framework (REDI) has not fostered cross-border cooperation to the same extent, as the key focus has been on increasing the deployment, rather than the integration and one single market focus. This is changing as the share of RES-E increases from marginal to mainstream. For RES-H/C, the situation is somewhat different. The heating and cooling sector is far more heterogeneous, with a wider variety of resources and applications, geared more toward local, decentralised solutions.
- It is assumed that the governance framework will include a consultation process on the national energy and climate plans (NECPs) between neighbouring MS in REDII. This offers an important starting point for defining topics for regional cooperation on RE deployment to 2030 (and beyond).
- On the aspect of support schemes to promote RE, the Environmental and State Aid Guidelines is likely to continue to play in shaping and coordinating national support schemes for renewable energy beyond 2020, e.g. the State Aid Guidelines may

[336] https://ec.europa.eu/inea/en/connecting-europe-facility

[337] This definition is take from the 2015 report published by Ecofys, "Driving regional cooperation forward in the 2030 renewable energy framework", see: https://eu.boell.org/sites/default/files/hbfecofys_regional_cooperation.pdf

contribute to moving the support schemes further in the direction of more market-based schemes as well as introduction of further harmonization/convergence measures.

2.7.5 Drivers and benefits of RE cooperation

It is necessary to understand the benefits of regional cooperation from a MS perspective. If MS do not see the benefit of cooperation and the possibility of exploiting these, the European Commission will encounter difficulties in facilitating and encouraging regional cooperation on RE in the 2020 – 2030 timeframe, also within the REDII (proposal). Table 94 summarises obvious benefits which MS could reap from regional cooperation with respect to RE deployment.

Table 94 Possible benefits MS could reap from RE-specific regional cooperation

Challenges/obstacles	Benefits to be achieved through cooperation
High cost start up investments for RE	▪ Capital expenditures (and support costs) could be lowered if Member States within a given region jointly exploit their RE potential by allocating RE support to locations where resources are most available and/or cheapest to develop. ▪ Regional cooperation could allow for enhanced economies of scale and efficiency in encouraging new investments in RE generation by pooling efforts between countries. ▪ Regional and larger projects can lead to CapEx and capacity factor improvements that will result in lower deployment costs.
Lack of market scale	▪ Regional cooperation on market opening can have important benefits in terms of economies of scale and scope to fasten market penetration of emerging technologies.
Lack of capital for RE projects	▪ Regional cooperation could pool efforts between countries with regard to among others public-private partnerships, which could stimulate and trigger the availability of more capital for RE investments. ▪ Regional cooperation could allow for using cheaper capital from one Member State in another Member State with less capital and/or higher cost of capital. For example, Germany is facing an abundance of capital leading to low interest rates which put the German pension system at risk. This money could be invested in wind power projects in faster growing economies, such as Poland. Access to cheaper capital in Germany would make a modernization of Polish infrastructure much cheaper as well as create jobs in both regions.
Developers often face difficulties in securing bankable RE projects	▪ Similar to point above covering 'high cost start up investments for RE', regional cooperation could lower capital expenditures through allocation of RE support to cheapest technologies and/or locations with best resources. In addition, deploying RE in regions where risks (and cost of capital) lower could improve chances of securing bankable RE projects. ▪ Common regional projects could also introduce certain set of administrative, grid related and possibly even common support regulations. This would allow for more mainstreamed bankability procedures, more experienced experts both on banking and project developing side, a stronger trans-border competition between banks even for smaller projects and financially more secure projects.

Challenges/obstacles	Benefits to be achieved through cooperation
Spatial and administrative constraints for RE deployment	▪ Some MS lack sufficient locations to develop RE. Even with good spatial planning procedures in place, space is congested with other uses or areas with good RE sources are simply not available. Regional cooperation could allow for identifying locations available and suitable for RE deployment within a larger geographical area rather than being limited to availability within a MS's own national borders. ▪ Alternatively, neighbouring countries could devise a zoning of a common area for wind farms along boarders and developing the grid and possibly storage infrastructure together (in the North-Sea this is happening already to some extent for offshore wind). For these common zoning areas, a common administrative procedure (environmental impact assessment, grid connection permits and building permits) could be offered. Bilateral or multilateral agreements could further define common rules for financial support, leading to a reduction of cost of capital. ▪ Another challenge is differing administrative procedures and regimes. Regional projects could be used to identify and align differences, in particular for wind onshore and offshore projects. ▪ An additional step to consider is the preparation of the Environmental Impact Assessment (EIA), geophysical surveys as well as some geotechnical surveys to be carried out in the planning phase ahead of the call for tenders, for example by the TSO or public authorities. This is proven practice in Denmark in case of offshore projects has led to significant reduction of risks and costs of capital.
Lack of public acceptance	▪ Expanding on the point above, regional co-operations along national boarders could specifically address regional and local co-operatives, for example by offering them easier access to auctions or privileged access to capital through revolving funds. ▪ Regional/EU-wide replication of the best regulatory frameworks providing better market access and better access to support for this target group of actors.
Integration issues, particularly for RES-E	▪ Regional cooperation could allow MS to find better solutions to the challenges of integrating higher shares of variable RES-E into the grid in comparison to national solutions. Benefits could also include working towards common solutions in MS with similar energy market and/or RE characteristics or even available solutions, such as storage capacities or use of other load partnerships (for example use of flexible Dutch pumping installations at dykes to balance out variable wind power from Denmark, Germany and the UK). ▪ Cooperation could entail regional impact assessments, system analysis, cost-benefit analysis, etc. ▪ For development such as offshore wind energy in the North or Baltic Sea, new load technologies could be designed, installed and implemented, taking advantage of economy of scale.
Negative spill-over (cross-border) effects which lead to distortion of competition	▪ Regional cooperation creates frameworks for members to discuss unintended consequences of individual Member States' RE policies, allowing MS to jointly find solutions to problems and early mitigate potential conflicts. ▪ Planned RE capacities in one Member State can be easier taken into account if other Member States are planning

Challenges/obstacles	Benefits to be achieved through cooperation
	industrial hubs that might be more energy intensive (such as computer server farms and internet-of-things applications).
RE are disadvantaged by price distortions and/or need for better support policy framework	▪ An important argument for RE support schemes is often anchored in the lack of the internalization of external costs of fossil fuel based energy supplied to end-consumers. MS could benefit from exchange & information sharing on how to best design RE support schemes on this aspect. ▪ An important cooperation has been the joint support scheme for renewables between Norway and Sweden to achieve a more cost-effective use of support towards RE. ▪ Another example is 'The International Feed-In Cooperation', a joint project between Germany, Spain and Slovenia, initiated in 2005 and fueled by the concept (at the time the cooperation was initiated) that feed-in tariffs were most suitable to effectively and efficiently promote renewable energies for the generation of electricity and would like to contribute to the improvement and the spreading of this policy instrument. The Feed-In Cooperation has focused on the exchange of experience on feed-in systems, with a view to helping other countries improve their existing or introducing new feed-in systems. This type of cooperation could also be considered to be an intermediary step towards joint support schemes.
Compliance with (post 2020) State Aid Guidelines (EEAG), i.e. further adaptation/ phasing out of support schemes to promote RE	▪ Related to the point above is the EEAG and its guidance on the design and phasing out of support schemes, e.g. under the current EEAG, Denmark and Germany have agreed to open up a portion of their support schemes to PV installations outside their territory. ▪ MS could strongly benefit from collaborating on how to adapt national support schemes with the help of post 2020 EEAG.
Difficulties in adapting policy and regulatory frameworks to complying with internal market requirements	▪ In a broader perspective, regional cooperation on RE-specificities can help foster policy convergence/compliance towards completing the internal energy market. This is increasingly important as RE moves from being a marginal-to-mainstream resource in the energy market.

Four main areas for benefits of regional cooperation on RE can be extracted from the above table:

- Better liquidity in access to potentials, financing and other preconditions for RE development;
- Economies of scale and scope for emerging technologies;
- Opportunities for policy learning and policy best practice exchange; and
- Particularly for near-border or cross-border projects, the reduction of 'border effects' in terms of e.g. grid integration and public acceptance.

2.7.6 Examples of existing regional cooperation initiatives

Existing cooperation initiatives could provide a valuable point of departure for scaling up cooperation in the 2020 – 2030 timeframe. As mentioned in the introduction section, one should also look at pooling rather than duplicating existing initiatives when looking into ways to enhance regional RE cooperation, as well as regional cooperation on energy issues in general. This section will briefly describe, firstly, regional cooperation initiatives which focus explicitly on RE (Table 95) and, secondly, initiatives within the energy field which are relevant for RE (Table 96), highlighting also important pros and cons[338].

We see also from non-exhaustive list of initiatives presented in the two tables below that they elements of one or more of the four modes of cooperation mentioned in the introduction section.

[338] Information presented in Tables 2 and 3 build on recent studies, such as Egenhofer (2015), DeJong (2015), Umpfenbach (2014), and Ecofys (2015).

Table 95 Examples of existing cooperation initiatives focusing on RE, including their pros and cons

Cooperation Initiative	Description	Pros	Cons
Joint NO-SE support scheme for RES	The Swedish-Norwegian green certificate scheme, which entered into force on 1 January 2012, is a joint instrument which provides for financial support to renewable power generation via an obligation on utilities and large electricity consumers to buy green certificates. The extra costs are passed on to end-users via their electricity bills. The scheme is technology-neutral.	▪ Allows both countries to exploit mutual benefits, e.g. better market functioning (through higher liquidity and better price formation), and increased cost-efficiency (through access to a larger production base). ▪ Changes to the common support scheme need to be approved by lawmakers in both countries before it comes into effect, providing for a more politically stable system, which improves investor certainty. ▪ Both countries have similar cost resource curves, which helps to reduce undesired distributional effects between the countries. ▪ Both countries agreed in 2015 to increase the joint 2020 RE target by almost 8 percent, from 26.4 to 28.4TWh/a by 2020.	▪ It took close to a decade from when the initial discussions started to the implementation of the joint scheme. ▪ Changes in national legislation were necessary, contributing to the long lead time in implementing the scheme. ▪ The technology neutral scheme does not provide sufficient support for more costly/emerging technologies, such as offshore wind.
North Sea Countries Offshore Grid Initiative (NSCOGI)	Involves collaboration between EU MS and Norway, with the objective to maximise the potential for renewable energy in the North Sea. The focus is on coordinated and cost-effective development of offshore and onshore grids which can link offshore wind energy and other RE generation across northern Europe. Political Declaration was signed in December 2009, followed by a Memorandum of Understanding signed in 2010.	▪ This cooperation targets RES deployment, and offshore wind energy in particular, and grid (inter)connection. ▪ Addresses the need to balance increased development of RES resources where the (cheapest) potentials are the highest through regional cooperation against availability of required cross-border grid infrastructure. ▪ Study results have been fed into the ENTSOE TYNDP.	▪ Largely seen as an inter-governmental study group. To date, results/outputs limited to studies on evaluating best offshore grid scenarios, market and regulatory designs and cost allocation. ▪ This form of cooperation has not led to increase in the deployment of RE in the short term. ▪
Concerted Action on renewable energy	CA-RES is a confidential forum, in which representatives of national	▪ Facilitates a structured dialogue and knowledge-sharing that supports	▪ This form of cooperation does not lead to any significant increase in the

sources (CA-RES)	administrations meet to share their experiences, exchange and enhance their knowledge and establish and strengthen the network of experts. The first CA-RES was established in 2010. Participants include relevant ministries, as well as regulators, TSOs, and national energy agencies. The CA-RES II (2013-2016) complements on the one hand the official meetings MS in European Council working groups, which focus on the development and adoption of new EU policies/legislation, and on the other hand the cooperation of national, regional and local stakeholders.	participating countries in identifying and implementing effective solutions with regard to the implementation of REDI. ▪ Provides for synergies between the REDI and other EU directives such as the Energy Performance of Buildings Directive (EPBD) and the Energy Efficiency Directive, via dialogue with other Concerted Actions covering these fields. Dialogue across the different CAs has resulted in cross learning on topics of common interest.	deployment of RES in the short term.
Nordic Working Group for Renewable Energy (under the Nordic Energy Research platform)	With a view to strengthening and promoting the Nordic countries as a region characterised by knowledge, high technology, and competitiveness, the Nordic heads of state and government launched a series of globalisation initiatives in which energy plays a pivotal role, including a top research initiative called the Nordic Energy Solutions, as well as an initiative focusing on the Nordic countries as a green technology laboratory for transport and energy.	▪ Long tradition in energy cooperation between Nordic countries, which have important potentials and shares of RES. ▪ The Working Group for Renewable Energy (WG RE) provides important assistance and support the work of the Nordic countries in the area of RE through the exchange of information and the development and implementation of cooperation projects.	▪ This form of cooperation does not lead to any significant increase in the deployment of RES in the short term.
Establishment of a European platform for RES cooperatives (via various EU-funded projects)	RES cooperative refers to a business model where citizens jointly own and participate in renewable energy or energy efficiency projects at local level. Several EU-funded projects (e.g. REScoop 20-20-20, REScoop MECISE, Community Power, Citizenergy) have and are contributing to further promote RES cooperatives as a way to involve	▪ RES cooperatives in general make it possible for citizens to actively participate in developing renewable energy and energy efficiency projects at local level, thereby creating public involvement and public acceptance for such projects. ▪ Local involvement and co-ownership, e.g. onshore wind in Denmark, proved to be an important success factor in the	▪ Not regulated, based on trust. There is a risk that trust is jeopardised by mismanagement of projects, in which case citizens would become skeptical towards such cooperatives. ▪ There are key questions which still need to addressed, such as: What are the barriers for citizens to invest in RE? How to speed this process up? Should

	citizens to take an active role in the energy transition.	deployment of onshore wind in Denmark. ▪ A platform can provide for pooling of financial resources and/or project ideas between countries and regions. E.g. one regional RES cooperative may have sufficient funds to invest in a project, but currently no project idea, or vice versa. ▪ Such a platform could also facilitate Revolving Funds.	only one finance model be used, or a combination of different finance models?

Table 96 Examples of existing cooperation initiatives focusing on energy, including their pros and cons

Cooperation initiative	Description	Pros	Cons
Pentalateral Energy Forum (PLEF)	THE PLEF was in initiated in 2005. A second political declaration of the PLEF was signed by AU, BE, FR, DE, LU and NL in 2015. The forum aims to foster open and transparent regional dialogue in order to increase security of supply, further market integration and pursue greater market flexibility. In particular, it will elaborate a common methodology for assessing the security of supply risks at regional level and to create right conditions for cross-border electricity trade.	▪ Signed Declaration provides a political backing for a stronger cooperation. ▪ This intergovernmental forum allows for governments to directly implement decisions once a consensus is reached. Thus, suitable for approaching new challenges before implementing at an EU-wide level. ▪ In addition to political guidance from energy ministers, important factors explaining PLEFs successful work include shared vision of increased connection and common market as well as slender working structures. (Umpfenbach, 2015). ▪ Outputs feed into other regional cooperation fora, e.g. the 2015 regional cooperation adequacy assessment will feed into the ENTSOE TYNDP. ▪ Could, but does not yet, exploit opportunity to exercise a 'peer review' of relevant national policies implications on neighbouring countries.	▪ To date, it has had little (direct) impact in terms of increasing RE deployment in the short term.
Baltic energy market interconnection plan (BEMIP)	The BEMIP High Level Group was established in October 2008 by COM and eight MS (DK, ES, FI, DE, LV, LT, PO and SE) and Norway (acting as an observer). BEMIP seeks to end the energy isolation of the Baltic Sea Region and to integrate it fully into the EU energy markets. In autumn 2014	▪ Cooperation has been instrumental in ending isolation of the region from the EU internal market. e.g. with regard to new interconnections between the Baltic States and the rest of the EU. (DeJong, 2015). ▪ Scope of the BEMIP cooperation was revised in July 2015 to include among others a focus on renewable energy. ▪ Consists of technical working groups which discuss and	▪ Renewable energy was not a specific/explicit topic during the first seven year of the cooperation initiative. (However,

	COM launched the reform of the BEMIP initiative to further reinforce cooperation on energy matters in the Baltic Sea Region.	coordinate specific measures and actions, and undertake projects and studies necessary for the implementation of the (new) BEMIP action plan. ▪ BEMIP projects have been part of the European Economic Recovery Plan (EERP), and thus benefited from more than half a billion euros in EU funding, e.g. from EU's European Regional Development Fund (ERDF), Cohesion Fund (CF), and, as projects of common interest, through the Connecting Europe Facility (CEF).	interconnection extensions are also important for RE, so indirect spin-off will certainly be beneficial).
Baltic Sea Energy Co-operation (BASREC)	The intergovernmental cooperation was initiated by the Baltic Sea countries and the European Commission in 1998. BASREC is pursuing energy efficiency and renewable energy measures, along with measures to develop and use new, low-carbon and energy-efficient technologies and Carbon Capture and Storage (CCS) in order to ensure sustained economic growth in the short and long run.	▪ Two key priority areas on RE include: increased use of renewable sources with specific focus on the forms of energy potentially dominant in the region, and increasing renewable sources in the heat market.	▪ The focus has been more to potential assessments and feasibility studies rather than concrete implementation of RES.
Central and Southern Eastern European Gas Connectivity (CESEC) initiative	A High level group was established with nine MS (AU, BG, CR, GR, HU, IT, RO, SK and SL) leading to a MoU and an Action plan signed in July 2015. The MoU was joined by six Energy community contracting parties and two observers (Montenegro and Kosovo*). The objective of the High Level Group is to establish a regional priority infrastructure roadmap and advance its implementation in order to develop missing infrastructure and improve security of gas supplies. Ultimately each Member State of the region should have access to at least three different sources of gas.	▪ Involves EIB and EBRD, i.e. cooperation will examine financing aspects together with EIB and EBRD.	▪ Cooperation in this region difficult to materialise, for among others, historical and cultural reasons. ▪ Cooperation focuses on gas supply diversification to the region, however, there is a potential to expand the cooperation to include RES.

From these tables we can draw some important conclusions. These include:

- There is a large variety of regional cooperation, most examples show that initiatives are driven by MS with different forms of support from the European Commission (e.g. financial support, role as mediator, role as observer, etc.)
- More binding cooperation commitments, such as joint support scheme, requires high level political commitment and take a long time to establish, particularly since national legislation needs to be amended.
- BEMIP and PLEF can be regarded as a good practice example of regional cooperation, leading to positive developments. For example, PLEF has achieved the creation of common rules and mechanisms for market coupling in North Western Europe, whilst BEMIP has achieved new interconnections. A key success factor behind both cooperation initiatives is the high level political commitment and guidance.
- In addition, BEMIP is an excellent example of how structured and defined regional cooperation has managed to channel significant EU funding towards BEMIP dedicated projects.

2.7.7 Exploring options for regional cooperation on RE

2.7.7.1 List of options to increase regional RES cooperation

Turning back to the specific task, a key question is what (additional) measures could be presented in the REDII to enhance regional RES cooperation. In order to address this question, we look into several options to enhance regional cooperation with a particular focus on RES in the 2020 – 2030 timeframe.

An obvious starting point would be the cooperation mechanisms presented in REDI. These were introduced to encourage cooperation between MS in order to increase the economic efficiency of the overall EU and the national binding RES target achievement, as well as to optimise the utilisation RES resources and to contribute to a better functioning internal energy market. A key question would be whether the changed approach for 2030 RES target compared to the 2020 RES target, i.e. binding EU-wide RES target instead of nationally binding RES targets, warrants a change in the design of the cooperation mechanisms presented in REDI.

A second option is regional cooperation centred around a specific RES technology deployment. This option is first and foremost motivated by the huge benefits to be achieved from cooperation and coordination between MS on increased deployment of offshore wind energy in the Northern sea basins.

A number of different regional cooperation initiatives have evolved with successful achievements. A majority of these are initiated from the perspective of improving the functioning of the internal energy market. Given the voluntary nature of many regional cooperation initiatives, an important question here is to what extent do the existing ‘energy market and integration’ cooperation initiatives offer opportunities for regional cooperation on RE.

Two additional options include, firstly, the opportunity to enhance regional cooperation through the forthcoming governance structure which is foreseen to ensure the 2030 RES target, and secondly, regional cooperation which may be necessary to enable a gap-filler mechanism (see further elaboration in Paragraph 1.2).

We summarise the options in the table below.

Table 97 List of options for enhancing RE-specific regional cooperation

Measure/instrument/option	Specific design features
1. Enhancing regional cooperation through cooperation mechanisms presented in REDI, e.g. joint projects	▪ As defined in existing EU legislation, i.e. REDI. ▪ Incentivized with an EU support instrument, i.e. special access to EU fund(s) providing grants and/or access to loans for joint projects. ▪ Pre-defined contribution, i.e. MS agree to achieve a certain amount/share of their pledged increase in RES deployment through joint projects.
2. As (1) but with focus on joint support schemes	▪ Harmonised EU-wide level support schemes. ▪ Regional level support schemes (group of Member States with joint support scheme). ▪ National support schemes fully or partially open to renewable energy producers in other Member States. ▪ Gradual alignment of national support schemes through common EU rules.
3. Regional cooperation centred around a specific RES technology deployment	▪ Offshore wind in the North Sea (and Baltic Sea). ▪ Biomethane in the countries where Natural gas Grids are well developed ▪ Options to cover other RES technologies
4. Strengthen existing regional cooperation initiatives	▪ Include RES deployment as a dedicated and explicit topic within an existing regional cooperation forum. ▪ Enhance the scope of NSCOGI. ▪ Extend the PLF into the North Seas/Baltic Sea area. ▪ EU platform for national RES cooperative.
5. Enhancing regional cooperation through a gap-filler mechanism	▪ See 1.2 for details

2.7.7.2 Continuation of the cooperation mechanisms presented in REDI, with a focus on joint projects

In this section we consider the continuation of cooperation mechanisms, with a particular focus on joint projects as defined in REDI/Art. 7, as an option of to enhance regional cooperation on RE[339].

We consider three different variants:

I. *As defined in REDI*
II. *As defined in REDI coupled with a (dedicated) EU funding instrument, and*
III. *Pre-defined contribution per MS (could be voluntary or mandatory), supported by (dedicated) EU funding*

[339] Whilst REDI does not refer to regional cooperation as such but to cooperation 'between Member States', the cooperation mechanisms can be regarded as a form of regional cooperation as well as an important incremental step towards broader regional cooperation, covering more MS.

Assessment:

I. As defined in REDI

To date, only a handful of countries have shown an interest in and investigated joint project opportunities, and concrete projects have yet to be implemented. Within the current framework, national binding targets are considered to be a hurdle for joint project implementation as they create a preference by MS to reach their targets with domestic projects. On the other hand, a situation with no binding national RES targets reduces the incentive for MS to cooperate from a cost-efficiency perspective. For the 2030 RES target, introducing indicative benchmarks on how much each MS should contribute with towards the 2030 EU target could mitigate the latter problem. The existing provision, which is voluntary in nature, could be included in the REDII proposal. However, a main drawback is the 'Catch 22' situation, i.e. without national benchmarks there would be no real incentives to cooperate on further RES deployment via joint projects, and with benchmarks (assuming that MS will find this acceptable) MS may continue to opt for achieving these with domestic resources, as is the case now. On this basis, we conclude that simply incorporating the current provision in REDII is not likely to have any significant positive impact establishing regional cooperation via joint projects.

II. As defined in REDI coupled with a (dedicated) EU funding instrument

Introducing an EU support instrument with earmarked resources to support the implementation of joint projects could be a way forward in providing stronger incentives for joint projects. For example, a dedicated project pipeline under the EFSI funds for regional RES cooperation, which includes joint projects, could play a role in providing such incentives. Allocation of financing under the CEF for Projects of Common Interest (PCI) could be mimicked for joint RES deployment projects[340].

Within the CEF funding framework, the PCI list provides an overview of the actions that are eligible for support. To become a PCI, a project must have a significant impact on the energy markets and market integration of at least two EU countries, boost competition on energy markets and boost the EU's energy security by diversifying sources, and contribute to the EU's climate and energy goals by integrating renewables[341]. As such, the objectives behind the promotion of regional RES cooperation via joint RES deployment projects and via PCI are very similar.

Changing the budget allocation, i.e. the MFF, and creating a new funding pipeline under the EFSI funds, with a view to promoting joint projects between MS on the promotion of new RES deployment, is however not simple. Both would require unanimity decision and ratification by MS. An alternative (easier) approach would be to stream money from existing pipelines and make changes within the existing framework for spending the money. However, this approach also has some

[340] The framework consists of five key elements: (1) a Financial Regulation (No 966/2012), (2) Rules of Application (No 1268/2012), (3) TEN-E Guidelines, (4) PCI list and (5) CEF Regulations (No 1316/2013). The CEF funding has the objective to speed-up the projects and attract investors. COM adopts an Award Decision, however, the projects must have the support of MS.

[341] https://ec.europa.eu/energy/en/topics/infrastructure/projects-common-interest

drawbacks. Firstly, post 2020 budget allocations are not yet known and still have to be negotiated, and secondly, within the relevant MFF timeframe, funds allocated to the relevant budget streams are likely to vary and therefore difficult to predict. A key question is therefore – see also considerations on the gap filler funding (paragraph 1.2) – how to get "sufficient" funds from a future framework not yet known.

COM could take the initiative to develop a list of project opportunities, similar to the PCI list, which could act as a basis for funding. This could be done jointly with MS, with a first input from their MS, e.g. via the NECPs as a starting point for identifying potential projects. The process of regional consultation foreseen in the 2030 governance framework provides an opportunity to define project joint opportunities. In some cases, market parties may be better suited to identify joint projects between MS than the MS themselves. Alternatively, one could also think of decoupling the process from the MS (which under PCI still propose projects), so that project developers can apply directly to COM for funding, and COM facilitates the negotiations between the MS. However, MS would still need to give permission for projects.

Clear and transparent eligibility requirements would be needed for allocation of funding. Similar to the MFF for allocation of financing under the CEF for PCI, the European Commission (together with EIB) could establish a set of required criteria and a template for applications for joint RES projects. These could also be made contingent on allocation of national support, e.g. via tendering and FiP, and/or accelerated licensing procedures for joint projects. (Ecofys, 2015)

III. Pre-defined commitment (per MS) to engage in joint projects, supported by (dedicated) EU funding

In this variant, a suggestion is to go one step further and couple an EU funding instrument with pre-defined commitment(s) on joint project and joint support scheme cooperation. Again, the approach could mimic concrete measures already implemented at EU level, such as the 10% electricity interconnection target. A similar target could be introduced for joint RES projects, which are beneficial for the EU from an overall EU 2030 target achievement perspective. A pre-commitment target could also be applicable to national support schemes, i.e. MS are obliged to open up a certain% of their national support scheme to projects outside their own borders. Currently, Germany and Denmark will both open up their support schemes for one specific tendering round, i.e. DK to participate in DE and vice versa for a given amount capacity. The amounts are small and no effect on the overall support scheme are foreseen. Still, this would require adaptions to the legislative framework and a cooperation agreement.

We assess the pros and cons of this variant in Table 98 below.

Table 98 Continuation of Joint Projects (as defined in REDI) coupled pre-defined contribution(s) and a (dedicated) EU funding instrument

	Joint projects as defined in REDI coupled with pre-defined commitments and a (dedicated) EU funding instrument
Pro	▪ Joint projects is an understood concept. Due to its voluntary nature, Art. 7. could be transferred to REDII. ▪ A clearly ex-ante defined commitment for new deployment in absolute terms to be achieved through joint projects (at EU level (and at MS level)) would help to make the concept more tangible.
Cons	▪ Defining ex-ante commitments at MS level would require a political process to determine the contributions per MS towards the 2030 target. Most MS will be opposed to setting national contributions or benchmarks of any kind.
Remarks	▪ In order to create public acceptance, it would be necessary to clearly communicate the direct benefits to citizens and market parties in the countries involved in cooperation, e.g. lower electricity bills, improved balancing options, etc.

Source: Own summary

Possible actions to be taken/way forward:

The existing (REDI) provision on joint projects could be transferred as a minimum provision to REDII. However, such a provision in itself is not likely to lead to any significant activities between MS on joint projects. Therefore, COM should consider providing financial incentives to stimulate joint projects through funding available under the MFF. The best option would be to be to stream money from existing pipelines and make changes within the existing framework for spending the money, such as the CEF. One way to identify joint project ideas is through the governance framework, i.e. regional consultation of the NECPs. Since market parties may be better suited to propose joint project, COM should consider the prospect of project developers applying directly to COM/EIB for funding, and COM facilitates the negotiations between the MS with respect to their approvals.

2.7.7.3 Opening of support schemes to cross-border participation

This section considers the continuation of joint supports schemes as a cooperation mechanism[342] as well alternative options for the opening of support schemes to cross-border participation as a way to enhance regional cooperation.

A number of options for joint support schemes / opening of support schemes to cross-border participation were listed in COM's Public Consultation on "Preparation of a new Renewable Energy Directive for the period after 2020"[343]. On the basis of this list, the following options are covered in this section[344]:

I. *Harmonised EU-wide level support schemes*[345]
II. *Regional level support schemes (group of MS with joint support scheme)*
III. *National support schemes fully/partially open to RES producers in other MS*
IV. *Gradual alignment of national support schemes through common EU rules*

Theoretically, more cooperation/coordination on the use of support schemes to promote RES across MS can lead to a more cost-efficient deployment of RES generation throughout the EU, i.e. cost efficiency would be ensured from better exploitation of the existing resource potentials by locating new generation plants where the (abundant) renewable sources are most available and/or cheapest to deploy. This is, however, not the only aspect to be considered in terms of minimising the cost of RES deployment. One also has to take additional aspects into account, such as public acceptance as well as grid and market integration issues. Concerning the latter, examples include access to grid, curtailment and compensation rules as well as market issues (e.g. market coupling and liquid short-term markets). For example, CEER points out in its response to the above mentioned consultation that: *"A lack of market coupling challenges any co-ordinated approach to joint support schemes. This is particularly true for areas where transmission constraints between nations would influence investment decisions, taking away from the intended outcome of efficient allocation. Many MS may have higher hurdles to overcome to interconnect with neighbouring nations (i.e. France and Spain, UK and mainland Europe) so not all MS will have the same ease of addressing these barriers."*

In addition, national preferences for generation mix, often linked to industrial policies, employment and local/regional development, and fiscal issues come into play.

These different issues will be assessed under the different options below.

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[342] Joint support schemes was introduced as one of the four cooperation mechanisms in REDI (Art. 11).

[343] See: https://ec.europa.eu/energy/en/consultations/preparation-new-renewable-energy-directive-period-after-2020

[344] A fifth option was included in the consultation, namely *National level support schemes that are only open to national renewable energy producers*, however, since we do not regard this option as a feasible option towards contributing to regional cooperation it is eliminated from the assessment here.

[345] Full harmonisation could be defined as follows: the existence of one binding support system for all member states although technology specific promotion strategies can exist. Central coordination on the other hand is defined as a binding framework for support mechanisms with mutual minimum design criteria, where the member states keep the legislative power over the concrete design of the instrument. Ragwitz and Held (2008).

Assessment:

I. Harmonisation of support schemes across the EU

The idea of harmonising RES support schemes has been frequently debated since first presented by COM in 1997[346]. Whilst there has been a gradual convergence of national support schemes, particularly in recent years and driven by the 2014-2020 EEAG, no harmonisation of MS support schemes has been achieved. Several reasons could explain this:

- There are important differences with respect to MS' emphasis on the overarching energy goals (competitiveness, security of supply, and sustainability). This has important consequences for the choice of energy mix and framework to promoting new energy (not only RES but also conventional) generating capacities. Additional goals, such as industrial and regional development goals with a MS also play a role. For example, several Eastern European MS, due to their strong dependence on oil and gas from Russia, have a strong emphasis on the security of supply goal. On the other hand, MS like Germany and Denmark have stressed the importance of the sustainability goal (as well as industrial opportunities which come with RES deployment) and have consequently put in place a relatively good framework for the promotion of RE.
- MS have chosen different schemes to support RE. In some cases, MS have opted for the same type of scheme, e.g. FiP, but with (significantly) different design details. Different design details often reflect different preferences as well as different emphasis on policy objectives (see bullet point above) and other national preferences. It is difficult to harmonise e.g. the tariff or premium level across MS since the level is influenced by many factors, such as permitting & licensing, and grid connection rules/costs, installation costs, country risks (affecting WACC and other financing arrangements), taxation, to name a few, which differ between MS. Hamonisation of support schemes therefore goes beyond just harmonizing tariff or premium levels.
- Lack of public acceptance (notably for wind farms onshore) is an important show-stopper in many countries. This effect is likely to increase if the public is faced with the concept of new RES generation in their home region contributing to the RES share in neighbouring countries, even though they may not face having to directly pay for it via surcharges on their energy bills.
- However, fully harmonized support schemes across EU MS would probably have distributional effects, i.e. transfers of money, between MS. This is likely to increase public resistance to the financing of RES deployment in neighbouring countries or other EU MS.
- Additionally, as mentioned in the introduction to this section, lack of sufficient grid capabilities to incorporate and transmit increasing RES

[346] In its 1997 white paper, COM pointed out that it "is examining closely the different schemes proposed or introduced by the Member States in order to propose a Directive which will provide a harmonised framework for Member States"

throughout Europe is likely to create a hindrance to an EU-wide harmonisation, especially in the case of ' physical transfer' requirements.

- Also, fiscal questions (depending on how the money to finance RES is collected) and, in any case, the redistributive effects of such a harmonisation will have to be dealt with by participating MS. Whilst this aspect might be solved relatively easily on a bilateral scale, it is likely to create difficult discussions on a broader, i.e. EU28 scale.

As pointed out by ENTSO-E in their response to the above-mentioned Public Consultation: *"If support schemes are to be harmonised, they should be designed with the aim to achieve (i) coherence between the development of the grid (interconnections in particular) and RES units and (ii) efficient geographic distribution of RES to allow using the benefits of complementarities between regions (particularly true for wind). A proper level of exposure to the wholesale market price is the obvious way to solve both these issues as well locational signals in use of transmission/distribution network system tariffs."*

Box 1 provides an example of the key challenges in harmonising feed-in support for biomethane in Germany and the Netherlands[347].

BOX 1: Example of challenges in harmonising feed-in support schemes for biomethane in Germany and the Netherlands

- In the Netherlands, biomethane is supported through the SDE+ FIP scheme, while German biomethane is supported by the EEG FIT.
- The Dutch scheme directly subsidies renewable gas, while in Germany only renewable electricity is supported. Biomethane producers thus only benefit from the FIT if they supply to cogeneration plants that receive the EEG tariff.
- Other key differences between the feed-in schemes include the way of financing (through tax revenues in the Netherlands, through a surcharge on electricity consumption in Germany) and the duration of support (12 years in the Netherlands, 20 years in Germany).
- With regard to the grid connection, key differences include the division of investment and maintenance costs (to be paid by the producer in the Netherlands, while to a large extent paid by network operators in Germany) and the balancing regime (1 hour in the Netherlands, versus 1 year in Germany).
- In addition, there are also significantly different policies with regard to for example the gas quality requirements, lists of biomass types eligible for (co-) digestion, options for and support for use of biomethane in the transport sector, possibilities for trading of Guarantee of Origin certificates, etc.

Table 99 below summarises the key pros and cons of an EU-wide harmonisation of RE support schemes across the EU.

[347] Example taken from the EU-funded POLIMP study, see: http://www.polimp.eu/images/POLIMP_Briefing_note_04.pdf

Table 99 EU-wide harmonisation of RES support schemes, pros and cons.

Pros	Cons
Option 1: Harmonisation of support schemes across the EU	
▪ Cost efficiency from exploitation of renewable energy sources where they are cheapest and/or most abundant ▪ Theoretically feasible, TGC schemes would seem most compatible with EU ETS scheme (this may work best for RES-HC and RES-T sector, however, less so for RES-E (since FiP, in some cases with auctioning, is most applied)	▪ Likely to take a long time to implement, e.g. NO-SW joint support scheme took close to a decade from initial interest to implementation ▪ Tremendous difficulties to decide on which scheme will be the basis for harmonisation ▪ Upon agreement on a common support scheme, care should be taken to avoid that current schemes in place are retroactively withdrawn to suit the harmonised approach ▪ Reciprocity may be requested by MS to ensure 'a sense of' win-win for all parties involved

Possible actions to be taken/way forward:

An important question is whether or not full harmonisation is possible or beneficial in the first place, (support schemes are not isolated, but linked to many aspects related to (the functioning of) the energy market, e.g. grid connection regimes (shallow vs. deep, curtailment policies (in other words if you harmonise support schemes, then you should/may also need to harmonise rid connection schemes for new RES-E generation and curtailment policies).

In light of key challenges, it is worth taking note of ENTSOE-E response to the aforementioned Public Consultation: "*(progressive) harmonisation would need to be encouraged through proper incentives (including evidences of common economic benefits) not immediately imposed by legislation."*

A step-wise approach would seem the most sensible way forward. For example, offshore wind in the North Sea would be a good starting point for (regional) alignment of support schemes and/or opening up national support schemes (partially, i.e. to offshore wind), whilst discussing and finding common solutions to the harmonisation of other relevant factors (mentioned above). As such, strengthened cooperation on this particular technology/in this particular region could act as a stepping stone towards broader EU cooperation (harmonisation) on support schemes.

Against this background, guidance rather than provisions in REDII at this stage may be considered to be the most feasible way for COM to support this option.

II. Regional level support schemes (group of MS with joint support scheme)
This option differs from the first option on two aspects. Firstly, the geographical scope, i.e. it does not entail the entire EU, and secondly, it entails a 'joint scheme' approach, i.e. resembling the joint Norwegian-Swedish scheme which was introduced in 2012. This scheme is not same as a harmonised approach. The two schemes are joined in the sense that relevant actors can trade certificates across borders, however, the joint scheme allows for national differences in non-support scheme framework conditions, such as levies, etc.

Whilst conceivably a lot easier than a full harmonisation of support schemes, there are still numerous complexities and hurdles to be faced. The Norwegian-Swedish approach is proof of this, as this cooperation required extensive ex-ante analysis of distributional effects and other impacts on the Norwegian and Swedish electricity markets as well as necessary changes to national legislation, the latter entailing long lead times before final implementation.

If a regional joint support scheme were to cover several countries, e.g. 3-5 countries, the same exercise and legislative changes would need to take place in parallel across all involved countries. The more countries involved, the more extensive the ex-ante analysis of distributional effects and other impacts. Necessary legislative changes would only be possible after negotiations between all countries are finalised and agreed on.

Table 100 below summarises the key pros and cons of an EU-wide harmonisation of RES support schemes across the EU.

Table 100 Pros and cons of regional support schemes (i.e. group of MS with joint support scheme)

Pros	Cons
Option 2: Regional support schemes (i.e. group of MS with joint support scheme)	
▪ Easier to accomplish in comparison to full harmonisation across all 28 MS.	▪ Long time to implement expected, e.g. NO-SW joint support scheme took close to a decade from initial interest to implementation. ▪ As for option 1 (harmonisation), reciprocity may be requested by MS to ensure a 'win-win' deal for all parties involved. ▪ Although wind and PV have reached a competitive position in many markets, there are still important barriers prohibiting full deployment, such as (local) public acceptance, grid interconnectivity, etc. ▪ Markets and development stages of relevant RES technologies vary greatly in the different MS, would potentially penalise best performers. A key parameter on which agreement needs to be reached is the reference power price e.g. the average of power prices in the national electricity markets of the cooperating MS.

Possible actions to be taken/way forward:

Identify and share lessons learned from the Norwegian – Swedish joint support scheme.

III. National support schemes fully or partially open to RES producers in other MS

Bottom-up convergence of support mechanisms has already led to decreasing support levels and making RES respond to market signals (e.g. with the introduction of FiP). As already highlighted above, further convergence will depend on the elimination of other barriers, such as those related to public acceptance, grid access conditions, and permitting and licensing as well as barriers preventing the completion of the internal energy market (e.g. regulated prices, subsidies for conventional power generators).

As aforementioned, Denmark and Germany have recently agreed to cooperate on pilot auctioning schemes for PV. This has been driven by COM's state aid approval of their national support schemes. For example, concerning the approval of Germany's Renewable Energy Sources Act 2014 (EEG 2014), the German government and COM agreed that from 2017 onwards, 5 percent of the newly installed renewables capacity per year will be opened to installations from other MS ("partial opening"). The pilot auctions for PV, with max. bid size of 10 MW for Germany and 2.4 MW for Denmark, will allow the two countries to gain experience with using this new instrument. Based on this experience an opening of auctions for other technologies as of 2017 will be designed and implemented.

The two countries are currently working out the specific details, and have so far agreed, among others,[348]:

- that there will be individual tenders, where each country decides its own tender specifications;
- that local rules and conditions will apply (e.g. spatial planning, grid connection, remuneration in the case of curtailment, taxation, etc.);
- on reciprocity and physical delivery; and
- on exchange of data.

Table 101 below summarises the key pros and cons of an EU-wide national support schemes fully/partially open to developers in other MS.

Table 101 Pros and cons of national support schemes fully/partially open to developers in other MS

Pros	Cons
Option 3: National support schemes fully/partially open to developers in other MS	
▪ Efforts in this direction are being driven by EEAG approval of MS support schemes. ▪ Allows for a stepped approach towards full convergence of support schemes through e.g. Denmark and Germany's (reciprocal) pilot scheme.	▪ Will require that treaties or agreements are signed bilaterally between relevant MS. ▪ As the auctions are designed nationally, if with agreed upon communalities, the detailed specs might be biased towards national players. ▪ Risk of discriminatory practices if physical delivery by awarded installations in partner MS are required. At least, physical delivery requirements may raise deadweight administrative costs. The other side of the medal is that applying "physical delivery" indicators may overcome reluctance among the home population against subsidizing foreign RES-E production.

Possible actions to be taken/way forward:

The extent to which the Danish-German cooperation, based on pilot auctions, is successful, and what lessons can be learned, will be important in paving the way

[348] https://www.agora-energiewende.de/fileadmin/Projekte/2015/integration-variabler-erneuerbarer-energien-daenemark/4.2_Rasmus_Zink_Soerensen_Slides_26052016.pdf

for further developments in this area, both for the countries involved as well as for other MS. Given the timing of this specific cooperation, it seems unlikely that COM can gain sufficient insights into lessons learned to be able to incorporate any provisions in REDII. It seems more feasible that way forward should be the post-2020 EEAG, based among others on lessons learned from the Danish-German pilot(s).

IV. Gradual alignment of national support schemes through common EU rules

Lack of political support remains an important barrier to cooperation on/coordination of support schemes, even in a very gradual manner. Whilst a gradual alignment remains less threating as opposed to full harmonisation (option 1), or even (partial) opening of support schemes (option 3), MS have difficulties in understanding precisely the costs and benefits and how these should/could be shared. A gradual alignment would facilitate better a bottom-up convergence of schemes, which by many MS is likely to be a more preferred option than a top-down approach EU-wide/regional approach. The danger is that if the alignment is too gradual in time, there is a risk that with political elections every four years in most MS new politicians enter into the scene with different views on renewable energy policy framework compared to their predecessors. Thus, COM would need to ensure momentum in the direction of increasing alignment of support schemes across MS.

Taking the recent Danish-German pilot cooperation as a starting point, a gradual approach could, for example, entail:

- a gradually opening after the first pilot phase, forbidding e.g. reciprocity and ‘physical delivery’ requirements
- after, e.g. an additional (expanded) pilot phase, mandatory participation in joint support schemes (e.g. joint auctions, joint renewable quota schemes)
- following a series of successful pilot phases, additional MS would be invited to join, notably in a non-overlapping way which does not necessarily imply that such schemes replace national support schemes: they may co-exist.

Table 102 Pros and cons of Gradual alignment of national support schemes through common EU rules

Pros	Cons
Option 4: Gradual alignment of national support schemes through common EU rules	
▪ Follows the approach that is currently taking place, in particular through the Guidelines State Aid for environmental protection and energy 2014-2020 (EEAG) and the 2009 REDI. ▪ Allows for bottom-up input, through lessons learned from e.g. the Danish-German pilot auctioning cooperation. ▪ Also, gives MS better time to adapt and change their schemes gradually over time, whilst ensuring investor confidence. ▪ Common design details may be expanded e.g. from FiP as default to floating feed-in	▪ Could end up being to gradual, and taking too long to achieve alignment, e.g. resulting from election of new politicians with differing views than their predecessors. ▪ Cost sharing mechanism is probably the most important factor of political acceptability of any alignment, this remains to be understood. If not understood, this will jeopardise even the most gradual alignment of support schemes.

premiums, standardised support periods, no support at, for example 3 hours in a row of negative electricity prices.
- Perhaps also politically more realistic, progress towards a genuine IEM for electricity.

Possible actions to be taken/way forward:

Convergence of (design features) of national schemes is already under way through the implementation of the 2014-2020 EEAG. Difficult to foresee a provision in REDII which could be applied to enforce regional cooperation through (gradual) alignment of support schemes. As mentioned above, alignment should be continued through the post-2020 EEAG. COM could however play a more active role in providing guidance on how to address the cost sharing issues, which is maybe one of the most important factors with regard to the political acceptability of support scheme alignment. Since this remains to be understood better, COM could also encourage through governance framework the inclusion of a chapter on regional cooperation in the NECPs, which would not only identify cooperation possibilities but also their cost/benefit per MS.

2.7.7.4 Regional cooperation centred around a specific (additional) RES technology deployment

This option explores a regional cooperation initiative which would be centred around a specific RES technology deployment, in a specific region. An obvious example would be offshore wind in the Northern Seas, i.e. the North Sea and/or the Baltic Sea. Offshore wind represents a huge potential in both sea basins, such as grid (inter)connection, spatial constraints, health and safety issues, as well as timely innovation (e.g. DC breakers), which could be better addressed by joint efforts from MS in the relevant regions than by MS alone. Different national standards (e.g. health & safety, operation and maintenance, environment) needlessly drive up costs and should be also addressed as part of a regional dialogue.

The following three options are considered:

I. *Offshore wind/North Sea, voluntary cooperation by MS with the EC acting as a facilitator.*
II. *Biomethane in countries where Natural Gas Grids are well developed.*
III. *Other RES technologies*

Assessment:

I. *Offshore wind/North Sea, voluntary cooperation by MS with the EC acting as a facilitator*

Offshore wind is well suited for the promotion of regional cooperation, particularly in the North and Baltic Sea basins. These two sea basins are surrounded by a group of countries with similar ambitions and facing similar challenges in developing offshore wind. Coordination of infrastructure, market regulation, marine spatial planning as well as addressing cross-border costs and benefits have been identified as key issues with respect to offshore wind development[349]. There is a unique opportunity to set up a framework for enhanced regional cooperation taking into account the immense energy potential of the North Seas, building on an already initiatives between North Sea countries to cooperate.

As seen from Table 95 and Table 96, several regional cooperation initiatives exist which directly or indirectly address cross-border cooperation and coordination aspect related to offshore wind energy in the Northern Seas. Enhanced regional cooperation should avoid setting up duplicate structures. Lessons learned from existing initiatives show that commitment and guidance from political level is impetus to reaching concrete results. This would be the case also regional cooperation focusing specifically on offshore wind.

It was recently proposed to establish a High Level Group for North Sea Offshore wind (HLG-NSOW)[350], with the aim to "*create a* ***vision and a roadmap for the development, coordination and collaboration*** *in energy infrastructure in the North Seas with the corresponding finance mechanisms that will expedite the interconnection between countries and between offshore wind farms and the mainland, facilitating a need to support a continuous pipeline of offshore wind and grid projects and the establishment of a European offshore wind technologies testing and verification centre*."

The North Sea in itself provides a 'natural' geographical delineation for regional cooperation concerning offshore wind, i.e. [Belgium, Netherlands, Germany, Denmark, UK (and Norway)]. However, there are peripheral countries, i.e. France, Ireland, and Sweden, which may wish to join such a cooperation. An approach could therefore be to allow MS to 'opt-in' if they, for example, fulfil the minimum defined criteria for the relevant region/technology. As suggested by (Egenhofer, 2015) these criteria would need to be defined, and linked to EU energy policy objectives. Such an approach could however undermine regional cooperation. Egenhofer also points out that *"offering states the opportunity to design partnerships for mutual benefit as opposed to simple compliance with regulations will create a sense of purpose and ownership in the process. This would allow member countries to go beyond information and knowledge-sharing and accept common policies or even joint instruments."*

An important question is whether there should be a specific regional/offshore wind target associated with this cooperation initiative. A target could evolve from a joint vision and roadmap, which the relevant MS could collaborate on with guidance from the European Commission. Setting a regional target for e.g. offshore wind in the North Sea through a bottom-up approach rather than top-down induced regional target reduces the risk of opposition from the involved MS, and it also does not undermine the MS' right to determine its own energy mix in accordance with the Lisbon Treaty.

Going even one step further, would entail MS cooperating on the design and implementation of support schemes, e.g. when shifting to auctioning schemes. MS could, for example, facilitate the deployment of offshore wind volumes by coordinating the timing and size of offshore wind auctions and identifying common

349 https://www.e3g.org/showcase/North-Seas-Grid
350 Ibid.

projects that could be up scaled or developed regionally so as to maximise benefits for consumers and the industry.

Table 103 Offshore wind/North Sea, cooperation by MS with the EC acting as a facilitator

Field of action / measure	Offshore wind/North Sea, cooperation by MS with the EC acting as a facilitator
Pro	▪ COM, Members of the European Parliament, several governments among others the Dutch Presidency to the EU), and market parties have been strong advocating for a stronger and more committed cooperation on offshore wind in the North Sea. ▪ Has the potential to set a framework which could be replicated to other regions and RES technologies.
Cons	▪ Overlaps with other regional initiatives (NSCOGI, PLEF). There is a need to define/set clear boundaries between the scope and focus on the different regional cooperation initiatives, in order to avoid unnecessary duplication and conflicts of interest. ▪ Purely voluntary approach may result in longer lead times before significant results, e.g. target for offshore wind in the region as well as beneficial coordination of relevant regulation, instruments and policies.
Remarks	▪ Under the Dutch Presidency to the EU, a declaration by North Seas region countries (Belgium, Denmark, France, Germany, Ireland, Luxembourg, the Netherlands, Norway and Sweden) to further strengthen their offshore wind-based cooperation was signed in early June 2016. ▪ In order to create public acceptance, it would be necessary to clearly communicate the direct benefits to citizens and market parties in the countries involved in cooperation, e.g. lower electricity bills, improved balancing options, etc.
Legal feasibility	▪ If voluntary, this option would be unproblematic.

Possible actions to be taken/way forward:

Following the recent strengthening of regional cooperation of North Sea countries on offshore wind energy, resulting from the signing of a memorandum of understanding by Belgium, Denmark, France, Germany, Ireland, Luxembourg, the Netherlands, Norway and Sweden in June 2016, under the Dutch Presidency, COM could play a strong supporting role in promoting the four different modes of cooperation under this initiative, which were presented under Section 2.7.3 (dialogue & information-sharing; joint analysis (of policies and measures) & knowledge creation on selected topics; common policies in selected areas; and joint instruments).

II. Biomethane in the countries where Natural gas Grids are well developed

Another possible option for regional cooperation on a specific RES technology could be on biomethane. Grid-quality biomethane can be of particular importance for MS with substantial decentralized demand for natural gas, which decarbonisation might (partly) need to take place through greening of the natural gas itself. Typical examples would be the Netherlands, UK, Germany, and partly Belgium, Denmark, Sweden and Austria. While the potential for biogas from anaerobic digestion is relatively modest and relatively evenly dispersed throughout the continent, joint efforts of these countries could focus on the development of gasification technologies for biomethane, and on questions related to the optimal balance between moving away from natural gas and greening it, including the grid dimension in this.

III. Other RES technologies

Cooperation on technology development and deployment for CSP might also be a good candidate. However, there are no other initiatives which specifically cover other RES technologies from a regional cooperation perspective, similar to that taking place e.g. in the Northern Seas. However, there are and have been several regional initiatives that also targeted (renewable) energy topics under the Interreg initiative[351], which were co-financed through the European Regional Development Fund. These projects focussed among others on bioenergy, and aimed to raise awareness, facilitate conditions for the reduction of emissions by sustainable use of bioenergy, develop regional management plans and tools for managing and planning within bioenergy and exchange experiences in specific regions[352]. The impact of some of these projects is quite regional but nevertheless very profound. The Transenergy Net project, for example, which funded the construction of geothermal installations, had the effect of a show case and lead to further investments by the private sector without public funding[353]. Other projects also focussed on transport technologies[354].

Whilst projects under the Interreg Programme are usually less scientific and a bit more hands-on and practical than projects under the Horizon 2020 programme, their advantage is that they built on many years of regional cooperation. It should be considered integrate these two programmes to a larger degree by connecting the programmes with the focus on specific innovative fields (such as implementation of new storage and integration technologies). The connection of the Horizon 2020 and the Interreg Programme would require actions at all levels by fostering the exchange between project participants as well as policy officers in the responsible DGs, opening the Interreg projects to a larger group of project participants and aligning the rules for participating in such projects.

Aside from the Interreg programme, the potential for regional cooperation is certainly there. For example, the production of biogas and energy using biomass and waste streams plays an important role in regions of West Flanders (Belgium), central Denmark and Schleswig Holstein (northern Germany), whilst the Energy Valley region (Northern Netherlands) and region of Halland (Sweden) are seeking opportunities to implement concepts like those already successfully implemented in these regions. The exchange of best practises between the interested regions

351 http://ec.europa.eu/regional_policy/en/policy/cooperation/european-territorial/
352 See for example the Bioenergy project in the Baltic Sea Region: http://www.bioenergypromotion.net/ and in Central Europe: http://www.4biomass.eu/en/project
353 http://transenergy-eu.geologie.ac.at/
354 http://www.rezipe.eu/

and the regions already operating successful concepts could facilitate a very efficient implementation of new technologies[355].

For other technologies, such as biogas and energy using biomass and waste streams, as example above shows, regional cooperation could take place at subnational level. As suggested by Ecofys[356], the European Commission could make the involvement of subnational regions in the drafting of the NECPs mandatory. Involving subnational regions to take part in the drafting of the NECPs, together with a process of consultation of NECPs between MS, could contribute to identifying RES technologies where subnational regions could cooperate on. Cooperation could be based on information sharing and exchange of best practice, but could also be developed further and include joint analysis, and even joint instruments and policies across involved subnational regions.

Possible actions to be taken/way forward:

The highest benefits can be obtained by joint support schemes. COM could stimulate this further through, e.g. designated contributions from European financial instruments. A possible provision in the forthcoming REDII could include a regional potentials analysis, however, the governance structure and the proposed regional consultation on the NECPs is probably a better suited approach to ensuring such an analysis, which may also incentivise further regional cooperation on different technologies. COM should consider setting up a new platform, or expanding an existing platform to identify opportunities for regional cooperation, such as the use of the greening of natural gas through biomethane. Regional cooperation on RES could also be promoted more strongly in existing programmes, such as the Interreg programme and Horizon 2020.

2.7.7.5 Expanding on existing regional cooperation initiatives

In this section we consider options for expanding existing cooperation initiatives as a way to enhance regional cooperation on RE. An overview of relevant existing cooperation initiatives was presented in 2.7.6.

The following options are considered:

I. *Include RES deployment as a dedicated and explicit topic within an existing regional cooperation forum.*
II. *Extend the Pentalateral forum into the North Seas/Baltic Sea area.*

Assessment

I. *Include RES deployment as a dedicated and explicit topic within an existing regional cooperation forum*

A concrete example where this option has already taken place is BEMIP. The scope of BEMIP was revised in 2015 to include among others renewable energy. The 2015 BEMIP Action Plan states, among others, that on renewable energy "*the countries intend to work together toward the 27% RES target in 2030, the*

[355] http://www.energyvision.info/index.php/results
[356] http://www.ecofys.com/files/files/hbf-ecofys-2015-regional-cooperation-res.pdf

cooperation on RES will include cooperation mechanisms, improving financing for RES and research & technology development".

The BEMIP forms a part of the overall 'EU Strategy for the Baltic Sea Region', and has working groups for electricity and gas under high level political supervision. BEMIP process has resulted in important developments, such as market coupling of Baltic States with Nordpool and the creation of new interconnectors. BEMIP projects have been part of the European Economic Recovery Plan (EERP) which means that they have been eligible for over half a billion euros in funding. Projects can also be funded through the European Regional Development Fund, the EU's Cohesion Fund, and, as projects of common interest, through the Connecting Europe Facility[357]. As a well-established cooperation platform, it provides a good foundation for enhancing regional cooperation on RE.

The new BEMIP is also reinforced in terms of management, providing for meetings not only at the vice-minister level, but at the minister level as well. In Europe, BEMIP is considered one of the most successful examples of regional cooperation.

COM could play a key role in promoting this type of cooperation as a good practice example. Need to identify common benefits of cooperation on RE, and on the basis of this identify cooperation indicators. Lessons learned from the BEMIP process so far is that political will is necessary, and COM acting as an independent „referee" facilitates resolving conflicts easier, and last but not least, all stakeholders must be involved.

A third variant would be to extend PLEF into the North Seas/Baltic Sea area, and cover explicitly offshore wind energy and grid integration issues. The advantage of this option is that PLEF is a well-established cooperation, established already in 2007, where governments, TSOs and national regulatory authorities have been working together. Their collaboration has led to success stories, such as the agreement and implementation of various phases of market coupling, which has become the target model for the EU market as a whole. (DeJong, 2015). The initiative provides a good foundation for enhancing regional cooperation with respect to offshore wind, in particular.

2.7.8 Enhancing regional cooperation through a gap-filler mechanism

Gap filler mechanisms and implications for regionalisation are elaborated in 1.2.

If at the start of preparatory REDII negotiations binding national RES commitments cannot be adopted, COM could invite the MS to form non-overlapping multi-MS regional groups. Horizontal negotiations could aim to result in draft multi-MS agreements for each group defining a normative group RES target for 2030.

Based on notably the ambition level to be determined by a COM-proposed method sanctioned by the MS, a major part of the total funding of an EIB administered RES funding mechanism could be allocated to each group for implementation of Tier 1 measures[358] for application to promote established RES technologies in a

[357] https://ec.europa.eu/energy/en/topics/infrastructure/baltic-energy-market-interconnection-plan
[358] As defined under 1.2 on the gap filler mechanism, Tier 1 and Tier 2 measure are defined as follows: Tier 1 ex-ante gap fillers (part of gap filling) would be applied at MS levels with soft encouragement

market-neutral way through competitive bidding procedures. Group MS wishing to participate could be invited to make and implement specified additional funding pledges into a regional REDII deployment Fund. Periodic cycles of auctions for investment finance could be organized with pre-set maximum funding per auction and pre-set reference energy prices per auction. In each successive auction within one cycle the maximum reference price could be set higher. MS could be invited to supplement the investment subsidies with floating FiP subsidies from their national support schemes in a converging fashion in close coordination with COM/EIB regional (RE) support agency. The regional support agency might also provide very limited MS-specific co-financing of FiP support for MS with a very low support contribution capacity, based on indicators such as GDPpc and Debt-to-GDP.

Tier 2 funding for co-funding the deployment of emerging RES technologies for the EU RES funding mechanism will be administered by the EIB in close coordination with COM through technology-specific tenders in ad hoc technology-specific regions. MS that wish to participate are invited to make co-financing contributions to successful bids for projects in their jurisdiction. A very limited differentiation in MS-contributions might be applied based on capacity to contribute.

towards regional/EU-wide convergence. Emergency gap filling measures are Tier 2 measures harmonised to the extent possible at least at the regional level.

ANNEX A. Benchmarking approaches

According to Council Conclusions, the 2030 EU binding target *"will be fulfilled through MS' contributions guided by the need to deliver collectively the EU target".* A reference benchmark against which pledges can be measured may be needed for several reasons:

- Firstly, in order to avoid strategically low pledges, some kind of benchmark would be needed to be defined for fair contribution of each MS (towards the EU-wide 27% RES target). Without a benchmark, it will be difficult for the EC to assess whether pledges by MS contribute adequately to meeting the EU target. As a direct consequence of this point, a benchmark approach can serve to help the EC with the negotiations related to MS pledges. In case COM can disposed on earmarked EU funds for support to RES deployment and has the mandate to influence its incidence among the MS, the reference benchmark could potentially help incentivising higher pledges during the negotiation phase/governance process, and help to limit or potentially also avoid an ambition gap. So far, the MS have not relegated authority to COM to impose national targets.

- Secondly, such a benchmark can serve as a reference for the approach used to share the cost of a mechanism aimed at covering an ambition gap (and later on also a delivery gap).

- A third and important reason for a benchmarking would be that MS need to know up front (any potential) consequences of their pledges before submitting their NECPs. Not knowing the consequences of their pledges up-front, MS may be inclined to present low targets. Moreover, the benchmark allows for planning security for stakeholders and industry and makes the contributions by MS towards the overall 2030 RES target more tangible.

- The benchmark can also be used one reference when the gap filler instrument is designed, foremost to preferably a regional approach requiring regional benchmarks. Should such approach prove not politically feasible a carrot-and-stick approach might be resorted to, to reward and penalise MS based on their pledges and actual deployment.

- Finally the benchmark allows MS for a constructive learning process. A critical benchmark shows the strong and weak elements of MS policies and allows for improvement on the basis of best practices

Possible benchmark options are presented in Table 104 below. These benchmark options could be applied individually or in a combined manner. Combination of benchmark options are presented in Table 105 below.

Table 104 Description of possible benchmark options for identifying MS contributions towards the EU-wide 2030 RES target

Benchmark options	Used in REDI	Description
Flat rate	Yes	This option would imply that all MS should aim for the same increase in the share of RES, either measured in relative terms, e.g. 7%-point increase. The argument for using this method is to treat all MS 'equally', however it does have the disadvantage that it does not take into account early efforts. It is also the simplest approach. When the flat-rate is measured in relative terms, this benchmark approach will favour MS with a lower than average GFEC per capital (Zehetner, 2015). However, it could disadvantage might be that it is quite burdensome for small and poor MS.
GDP per capita (default)	Yes	A pure GDP-based benchmark implies that the additionally needed RES to meet the 2030 RES target is distributed to MS according to their GDP share in the total GDP of the EU, thus factoring in the economic strength of MS.
GDP alt I: GCEF per capita	No	This option implies that the additionally needed RES to meet the 2030 is distributed according to the energy intensity of each MS. GDP per capita (as calculated for 2020 targets) penalises energy efficient countries (with low GFEC per capita or per GDP point). This option could be used in combination or instead of the GDP per capital option (above). This option would increase the spread of the benchmark result between MS compared to the GDP per capita approach. (Zehetner, 2015)
GDP alt II: government debt/GDP	No	This option would include the Debt-to-GDP ratio into the benchmark determination, where Debt stands for government debt. It relates the country's 9official) indebtedness to the country's economic activity. As such, this indicator is recognised as the most important one as a proxy for the government's solvency capability. [359] The Debt-to-GDP ratio could supplement the GDP per capita indicator with the relative weight attached to Debt-to-GDP relative to GDP per capita set to be constant. Alternatively, the weight of Debt-to-GDP could be set to rise from zero, when exceeding 60%. This latter rate is considered a prudent ceiling, below which the national sovereign debt can be managed well, even under quite adverse macroeconomic conditions; it plays a prominent role in one of the Stability and Growth Pact conditions.
RES Potentials	No	A potentials-based benchmark implies that the potentials for RES and related costs are used as a basis for distributing the expected contributions from each MS in terms of reaching the overall 2030 RES target. This benchmark will require modelling of a future ('least cost') expansion of RES to reach the 27% target, where a set of assumptions for the modelling exercise would have to be agreed upon, including a barriers assessment and assumed mechanisms to reduce the cost of capital from the side of the EU Commission. Different variants of the different assumptions could be foreseen.
Early efforts	No	This option could provide MS who over-achieve their 2020 nationally binding targets with a discount in their 2020-2030 contribution, i.e. a given reduction on their indicative contribution to reaching the EU-wide 27% target, which could be equal to or higher than the over-achievement of their 2020 binding target. Provided there will be a gap avoider, such MS could also specifically benefit from such an instrument.
Innovation efforts	No	This option could provide an (indirect) incentive to MS that are investing in innovative RES technologies (a similar approach to double counting advanced biofuels can be considered). TRL 6 and 7 based technologies could,

[359] (INTOSAI, 2010)

		for example, be the main focus.
Investment climate	No	This option could provide EU/MS with a tool to assess the willingness to invest in the RES sector in a certain MS, e.g. an indicator for the trust from the part of the private sector in a stable and coherent investment climate realised through NECPs

Several combinations of these could be foreseen.

Table 105 Possible combination of benchmark options for identifying possible MS contributions towards the EU-wide 2030 RES target

Possible benchmark approaches	Flat rate	GDP-def.	GDP-alt I	GDP-alt II	Pot.-based	Early efforts	Innovation efforts[360]	Justification:	Issues and concerns:
Alt I: 2020 approach	50%	50%						Well understood approach, and implies a continuation of approach used for REDI, where flat rate component ensures a minimum contribution from each MS and the GDP component leads to a somewhat higher burden on MS with stronger GDP/economies.	Whilst it may be considered more politically feasible since it has been used before, an important drawback is that it does not take into account cost-efficiency of deployment nor respective deployment potentials in MS. The connection to the GDP has the additional disadvantage that there is not a necessary connection between GDP and the ability to develop RES, especially when the country is very small for example Luxembourg. Moreover, it is also a problematic narrative, because seems to consider RES as a burden for less developed MS and not as a chance for development. Giving mainly rich and small countries the opportunity to increase growth of RES would basically exclude poor MS from development of new technologies. This is in particular relevant if the 2030 package also contains instruments that should help MS to fulfil their pledges.

360 For simplicity, this option is not factored in the combined options in the table. It is likely to have small implications for the percentage contributions, and could instead be included as a small add-on.

Possible benchmark approaches	Flat rate	GDP-def.	GDP-alt I	GDP-alt II	Pot.-based	Early efforts	Innovation efforts[360]	Justification:	Issues and concerns:
Alt II: 2020 approach (modified)	50%	25%	25%					A variant of the REDI approach. Flat rate component is left unchanged to ensure minimum contribution from each MS. However, the GDP component is adjusted to avoid penalising countries with relatively low energy intensity/high energy efficiency.	As for Alt I, important critics of this approach is that it does not take into account cost-efficiency of deployment nor respective deployment potential in MS.
Alt III: Same as Alt III but incl. early efforts compon-ent	50%	20%	20%			10%	x/✓	Same as for Alt III, however, an adjustment to the GDP and GFEC components and allowance to reduction in efforts due to over-achieving nationally binding RE target. The latter 'early effort' component is introduced to incentivise MS to at least achieve their 2020 RES target by 2020.	Adds more complexity to calculation.
Alt IV: Flat rate + potentials	50%				50%		x/✓	This approach would include a mix of (a) flat-rate (e.g. 3.5 percentage point increase per MS) and (b) MS effort resulting from a least-cost resource allocation from an EU-level perspective (e.g. as captured under various PRIMES optimisation scenarios).	Would require a 'least cost' modelling exercise as well as agreement on several debatable assumptions needed for the 'least cost' modelling. Focusing on a dynamic 'least cost' projection would be challenging in the modelling exercise due to numerous uncertainties, such as evolution of energy demand and carbon prices. Arguments for including a 'potentials' component encompass 'a least cost' deployment. This would imply deploying more RES in those countries with relatively more RES potentials with relatively lower cost. However, more emphasis on regional cooperation and the fact that there will be no binding national RES targets renders the 'potentials' component less relevant as compared to the REDI framework. Cost-efficient potential and deployment could be

Possible benchmark approaches	Flat rate	GDP-def.	GDP-alt I	GDP-alt II	Pot.-based	Early efforts	Innovation efforts[360]	Justification:	Issues and concerns:
									defined at regional level.
Alt V:	33.3 %	33.3 %			33.3 %		x/✓	This alternative provides a balance between (i) having all MS contribute, (ii) having "rich" MS contributing more, while (iii) ensuring some cost-efficiency of overall deployment.	
Alt VI:	33.3 %		33.3 %		33.3 %		x/✓	This option provides a balance between (i) having all MS contribute, (ii) having MS with "higher energy intensity" contributing more, while (iii) ensuring some cost-efficiency of overall deployment.	
Alt VII:	25%	25%	25%		25%		x/✓	This alternative would reap the benefits from each of the four individual benchmark options.	Adds more complexity to calculation.
Alt VIII:	30%	20%	20%		20%	10%	x/✓	Variant of Alt VII, which also allows for a small amendment to take into account early efforts by MS, i.e. (over-)achievement of their 2020 RES target.	Adds more complexity to calculation.

ANNEX B. Preliminary assessment of detailed design elements of the three RES-E gap-filler instruments considered

Support auctioning (SA)

In case of ambition and/or delivery gap, FiP/investment subsidies for RES capacity could be auctioned at regional level. There are many open issues with regard to designing such a gap filler mechanism. The ensuing table seeks to provide an overview of main features with their pros and cons.

Table 106 Advantages and disadvantages of support auctioning

#	Design feature	Advantages/remarks	Drawbacks/remarks
1	Feasibility of regionalisation	In principle, it can be embraced as a joint support scheme by neighbouring or near-by MS that have largely comparable administrative cultures.	As the Commission needs maximum certainty to introduce effective gap-filler instruments, individual MS operating auctions themselves under a regional agreement to partial open up their national FiP auctioning scheme would seem less adequate and less compatible with the IEM.
2	Operation and supervision	Again, as the EU should have maximum certainty, joint implementing and supervisory agencies could be considered with the EC (through e.g. ACER and/or EIB) represented in the boards concerned.	A regional FiP auctioning scheme warrants a regional FiP fund. It might be considered to make either power suppliers/ large power consumers or TSOs/DSOs responsible to transfer RES-E surcharges, proportional to power consumption. The first modality might be preferred to account for consumption of power generated by captive power (medium and large-scale) power plants as well.
3	Staged, technology-neutral auctions with maximum strike price ascending per stage (vs technology-specific auctions)	Technology-neutral auctions between technologies with broadly comparable levelised cost of energy may provide extra stimulus to cost-reducing innovation. The staged auction design should ensure that also emerging technologies are given deployment opportunities.	Yet for emerging technologies in an early development phase, technology-specific auctions might be considered with legislative room for individual MS to organise them. The reason is that certain MS might wish to invest in developing an industrial capability as regards specific emerging RES-E technology.
4	Fund ceilings (vs MW ceilings)	Auction fund ceilings provide the best certainty on support funding needs. If the average level of strike price bids can be anticipated well, support effectiveness can be commensurately high. In practice though, realisations tend to diverge from modelling projections.	MW ceilings provide the best certainty on support effectiveness. This holds even stronger for investment subsidies than for production subsidies. Deviations of realisations from modelling projections, "virtually 100%" certainty though is only possible at the risk of target overshoot with associated surging funding needs.
5	Pay-as-bid (vs uniform strike price)	The nature of the retained strike price can influence the bidding strategy. If all bidders reveal their	Bidders expecting to have below average unit cost may be tempted to raise their bid. Hence, only under

		expected unit cost including a normal return to capital employed, pay as bid may yield lower support costs than uniform strike price assignment.	competitive market conditions pay-as-bid may yield the lowest support costs.
6	Harmonisation of support levels	If pay-as-bid prices are applied in the whole regional bidding area, the result might be dense clusters of RES-E projects for each eligible technology. This would be at locations with the most favourable cost conditions for the technology concerned. This might be most cost-effective, provided use of system grid charging methodology applied provides proper locational signals.	Harmonized FiP design could include moderate region-wide adjustment factors for support levels based on average natural resource availability (e.g. for onshore wind and solar PV) in a trade-off between achieving a fair extent of deployment dispersion all over the regions and cost-effectiveness of intra-regional deployment patterns. [361] Moreover, this may result in less congested power networks, notably in the absence of proper locational signals in grid charging methodology applied by the MS concerned.
7	One overall power benchmark price	When intra-regional interconnectivity between participating MS is adequate, one regional benchmark reference electricity price might be desirable.	For regions with poor interconnectivity between participating MS, national benchmark electricity prices might be opted for**.**
8	Floating premiums	Given lessons learnt with the volatility and poorly anticipated direction of electricity market prices, resulting in either over-compensation or under-performance regarding RE(S-E) deployment in fixed premium schemes, floating FiP schemes would seem preferable. Furthermore, it seems reasonable to refrain from introducing a premium ceiling or negative premiums. Otherwise, project WACCs might be affected in upward direction because of more investor uncertainty.	
9	No premium for generation during trading periods with negative (avg) electricity prices	At times of negative electricity prices, so-called "must run capacity" may run at a loss in order to avoid higher restart costs. In such periods, demand is too low to render this capacity to run profitably. Under such conditions, stimulating RES-E aggravates the loss of must-run capacity. For that reason, it is often proposed to discontinue FiP payment when electricity prices are negative.	
10	Discrete price reference period	Longer price reference periods may raise the attractiveness for RES-E	

[361] See (BMWi, 2016: 6, Standortqualität figure) for an example of location adjustment factors for onshore wind integrating both considerations (locational resource base and cost-effectiveness). Moreover, locational network cost considerations would ideally need to be allowed for by time-contingent locational use-of-system charges. On the latter aspect, quite some regulatory reform enabled by warranted IT advances are still in the offing.

	for premium determination ≥ one month	plant operators to offer balancing services and other system services, contingent on market design reforms which facilitate the participation of RES-E plants.	
11	Generic project preparatory investigations by operating agency	For large-scale RES-E technologies facing major project development costs to investigate parameters with a potential material impact on project profitability, it might be optimal from a social perspective if the operating agency running the support scheme undertakes the investigations on behalf of competing potential bidders. Notably, for offshore wind this can importantly reduce project development costs.	
12	One-stop shop for eligibility review and permitting with maximum support proposal assessment periods	Efficient permitting and pre-qualification procedures can significantly reduce project development costs.	MS with currently limited institutional capacity to organise an effective one-stop shop may need technical assistance.
13	Up-front auctioning fee	Appropriate measures need to be taken to reduce risks that approved proposed projects are not carried out within the maximum available period.	Very high fees may raise project WACCs significantly
14	Penalty in the event of failing to timely install and commission	Ditto	Ditto regarding non-implementation penalties
15	Feasibility of upscaling to EU level		Challenging in practice due to extremely complex administrative procedures; the more so when allowing for differences in resources. On the other hand, through REDII cooperation mechanisms close support cooperation between MS may go beyond regional borders, e.g. in the case of offshore wind.

Uniform Renewable Quota Scheme (RQS)

Similar to an auctioning scheme, there are many design features that need to be addressed. The table below provides an overview, with pros and cons.

Table 107 Advantages and disadvantages of RQS

#	Design feature	Advantages/remarks	Drawbacks/remarks
1	Feasibility of regionalisation	The NO-SE Elcert scheme sets an example of a support scheme that is effective in target compliance at support costs to electricity users that are among the lowest in the EU.	Contingent on good interconnectivity and compatible electricity market rules. Moreover, in case of concentrated areas of RES-E projects electricity networks need to be reinforced accordingly.

2	Operation and supervision	Given the EU should have maximum certainty, joint implementing and supervisory agencies could be considered with EC represented in the board. Implementing (supervisory) agency with representation of TSOs (NRAs) concerned	
3	Obligated actors on the supply side		Import of "renewable" power fraud-sensitive. Less clarity on support costs as producers may pass on more (or less) than the costs of certificates needed into the power price. Less flexibility in (partially) shielding exposed power-intensive industries.
4	Obligated actors on the demand side	The RES target is related to gross energy consumption (demand). Equalisation of support cost per unit of power consumption. On the electricity bill clarity can be given of the support costs per kWh in the past period. Flexibility to grant (partial) waivers to exposed electricity-intensive industry.	
4	Target% share (as against MW or TWh)	When power demand is e.g. lower than anticipated at the time of target setting, this is no problem.	With a MW or TWh target a surplus of certificates could unfold. This is currently the case with the NO-SE scheme. Although on the whole latter scheme would seem well designed, the definition of the target in terms of TWh might need to be reconsidered in due time.
5	Certificate price floor and ceiling	Could be considered in the initial years to create confidence. Fore efficiency reasons, later on market parties (investors, consumers) should bear certificate price risk.	Typically WACC tends to be higher than under support schemes that shields RES-E generators from market (price) risks. Furthermore, in the face of fast cost-reducing technological progress, under a market-based support scheme, such as a RQS RES-E installations tend to be scrapped faster. This may further raise the WACC of cost-dynamic RES-E technologies under a RQS. On the other hand, an often unreported possible effect of competition between RES-E technologies is the extra stimulus it may give to cost-reducing innovation.
	Obligation on the demand side of the wholesale power market to enter into long-term contracts to buy renewable power	When the scheme has a target of x% for a certain year it could be considered to have obligated actors to fully or partially (say for 80%) buy power and RQS certificates y (say 5 years) ahead as well, so as to provide more certainty to RES-E	Price risk is passed on from RES-E generators to power suppliers. Moreover, this would entail some incremental administrative costs (PPA contracting + showing PPA contracts to the RQS operating agency). In Texas an obligation obtains for power utilities to enter

		investors.	into long-term RES-E PPAs for a set share of delivered power.
	Banking	Provides flexibility to obligated actors and dampens certificate price volatility.	A large certificates surplus might develop. For good market functioning, if at all only small restrictions to banking should be introduced.
	Borrowing	Provides flexibility to obligated actors.	Might reduce the integrity of the scheme. Hence, if at all only a very small maximum% of the certificates needed for compliance should be allowed to be borrowed.
6	Technology banding	This can be done e.g. by technology specific certificate price floor and/or cap (which comes close to FiP) or technology-specific certificates per MWh. This seeks to account broadly for cost differences between technologies.	Ample experience has pointed at the large drawbacks of technology banding, such as: • reducing liquidity by market partitioning • risk of mistakes in discrete decisions on e.g. certificates per technology because of technology cost and/or certificate price dynamics If and when needed, technology-specific features should be introduced outside the RQS (See hybrid option below).
5	Penalty per certificate for target under-compliance	Penalty should be well above the additional marginal cost (on top of the average electricity price) of the marginal RES-E technology. This feature is key for ensuring (virtually) 100% target compliance.	Penalty should not be set unduly high as this could significantly raise investor uncertainty.
6	Recycling of proceeds to obligated actors		In a market with a few large integrated utilities this can work as a perverse incentive: under-compliance costs are (at least partially) passed on to the customers, whilst the RES-E generating assets fetch surplus regulatory rents as certificate price is driven up by anticipated revenues from penalty recycling.
7	Headroom mechanism		Bears a similar perverse incentive. Moreover, its complexity is hard to understand by market parties. This holds In particular for power consumers.
8	Feasibility of upscaling to EU level	In principle, this is feasible	All MS should have adequate power network infrastructure including high interconnectivity and compatible electricity market rules.

Table 108 Comparative assessment

Criteria	Sub-criteria	FiP auctioning	Uniform RQS
2. Efficiency	Static	-	-- / ++
	Dynamic	+	0
1. Effectiveness		+	++
3. Ease of implementation		0	-
4. Political feasibility/social acceptability		+	-
5. Flexibility		++	0
6. Feasibility of harmonised EU-level application		--	-
7. Investor certainty		+	-
8. Compatibility	MS level	++	-
	EU level	-	+
9. Budget impact	MS level	--	++
	EU level	--	++
10. Legal feasibility		+	-

Legend:

++Very positive, + Positive, 0 Neutral – Negative,**– –** Very negative

For an RQS no public budget support is needed, but preferably volumetric (i.e. energy-dependent) surcharges in a similar fashion as e.g. the EEG Umlage.

Auctioning can have a production capacity component (per kW basis) and a production volume component (per MWh basis).

Production subsidies are to be financed through auctions for access to national FiP support schemes [[[or a regional FiP support fund, but BMWi has floated an interesting idea of joint auctions with a randomised access procedure to national FiP support schemes]]]. Preferably through user charges. If through central government budget as recently in DK, this is prone to ad hoc national political bickering/stop-go decision-making.

The production capacity component might refer to public (national/EU) participation in access to a debt finance facility and – only for MS/regions – with a very poorly developed financial sector / high WACC conditions – public equity participation. This requires financial tailoring in which the services of the EIB can put to very productive use. Potential sources for EU co-funding of a guarantee/debt & (very limited) equity co-finance include:

- Ringfencing EFSI funding to RES deployment investment co-financing with COM as principal and EIB as operating agent
- Structural funds (notably ERDF). Part should be spent on GHG mitigation. Sub-earmark for RES deployment to be reached by qualified majority decision. MS will quite likely resist reallocation of un-spent national allocations to an EU fund, perhaps somewhat less so to a regional RES finance fund instead of burdening the national central government budget for contributing to a possible regional fund for auctioning RES financing support.
- Horizon 2020: RES demo project finance in category B (high-cost, "innovative") RES technologies
- InnoFin (EU Finance for innovators) joint initiative by EIB, EIF and COM under Horizon 2020: funding of the "Ambition window" targeting category B technologies
- EU ETS revenues from auctions: 50% mandated to be spent for climate-related purposes. COM may persuade MS to earmark a part to fund joint auctions focusing on category A (established) RES technologies (Pledging into the Delivery window of a regional EIB-managed RES project investment guarantee and co-finance and to supplement the funding from capped final energy user charges for national RES support scheme, as e.g. done in Czech Republic)
- EU ETS (Modernisation fund + free allowances for co-financing RES-E projects in low-income MS (ETS Directive, article 10c))
- Connecting Europe Facility + Cohesion Fund: COM may seek to obtain special earmark for financing interconnections/ transmission grid infrastructure investments to transport RES-E within/from low-income Member States and co-financing RES-E projects (Cohesion Fund)

Effectiveness

As a gap-filler a fair but not typically no maximum amount of certainty is obtained through the auctioning option. Theoretically, maximum ex-ante certainty is possible at the price of a significant risk of target over-compliance and associated surging support cost. Through proper target compliance enforcement features both the RQS and the hybrid RQS/auctioning option can achieve virtually 100% RQS target compliance. For high RES target compliance the regional RQS target needs to be well aligned to the RES-E required for reaching the regional RES target.

Cost efficiency

Contrary to widespread intuitive perceptions, cost-efficiency of a support scheme and a reported low average WACC for RES-E projects do not necessarily coincide. For example, Denmark, Germany and Sweden are all well on track to meet their 2020 RES targets. But quite large differences in support costs are notable. Indeed RES-E support cost on the household electricity bill for these three countries diverge by orders of magnitude. In 2014 RES-E support cost are approximately 28 €/MWh, 62 €/MWh and 3 €/MWh for Denmark, Germany and Sweden respectively[362]. These support cost compare to an average WACC on onshore wind projects, reported to assume a range of 5-6.5%, 3.5-4.5% and 7.4-9% respectively (Diacore, 2016). Even allowing for e.g. large differences in RES resource endowments, these figures would seem to suggest that FiP regimes imply lower risks for project developers (and hence lower WACCs) indeed. But the figures above suggest as well that a reported low average WACC rate is a rather poor predictor of the efficiency of a certain category of support schemes for society at large.

The static efficiency of the auctioning option is moderate as the technology mix and localisation of RES-E projects might be less optimal. Furthermore, contingent on design and market conditions auctioning might not necessarily give efficient outcomes. In general, the uniform RQS can only considered for application in regions with an abundance of RES-E technologies with a moderate support need as well as robust networks with high interconnectivity. Most if not all presumed REDII regions fail to meet these conditions. This would imply under a uniform RQS high regulatory rent for operators of low-cost support-eligible RES-E and congested networks. Its strongest points are: maximum certainty on target achievement (with proper target compliance regulation) and in regions that do meet the aforementioned conditions high static efficiency.

The hybrid RQS-auctioning option marries static efficiency benefits of RQS to benefits of steering project siting through auctioning design. If the siting management through auctioning dominate, the static efficiency benefits resulting from the RQS instrument will be less.

Its weakest point of a uniform RQS is that emerging technologies may be developed in a more distanced future than socially optimal. On the other hand, the stimulus of inter-technology competition on cost-reduction innovation tends to be downplayed if not totally neglected in most innovation discussions regarding RES deployment. Another point requiring dedicated attention is the risk of stranded RES-E assets when technological progress goes faster than anticipated for the technologies concerned. During the contractual support period, operators benefiting from RQS support have higher exposure to this risk than operators benefiting from FiP support.

Both the auctioning and the hybrid option score better on cost-reducing innovation, as emerging technologies are given more room for early roll-out. This may result in a fast roll-out of emerging technologies, that turn out to be learning fast technologically.

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[362] Using figures for year 2014 throughout this footnote, in Denmark the public service obligation for environmental friendly energy, excluding research expenditure, on the household electricity bill amounts to 0,210 DKK/kWh. Though we do not avail of information on dedicated expenditure for RES-E support, RES-E support appears to account for the lion's share of PSO expenditure reported by EnergiNet, when excluding research expenditure. In Germany the EEG surcharge for year 2014 amounts to 6,24 €/kWh. This amount would be significantly, but not orders of magnitude, lower when allowing for (partial) exemptions granted to German industry. On the other hand, support through ample availability of KfW financing at concessionary terms (compared to terms of commercial banks) is not matched by public financing facilities for RES investments available in other MS. In Sweden, the RES-E (Elcert) surcharge for year 2014 on the electricity bill is 0.028 SEK/kWh.

Ease of implementation/political feasibility

For all three options there are large challenges to regional implementation. Given accrued experience, the political feasibility of the auctioning system might be highest and likewise the willingness to overcome the large implementation challenges.

A major impediment for implementing the hybrid option is the complexity of introducing a RQS and an auctioning at the same time. Yet combining them would seem easier than perceived at first notice. When auctioned FiP has a reference period of say one month, the ex post settlement of a floating premium needs to allow for the average benchmark power price and the average RQS certificate price during the past month. If the auction concerned is technology specific, based on the average technology production profile the hourly power price could be weighted accordingly. Such weighting procedure for the RQS certificate price would seem to make less sense as the RES-E producer can make discrete decisions on the timing of selling RQS certificates. Furthermore, for the economically less advanced REDII regions the absence of robust and well-interconnected electricity networks is a major practical bottleneck to apply the second (RQS) and third (hybrid) option.

Flexibility

After the introduction date of the possible gap-filler mechanism, the Commission and the regional implementing agencies need to have the flexibility to tweak the option parameters upon upcoming new information on aggregate and regional RES deployment against the EU and regionally committed RES target trajectory. The auctioning option has high flexibility in adjusting the size of auctions. The other two options might include adjustment features regarding the RQS target trajectory for upcoming years. As such this type of flexibility is somewhat less, compared to the auctioning option. On the other hand, given higher certainty on RQS target achievement these options might face lower need for flexibility tweaking.

Harmonised application at EU level

For none of the options the chances for EU-level harmonised application would seem high, although theoretically a uniform RQS or a combined RQS at EU-level and auctioning at regional level would seem possible.

Investor certainty

The auctioning option provides the most certainty to benefiting operators of RES-E installations. Hence, as such negotiating a financial close under investment/production subsidy benefits is easier than under the perspective of gaining (less stable) RQS benefits. As for RQS beneficiaries, they may mitigate prospective cash flow risks through entering into long-term PPAs for the combined transfer of power and RQS certificates. Moreover, as the auctioning option as a gap filler requires (at least partially) public funding, investors may perceive political risk of e.g. retroactive FiP squeezes. This risk can be mitigated through high-profile EU involvement with sanctions against MS introducing retroactive support cuts. More ambitious options are a stronger engagement from private insurance companies or even financial guarantees of EU institutions that would be activated when MS retroactively change their policies. The latter option would require a legal system that will ensure that the respective EU institution can hark back the guaranteed funds from the Member State if the necessity arises. The control mechanisms of the CAP, through which COM has regained about € 8 bn, could be a used as an example and inspiration for such an administrative process. Such private or public guarantees would significantly increase the investor certainty and thereby reduce risk premiums of RES investments.

Compatibility with MS support schemes and with the European IEM

Compatibility with MS support schemes is highest for auctioning, while for the hybrid scheme it seems fairly high. A regional uniform RQS is incompatible with existing MS support schemes but for those few countries with a RQS in place.

Compatibility of auctioning (uniform RQS) with the IEM is fairly low (high), with the hybrid scheme assuming a middle-of-the-road position regarding this criterion.

Budget impact

Auctioning as a gap avoider can be financed through surcharges on the electricity bill. But applied as a gap avoider, financing means need to be mobilised swiftly and with a high amount of certainty. Hence, auctioning as against a uniform RQS will have material budget impacts on both MS and EU level. Again, the hybrid scheme assumes a middle-of-the-road position.

Legal feasibility

Under Article 194 para. 2 TFEU, the MS enjoy a right to determine the conditions for exploiting their energy resources, choice between different energy sources and the general structure of their energy supply. This right seems to be conditioned only upon Article 192 para. 2 lit. c). Now, depending on the interpretation given to this provision, it at least becomes clear that it constitutes a certain restriction to EU actions in the field of energy, including renewable energy. In any event, it would appear that MS will have to agree to what the Commission proposes – may it be by simply not invoking their rights under Article 194 para. 2 TFEU.[363]

Considering the different gap filler options in regard of their acceptability to the MS, one should recall the discussions around the Directive 2001/77/EC and the REDI, where the MS heavily opposed quota obligations, and even required an explicit statement in the REDI that Guarantees of Origin are not tradable certificates. On national level, most MS have turned away from quota obligations as well. Proposing options 2 and 3, behind this background, seems very difficult to get through, therefore.

However, all three options could be considered rather intrusive on the MS sovereignty, though option 1 with the auctioning potentially the least intrusive. Still, even under option 1, MS would have to agree to any RES winning in the auctions to be built on their sovereign territory. Note in this regard that technology-neutrality in the auctioning may in this regard cause even more of a problem, as this would seem to take away the choice for or against certain resources from the MS entirely. Further, it may not always make sense (e.g. due to grid and infrastructure issues, or threat of strategic bidding), which is why for

[363] Compare e.g. Johnston, A; Van der Marel, E; (2013) Ad Lucem? Interpreting the New EU Energy Provision, and in particular the Meaning of Article 194(2) TFEU. European Energy and Environmental Law Review , 22 (5) 181 - 199.

example in the Guidelines for Environmental and Energy Aid 2014-2020 certain exemptions were introduced. In order to increase the legal feasibility (i.e. political acceptance) of option 1, one should thus consider allowing well-justified exceptions to the technology-neutrality in the auctions, if requiring it at all.

Thus, in order to ensure legal feasibility in the sense of getting around the restriction to the EU competence arising from Article 194 para. 2 TFEU, it seems that all options should offer some flexibility to the MS. One could imagine a design that features different ways to participate in the gap filler, e.g. through either making payments to a fund from which auctions may take place, or submitting to a (sectoral) quota, etc. Giving such choices – comparable e.g. to the system under the Energy Efficiency Directive (EED) – might make the gap filler instrument more complex, but it may in the end be the way to make it acceptable and thus possible.

In any event, gap filling auctioning organised by the EU Commission need as pre-condition in view of the above a consent by the Council to allow for such an instrument, meaning a clear proposal under RED II to which the Council would agree and clear EP and Council regulations for the pathway of those tendering for gap-filling. Likewise, it would be necessary to reflect on the financing side for such projects which come out after a successful tendering took place. If the European Structural fund regulations would be chosen or other established funding instruments, again modification in the legal framework of these funding instruments may be needed.

Concluding observations on the assessment process

It might be considered from a perspective of political convenience to leave the choice of RES-E gap-filler instrument for each REDII region up to negotiations between the governments of the MS making up the respective MS regions. The choice of gap-filler is secondary to the primary goal of reaching the at least 27% RES target. Yet it would seem that the REDII is to specify the contribution each REDII region is expected to make towards reaching that goal, should evolving circumstances yield those pre-set objective indications that warrant the automatic activation of the gap-filler process. The auctioning option can be considered as the default option when no agreement among the MS of a REDII region exists regarding the choice of support option. Most practical experience has been obtained with this option, applied to the auctioning of production (FiP) support.

ANNEX C. Sources of funding an EU gap-filler

A gap-filler mechanism would require a source of funding. Funding sources could include (options below include those presented in Commission's excel sheet).

Consumer surcharges

Different consumer surcharge modalities

Consumer surcharges can either be a volumetric surcharge (in terms of €ct energy per kWh consumed) or a periodic (e.g. annual) flat-rate (lump-sum) surcharge per customer connection. In the latter case, a rough discrete differentiation might be applied depending of the capacity level (e.g. W) of the customer connection.

In the case of support auctioning, a clear choice needs to be made between a volumetric surcharge or a flat-rate surcharge. The advantages of a volumetric surcharge are that (i) it is the most equitable, (ii) the most transparent and (ii) gives an incentive towards energy savings. Disadvantages include: (i) slightly more administrative effort/cost, and (ii) a lower surcharge taxing base in the case that net metering incentives are given to prosumers. Most MS mandate the application of a volumetric surcharge by energy suppliers.

As for RQS, a simple annually adjusted charge in terms of €ct per kWh is usually applied. The RQS supervisory agency would then need to project next year's final consumption level and next year's average certificate price. Given next year's RQS target, next year's support cost covering surcharge can then be determined, allowing for any intervening overhang of issued certificates that are not yet cancelled.

Suitability assessment

The table below presents a general suitability assessment. The specific pros and cons will, of course, depend on the chosen gap-filler instrument.

Table 109 Pros and cons of funding gap filler costs covered by consumer surcharges

Pros	Cons
• No budgetary burden (at EU or MS level) as the funding costs would be borne by energy consumer in the form of higher electricity prices. • Cost-effective way of funding the gap-filler mechanism if designed correctly. • There would be no need to remove existing support schemes for RES deployment. • Consumers would be obliged to pay a surcharge which should provide a reliable source of revenue for the gap-filler mechanism. If there is a predictable revenue stream for surcharge-based policies revenue certainty can be achieved, which can provide comfort to investors that policies introduced by the EU to reduce the Weighted Average Cost of Capital (WACC) will persist. • A centrally determined, 'one-size-fits-all' surcharge across all MS could be easier to implement administratively. This may improve cost-effectiveness of the scheme and enable the EU to set both timing and scale of revenue streams. The scale can be determined when setting the surcharge amount and this level can be adjusted over time creating a degree of flexibility.	• Would require engagement of all actors involved in energy billing, which could lead to a high administrative burden. • Social acceptability might be low. Being transparent about paying for RES deployment via a surcharge on energy bills, while at the same time being opaque about the costs of fossil fuel deployment that are being covered by higher energy prices and state budget allocation, could lower public acceptance of the surcharge. • Depends on consumer willingness to pay for RES which varies across the different MS. • Risk of low public acceptance in certain MS and therefore less political buy-in from MS governments for introducing (increasing) a surcharge.[364] • Higher electricity bills for businesses may deter further direct private investment into RES if companies feel they are already paying a premium for RE, which already affects their bottom line results. • Surcharges can effectively guarantee utilities recovery of their fluctuating costs, thereby, shifting financial risk away from the investors and onto consumers. • Risk of RES deployment targets not being achieved, and if funding needs to be scaled up over a short period of time, a surcharge might not be flexible enough as it takes time for funds to be collected through electricity bills. This differs to alternatives such as direct allocation of EU or MS budgets where funds could be provided at a scale necessary, and in a relatively timely fashion. • Use of surcharges is a deviation from

[364] Consumer surcharges have played an integral role in providing a source of funding to finance deployment of renewable energy technology in Germany to support the ambitious Energiewende. However, as Bloomberg New Energy Finance (BNEF) has recently reported[364], the German government to reform its consumer surcharge approach to funding renewables deployment (introduced under the German Renewable Energy Act of 2012 (*Erneuerbare-Energien-Gesetz* – "EEG")) which has led to spiraling consumer energy prices. Germany is planning to implement an auction-based system. If laws are passed to cap subsidies that are paid through the consumer's electricity bill, it might send a signal to other MS governments that consumer surcharges are not necessarily the right funding option to take.

	traditional rate-making and puts customers at risk for overpaying for safe and reliable utility service. Use of numerous alternative ratemaking mechanisms and surcharges can defeat some of the primary principles of the rate-setting and regulatory review process. Besides increased costs to consumers, surcharges can result in such additional undesirable consequences as reducing utility incentives to control costs and shifting utility business risks away from investors and onto customers.[365]

Emission of EU Bonds through EIB

Bond emissions modalities

Another source of funding an auctioning scheme would be direct payments provided by the EIB either directly to plant operators or national intermediates that will allocate the payments at national level. The EIB could acquire the necessary means for the payments by emitting EU long-term bonds at the financial markets. The bonds can be then acquired by the European Central Bank within the expanded asset purchase program. The financing must be designed very carefully to prevent that state policies will be based on money financing which would constitute a breach of the EU treaties.

Suitability assessment

The table below presents a general suitability assessment. The specific pros and cons will, of course depend on the chosen gap-filler instrument.

Table 110 Pros and cons of funding gap filler costs from Emission of EU Bonds through EIB

Pros	Cons
• There is no budgetary burden (at EU or MS level) as the funding costs would be borne by European Central Bank. The cost discussion can be significantly reduced. • Without a discussion between MS on costs the gap-filler can be immediately installed and thereby ensure that the RES target will be achieved. • The purchasing of Bonds through EIB can be easily aligned with the ongoing quantitative easing and expanded asset	• In some MS, the political opposition against such a policy will be extremely high. • The viability of this option depends on the future policy of the ECB, particularly whether the ECB will continue the quantitative easing and expanded asset purchase program. • Financing the development of a whole industry sector with fiat money can lead to a slippery slope. It must be explained why the renewable energy or the green energy sector in general should benefit

365 See page 16 - http://www.aarp.org/content/dam/aarp/aarp_foundation/2012-06/increasing-use-of-surcharges-on-consumer-utility-bills-aarp.pdf

purchase program by ECB. • The approach would support the ECB's and EU Commission's endeavours to increase economic growth and revive the sclerotic economy in some MS. • The application of a tender scheme as gap-filler provides a cap-mechanisms and thereby prevents the risk of inflationary tendencies.	from such funding and other sectors not. The success of this argumentation will strongly depend on the advancement of the post-Paris process.

ANNEX D. Cost sharing methodology

Introduction

Task 1.2 includes an assessment of the possible costs of a gap-filler mechanism and possible allocation among MS. An excel tool has been designed and built for this. The tool is intended as an interactive tool to assess different gap filler designs, allocation rules, and combinations thereof. Several relevant examples will also be analysed and described within this project.

The outcomes of the tool will be of approximate nature, capturing the main effects only, neglecting subtleties and nuances, and providing indicative values and orders of magnitude rather than accurate and absolute figures[366]. In this sense the tool can be used to gain a first insight on the consequences of different gap-fillers and allocation rules, possibly singling out the most promising options. The detailed analysis of these options can then be carried out on a more detailed level with dedicated energy-modelling studies.

The tool will addresses the case of an ambition gap in 2020 of user-defined size, as well as a delivery gap in 2025. The user-defined parameters in the tool that allow the definition of specific cases are:

- A gap-filler storyline, specifying an overall context for the case to be analysed. This includes for example: choice of ambition or delivery gap; type and nature of the gap-filler; sectors, technologies and regions involved in the gap-filler
- Gap size in percentage
- Technology shares in the gap filler mix
- Share of generation costs that need to be subsidized
- List of MS participating in the gap filler
- Choice of allocation rules.

The main outputs of the tool are:

- Estimate of gap-filler generation costs
- Estimate of gap-filler support costs (where possible)
- Shares of additional RES deployment per MS

The calculations performed in the tool build on a series of core input data, namely:

- Projections of GFEC, GDP per EU MS in 2020, 2025 and 2030 (Primes)
- Estimate of generation costs of selected RES technologies in 2025 and 2030 (ECN internal database)
- Projections of electricity prices in 2025 and 2030 (in-house)

[366] Accuracy is prohibited by the numerous uncertainties.

- Most recent estimate of public debt (Eurostat)

The user is free to change these core inputs, whenever better or more recent data become available.

Table 111 Methodology overview

What do we need to do	Why do we need to do this	How do we do it	What problems do we encounter and how can we solve
1. Baseline, i.e. a linear trajectory for deployment of RES in 2020-2030, w/2020 RES targets as a starting point	• We need to have a basic understanding of a pathway towards the 2030 target. A linear trajectory will provide this.	• Use PRIMES 2013 data to make a linear trajectory to 2030 for EU	• No problems foreseen
2. Define different benchmark options for MS contributions from towards the 2030 RES target, list possible benchmark combination, identify pros and cons of different benchmark options	• We need to have a basic overview of how MS should/could contribute to overall target under different assumptions. • If an ambition/delivery gap occurs, the question of who will contribute will arise.	• We take the options analysed in the TU Vienna study [ADD REFERENCE]. If budget permits we can also consider alternative options. • We describe the benchmark options and different possible permutations (qualitatively), and their pros and cons • Quantitative: we put the MS shares under different options in in a spreadsheet. The numbers will be used later in the cost assessment.	• No problems foreseen
3. Elaborate on different gaps and provide an estimated cost (order of magnitude)	• We need to have a basic understanding of how many PJ and how many € we are talking about when we are faced with different gap sizes. • Important for determining what type of gap filler instrument and technology portfolio required to fill the gap.	• Cost range estimated based on sets of possible technology portfolios and corresponding generation costs. • The user defines sets of compatible technology portfolios and gap-filler mechanisms; some relevant examples will be analysed within the project. • By choosing relevant sets of compatible technology portfolios and gap filler mechanisms we can identify the main uncertainties and bottlenecks, and qualitatively discuss	• We need to make some choices on which sector(s) will contribute to the gap-filler, which technologies will contribute to the gap-filler, which countries (if a regional approach is chosen). • We will choose (eventually in consultation with the Commission) a series of illustrative examples.

		how they could be addressed.	
4. For each set of gap filler & technology portfolio show the distribution of costs per MS	• We need to understand the distributional effects of different gap filler – technology portfolio sets	• We will take the shares per MS in point 2 and use them to distribute the costs. • For regional mechanisms, where the gap is filled by a few MSs only, we will apply analogous methodologies as those underlying the shares in 2, but then only for the countries in the region.	• No problem foreseen

Detailed methodology for steps 3 and 4

Considerations

The most reliable way to analyze in detail the path from 2020 to 2030 at MS level under different levels of ambition/delivery gap and different gap-fillers would be via a set of dedicated modelling studies. While it is advisable to initiate such studies as soon as possible, a first step to screen certain options and provide a 0^{th} order estimate of the costs and distributional effects can be set with a relatively simple methodology.

Gap size and ambition vs delivery gap

In order to specify the size of the gap to be analyzed in the tool, the user can provide either an overall figure for the EU as a whole (e.g. 1% gap), or a deviation from the expected trajectory for one or more MS. This can be done in two target years: in 2020 or in 2025. In the former case the user is analyzing an ambition gap, in the latter a delivery gap.

Ambition and delivery gap differ mainly in the following aspects:

- Timing (ambition gap in 2020, delivery gap later on)
- Technology generation cots (linked to timing – cost decline due to technology learning)
- Carrier prices (e.g. €/MWh prices for RES-E)

Once the user has chosen the target years costs and prices will update automatically in the tool.

Estimating gap filler costs (step 3 in table above)

The main difficulty in estimating the costs of an ambition/delivery gap is that these depend inherently on

1. the portfolio of RES technologies that will be deployed to fill the gap,
2. the relative contribution of each of these technologies, and
3. where these technologies will be deployed (since certain cost components depend on location).

Items 1-3 are unknown, and they depend dynamically on each other and on the nature of the regulatory framework surrounding the gap-filler mechanism. They can only be determined with some accuracy via dedicated modelling studies using EU energy system models. However a 0^{th} order cost estimate can be achieved by

- considering main technology sets in RES-E, RES-T and RES-H/C sectors,
- estimating their (dynamic) generation costs per unit of energy,
- building a gap filler technology portfolio, and
- calculating the total generation costs.

By repeating the process under different assumption one can then estimate various cost ranges in different *technology scenarios*. For example one can choose to fill the ambition gap solely with the RES heating/cooling technologies. This choice could be justified in the context of a sector-specific gap filler, e.g. a (strengthening of an existing) quota on RES share in the heating/cooling sector. One could then select several sets of heating/cooling technologies (each set characterized by different technology shares) and estimate a range of investments needed to fill the gap.

As already hinted at in the example above, each *technology scenario* should be linked to one or more compatible *gap filler instruments*, such as technology or sector specific instruments, regional gap instruments, etc.

Gap filler options

Currently, the spreadsheet tool allows for two types of gaps, namely, ambition gap and delivery gap.

Practical implementation

Once a gap-filler mechanism and a gap size have been chose, the assessment will be carried out in the excel tool by choosing a set of compatible technologies and specifying their shares in the gap-filler. The technologies will be presented in table format:

Table 112 Compatible technologies, generation costs and gap filler contribution

Sector	Technology	Generation costs [€/PJ]	Gap filler contribution [PJ or%]
…	…	…	…
…	…	…	…

Each technology will be coupled to a sector. The generation costs will be estimated based on ECN in-house databases, but can at a later stage be adjusted by the user if better or more recent data become available. For each chosen gap-filler mechanism a number of compatible technologies in the table will be identified, and their contribution to the gap filler will be specified in the last column of the table. By changing the relative contribution of each of the relevant technologies one can obtain different estimates for the total generation cost of the gap filler – in particular by choosing to fill the gap with the most expensive and the cheapest of the relevant technologies, one can estimate a cost range for the particular gap filler. Optionally, once can also specify carrier prices (i.e. electricity price for the electricity sector) and calculate the total support costs needed to finance the gap-filler. In case the estimate of the carrier price is problematic (e.g. this is typically the case in the heating/cooling sector, where the costs of heating/cooling vary greatly depending on RES technology, region, non-RES alternatives, etc.), once can provide (per technology in the table) an exogenous estimate of the required support as percentage of the generation costs.

Allocation per Member State (step 4 in table above)

Once a set of technology scenarios have been identified and linked to a set of compatible gap filler mechanisms, and the corresponding (range of) generation costs have been estimated, one still has to tackle the distribution of these costs among MS.

The excel tool will include a series of preset allocation rules, based on (single or combinations of[367]) the indicators, viz.:

- GDP based
- GDP + flat-rate
- GDP per capita
- Debt-to-GDP ratio: public debt as percentage of GDP
- Potentials

These rules can be applied at EU-level or at regional level, by selecting the relevant MSs that participate in the gap-filler.

The rules are specified in a separate worksheet as share per MS. On top of the preset rules, users can also define additional rules of their own.

Examples

The simple methodology outlined in the previous sections obviously only provides a very rough, 0th order estimate of costs and allocation effects. It does not capture all the nuances and complex dynamics that would actually take place. Examples are: the interaction of EU-wide gap filler instruments with existing national policies, possible effects on energy and the climate plans for 2030, macro-economic effects (e.g. jobs creation), a more accurate estimate of total system costs, acceptance issues, etc. The tool is meant to provide a first assessment and a screening of relevant options, while the analysis of the more intricate effects should be carried out through dedicated energy modelling studies.

[367] E.g. a combination of GDP per capita and Debt-to-GDP indicators, where the latter could assume a weight zero for values up to 60% (assumed to be a ratio level below which debt can be managed well, even under rather dismal macroeconomic conditions), whilst assuming a rising weight thereafter, e.g. by 0.05 per percentage point above 60% up to 260%, where it would assume a weight of 1.

In order to define relevant options to be assessed with the excel tool a number of decisions has to be made:

- Is the gap-filler regional?
- If so, what MSs are involved?
- Is the gap-filler sector-specific?
- Is the gap-filler technology-specific?
- Which allocation criteria make most sense for the specific gap-filler?

It is clear that many viable options could be defined and assessed. In order to provide the Commission with a first set of relevant options, some cases will be analyzed with the tool within this project. We define the cases in general terms. The following example is provided:

Case 1: Technology-specific regional gap-filler

In this case an ambition or delivery gap is filled entirely with a one single technology, deployed within a specific region. This case is interesting when a number of countries in a region can benefit from the large scale deployment of a particular technology.

A concrete example is the deployment of offshore wind in the North Sea. The relevance of the example stems from the large potential for offshore in the North Sea, a potential not only for the use of the abundant physical resource (wind energy), but also for boosting effective regional cooperation and grid integration. A similar example could be offshore wind in the Baltic region.

The most relevant gap-filler instrument for this case is a regional FiP with auctioning.

This option, when applied to offshore wind, requires very early decisions on:

- Starting a fast-track negotiation procedure to reach agreement on the necessary harmonized legal frameworks, net codes and institutional framing (regional planning& supervisory agency (encompassing ACER and NRAs) and regional implementing agency (encompassing ENTSO-E and TSOs)
- Early implementation of demo project with hybrid network assets spanning more than one MS to test technologies required and novel regulatory approaches needed.

Assessment with the excel tool

Step 1: The (initial) size of the gap is determined (e.g. 1%) and the time frame is chosen (2020 – ambition gap, or 2025 – delivery gap)

Step 2: A share of 100% is assigned to the chosen technology

Step 3: A share of 0% is assigned to the countries that do not belong to the chosen region

Step 4: The allocation rule is selected, or a custom allocation rule is defined

The tool will then calculate the total generation costs, the total support costs (if carrier prices, or required support shares are given in the input sheet), and the cost break-down per country in the region. The analysis can then be repeated for a different gap size and/or a different time frame. This will provide insights on how the costs scale with the gap size and how the costs will change in case an ambition or a delivery gap is addressed.

The tool will not address the question of to what extent each single country in the region will benefit from the extra deployment. This is because this simple tool cannot handle complex potentials calculations, which are better addressed by advanced energy models.

ANNEX E. ILUC Directive Annex IX

Part A. Feedstocks and fuels, the contribution of which towards the target referred to in the first subparagraph of Article 3(4) shall be considered to be twice their energy content:

a. Algae if cultivated on land in ponds or photo bioreactors.
b. Biomass fraction of mixed municipal waste, but not separated household waste subject to recycling targets under point (a) of Article 11(2) of Directive 2008/98/EC.
c. Bio-waste as defined in Article 3(4) of Directive 2008/98/EC from private households subject to separate collection as defined in Article 3(11) of that Directive.
d. Biomass fraction of industrial waste not fit for use in the food or feed chain, including material from retail and wholesale and the agro-food and fish and aquaculture industry, and excluding feedstocks listed in part B of this Annex.
e. Straw.
f. Animal manure and sewage sludge.
g. Palm oil mill effluent and empty palm fruit bunches.
h. Tall oil pitch.
i. Crude glycerine.
j. Bagasse.
k. Grape marcs and wine lees.
l. Nut shells.
m. Husks.
n. Cobs cleaned of kernels of corn. L 239/28 EN Official Journal of the European Union 15.9.2015
o. Biomass fraction of wastes and residues from forestry and forest-based industries, i.e. bark, branches, pre-commercial thinnings, leaves, needles, tree tops, saw dust, cutter shavings, black liquor, brown liquor, fibre sludge, lignin and tall oil.
p. Other non-food cellulosic material as defined in point (s) of the second paragraph of Article 2.
q. Other ligno-cellulosic material as defined in point of the second paragraph of Article 2 except saw logs and veneer logs.
r. Renewable liquid and gaseous transport fuels of non-biological origin.
s. Carbon capture and utilisation for transport purposes, if the energy source is renewable in accordance with point (a) of the second paragraph of Article 2.
t. Bacteria, if the energy source is renewable in accordance with point (a) of the second paragraph of Article 2.

Part B.

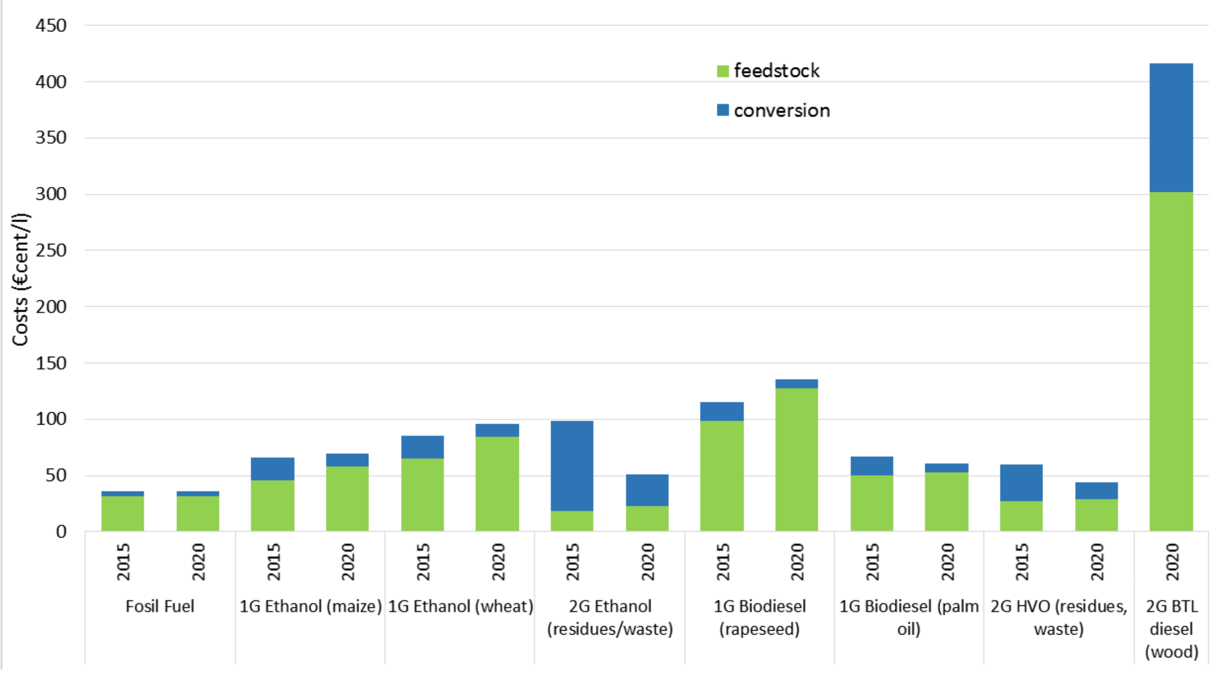
Feedstocks, the contribution of which towards the target referred to in the first subparagraph of Article 3(4) shall be considered to be twice their energy content: (a) Used cooking oil. (b) Animal fats classified as categories 1 and 2 in accordance with Regulation (EC) No 1069/2009 of the European Parliament and of the Council (*)

ANNEX F. Indications of costs of various biofuels

Advanced biofuels for road transport

Currently around 5.4% of the total road transport have been met by biofuels, mainly biodiesel and bioethanol, produced from food crop-based feedstocks, also referred as 1st generation or conventional biofuels. There have been also an increase in HVO production based on animal fats and UCO due to the double counting mechanism introduced in REDI. The role of advanced biofuels from more innovative technologies have been very minor.

Several modelling exercises have been carried out to investigate production costs of biofuels in the short- to longer-term (e.g. IPCC 2011; IEA-ETSAP & IRENA 2013a). Figure 46 shows current 2015 and expected 2020 costs for different biofuel pathways. Feedstocks represent up to 80-90 % of palm and rapeseed biodiesel, and maize ethanol (IEA-ETSAP & IRENA 2013a). Conversion costs are only of relatively minor importance for 1G biofuels, while relevant for 2G ethanol, HVO, and especially BTL, particularly by 2020 assuming larger production scales. The competitiveness for 2G biofuels is expected to increase in the mid- to long-term due to learning curve effects.



Source: Adapted from Festel et al. (2014); data given for 50 €/bbl crude oil price)

Figure 46 Production costs for selected biofuels pathways

Alternative jet fuels for aviation

Alternative jet fuels are currently produced batch-wise in small quantities and there is the 2 Mton target from alternative jet fuels in 2020[368].

Currently ASTM International, formerly known as the American Society for Testing and Materials (ASTM), develops the international standards for Jet Fuel. Two biofuel pathways, HEFA/HVO and FT, have been certified for use in aviation up to blends of 50%. A brief summary of the technology status are introduced below.

Table 113 Biojet fuel production technology status

Biojet fuel production technology	Type of feedstock	ASTM Certified	Status
Hydroprocessed Esters and Fatty Acids (HEFA)	Vegetable oils Waste streams from food industry Vegetable oil refining by-products Algal oil	**Yes (50%)**	Neste Oil operates two 190,000 t/a HEFA plants in Finland and one 800,000 t/a plant each in Singapore and Rotterdam. UOP and its customers have announced several HEFA projects worldwide. In Europe both ENI and Galp Energia have plans for HEFA plants at 330,000t/a each but these are yet to start construction. However, the output from these facilities is designed for diesel replacement in road transport and as such cannot be used for aviation unless some process modifications are carried out on the existing facilities. Algal oils can replace vegetable oils in HEFA or similar processes but these will not be commercially available at least within the next 5-8 years. Due to very high infrastructure cost for industrial algal cultivation it is unclear when competitiveness vs. conventional plant oil or other advanced biofuels cost will be achieved.
Fischer-Tropsch (FT)	Woody (lignocellulosic) biomass Municipal waste Agricultural waste Forestry waste	**Yes (50%)**	There are a few projects that have been nominated to receive NER300 grants and there are other demo plans that aim to produce FT biofuels in 2018 in Europe.

368 The Biofuel FlightPath Initiative was introduced on the 24th of June 2011, at the 49th International Paris Air Show Le Bourget. The European Commission alongside with Airbus, Air-France-KLM, British Airways, Lufthansa and biofuel producers Chemtex Italia, Neste Oil, Biomass Technology Group, UOP and UPM are targeting two million tonnes annual production of fuel derived from renewable sources by 2020.

Direct Sugar to Hydrocarbon (DSHC)	Any fermentable sugar Aiming for cellulosic biomass and by-product streams, e.g. bagasse	Yes (but max. blend of 10%, certified in June 2014)	
Alcohol to Jet (ATJ)	Sugars Starches	**no**	ATJ is currently still at pilot plant scale. Major players are Swedish Biofuels AB in Europe and Gevo in the United States.
Hydrogenated Pyrolysis Oil (HPO)	Woody (lignocellulosic) biomass Municipal waste Agricultural waste Forestry waste	**no**	HPO is still at research status.

The EU report on '*A performing biofuels supply chain for EU aviation*' investigates the costs of bio jet fuels for a target of 2 Mt per year by 2020. According to the document, sustainable bio jet kerosene currently comes at significant additional costs for airlines. In addition to the estimated 3 billion euros investment in technologies and production facilities to enable a constant production flow of bio-kerosene, mechanisms are also needed to address the cost increase, which is currently attached to bio- kerosene. This cost increase, calculated at €3 billion for 2 million tonnes (ca. 1.20 €/L), reduces the potential market uptake. To put this number into perspective, as of February 2015, the price of conventional Jet Fuel was 621 $/tonne[369] (**0.48 $/L**) and in 2012 fuel costs accounted for approximately 30% of operating costs for airlines[370] (Deane et al, 2015).

Table 114 presents price estimates for HRJ/HEFA, FT, and ATJ fuel pathways. Price estimates are based on current technologies, and major technological advancements are not factored in. The minimum selling price is a plant gate price and excludes transport, taxes, and retail mark up.

369 http://www.iata.org/publications/economics/fuelmonitor/Pages/index.aspx

370 http://airlines.iata.org/reports/special-report-fuel-slick-oil britishairways.com/engb/bamediacentre/newsarticles?articleID=20140416080250&articleType=LatestNews#.VNuHU_nGrwt

Table 114 Theoretical fuel prices for alternative jet fuels from different feedstocks and pathways(REF: IATA, Alternative fuels, 2014)

Type of biofuel	Minimum selling price ($/L)	Main feedstock
FT jet fuel	**1.42-2.52**	**switchgrass**
	0.77-1.28	Natural gas
	0.87-1.97	coal
Hydroprocessed renewable jet (HRJ) / hydroprocessed esters and fatty acids (HEFA)	1.16-1.27	soybean
	1.05-1.09	**tallow**
	0.88-0.99	Yellow grease
ATJ	0.61-2.34	Sugar cane
	0.71-3.65	Corn grain
	1.09-6.28	**switchgrass**
Conventional Jet fuel (in 2015)	0.48	

Alternative fuels for shipping

The marine fuels are mainly produced from crude oil or natural gas. Only gaseous and liquid biofuels (i.e. Bio LNG, methanol, hydrogen and biomass-derived products equivalent or substitutes for marine distillates and residual fuel) are considered as alternative fuels for shipping.

Figure 1 illustrates the alternative fuels for water transport. The shipping sector is in a very early stage of orientation towards biofuels. Currently, no significant consumption of biofuels for shipping takes place within the EU. The most promising option, from a technical point of view, seems to be small percentage biodiesel blends (up to 20 %) with marine diesel oil or marine gas oil (MDO/MGO), besides the 100 % replacement of heavy fuel oil (HFO) by straight vegetable oils (Ecofys 2012).

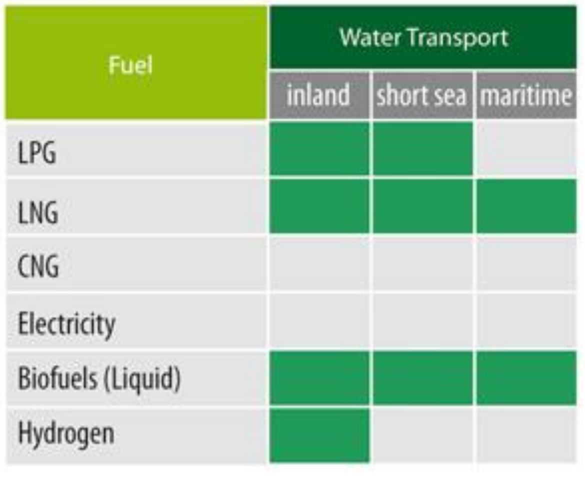


Figure 47 Coverage of travel range by main alternative fuels (COM (2013) 17)

The biogas and biomethane for heating and cooling

Biogas is produced applying anaerobic digestion (AD) technology. It consists of a mixture of biomethane CH_4 (65-70%) and CO_2 (30-35%) and small amounts of other gases. After removal of contaminants, biomethane is the same as natural gas, and can be either injected into the natural gas grid or used as a transport fuel in the form of Liquid Natural Gas (LNG) or Compressed Natural Gas (CNG).

Bio-SNG (Bio Synthetic Natural Gas) is produced by gasification of lignocellulosic (woody materials) and can be injected into the natural gas grid, or used as transport fuel.

There is a large cost range for biogas production and upgrading them into biomethane or Bio-SNG production. Biomethane market exists in countries like Germany, France, Austria, the Netherlands and Sweden. Sweden focuses on direct applications of biomethane such as biofuel. Germany focuses on applications in CHP plants, while the Netherlands and UK have established a heat market for green gas.

The generation costs depend on the feedstock type, feedstock prices and the conversion technologies used. Figure 48 illustrate the EU average generation costs for 2016 and 2030.

- biomethane generation costs from upgrading biogas from landfill or sewage gas to biomethane as the lowest end and upgrading of biogas from manure mono-digestion as the highest end,
- generation costs of heat and electricity production from biogas in CHP; biogas from digestion of industrial organic waste stream as the lower end and biogas from mono-digestion in CHP as the higher end.

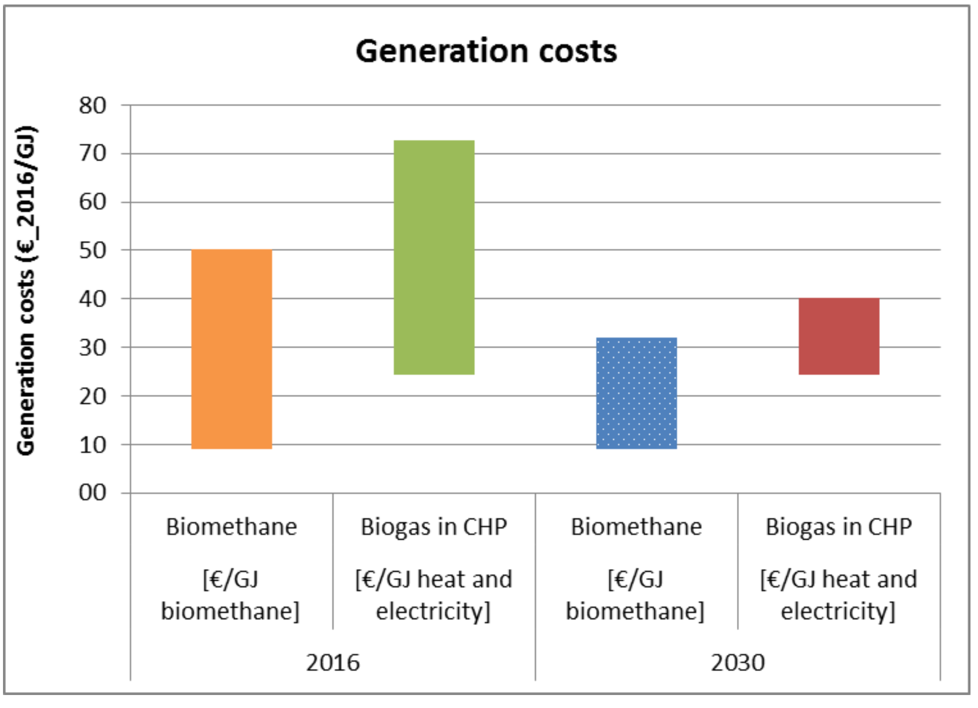


Figure 48 Biomethane generation cost and electricity and heat generation cost of biogas (source:ECN)

Biomethane for transport

According to the publication from IRENA 2013, current production costs for biomethane that is suitable for vehicle use have a range of about 0.45 $/lge (12.9 $/GJ[371]) for wastes to as much as 0.93 $/lge (26.7$/GJ) for small-scale systems purchasing maize silage.

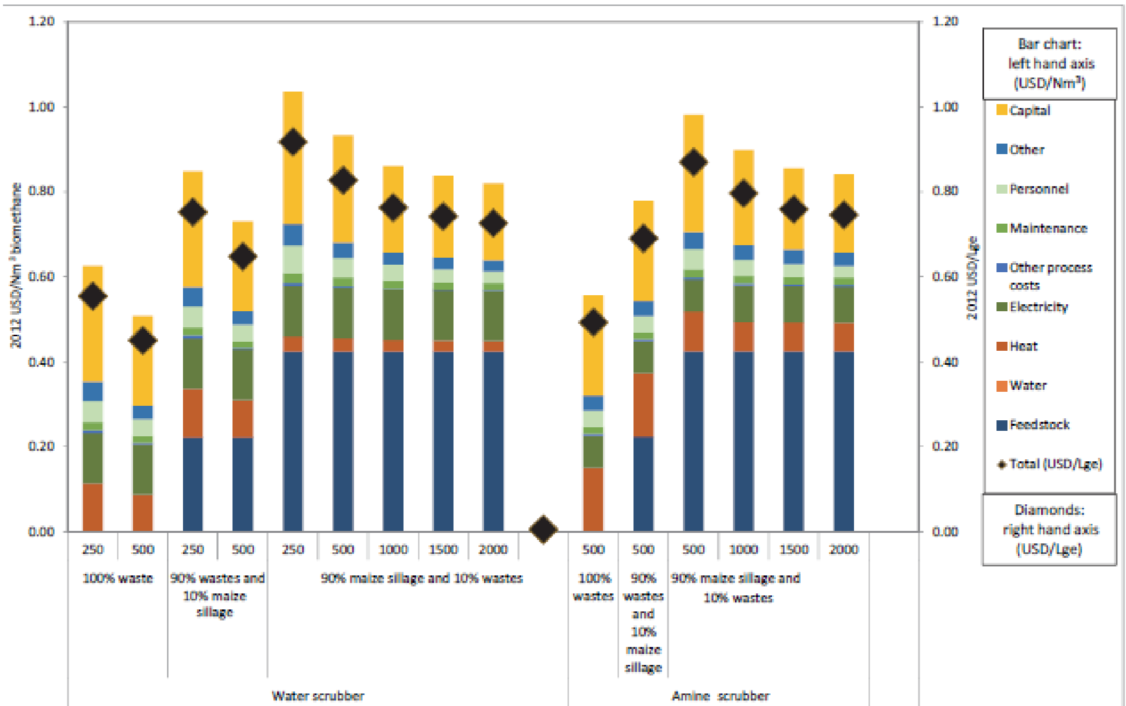


Figure 49 Total production costs for biomethane suitable for vehicle use by upgrader type and size

[371] 1Nm3=0.0348GJ

ANNEX G. Commercial production of advanced biofuels in the EU

Table 115 presents the status of advanced biofuel plants that are commercial (planned production capacity is equal to or above 50 kton/year) in Europe. Among them, the only operational plant using wheat straw as feedstock is in Italy. In 2013, Beta Renewables started the commercial production of cellulosic ethanol in Italy. The Crescentino plant has an annual production capacity of 75 million litres using 270,000 MT of biomass. The feedstock consists of wheat straw, rice straw and husks, and Arundo donax, an energy crop grown on marginal land. Wood waste from the forest industry and lignin from the ethanol plant are used as feedstock at the attached power plant. Italy has mandated the use of advanced biofuels. The Italian Decree requires gasoline and diesel to contain at least 1.2 % of advanced biofuel as of January 2018, rising to 2 % by 2022 (ref Gains, 2014).

Commercial production of cellulosic ethanol is limited in the EU. Beside the plants in Italy, other commercial operations producing lignocellulosic ethanol have recently been announced (Gains, 2015).

- In Finland a plant with a capacity of 72 kton/year is planned to be operational in 2017.
- Beta Renewable is planning to use its technology for a 70 million litres cellulosic ethanol plant in the Slovak Republic. The start-up is expected to take place in 2017.
- In Denmark, a cellulosic plant of 50 kton/year is planned to be constructed, in 2018.
- In France, a 62 kton/year is planned but the planned date is not known.
- Also, in Poland and Slovakia cellulosic ethanol plants are planned with production capacities around 50 kton/year.

Advanced biodiesel production (thermochemical processes) has been dominated by hydrogenation to produce hydrotreated vegetable oils (HVO)372. Currently, there are no commercially operating FT diesel plants in Europe. There are two plants planned: one in France for 2017 and the other one in Sweden (the date is not known). They are planned to have a production capacity of 200 kton/year and 100 kton/year, respectively. There are also plans to contruct two methanol plants, one in the Netherlands and one in Spain.

[372] In 2010, Neste Oil opened up a renewable diesel plant in Singapore with an annual capacity of 910 million liters and a similar scale plant in Rotterdam in 2011. In 2013, the Neste plants were operating at full capacity. By the end of 2015, Neste is expected to expand the annual capacity of both plants to 1,080 million liters. In 2014, Neste refined globally 1.6 MMT of waste residues and 0.97 MMT of palm oil. The waste and residues consist of mainly palm fatty acid distillate (PFAD), animal fats, UCO, and in smaller volumes, tall oil pitch, technical corn oil, and spent bleaching oil. Neste Oil is gradually replacing palm oil with waste fats and oils. The company’s goal is to use only waste oils and fats as feedstock as from 2017. In 2013 and 2014, Neste exported significant volumes of its product to the United States and Canada.

Table 115 Status of advanced biofuel plants in the EU(50 kton/year or above)

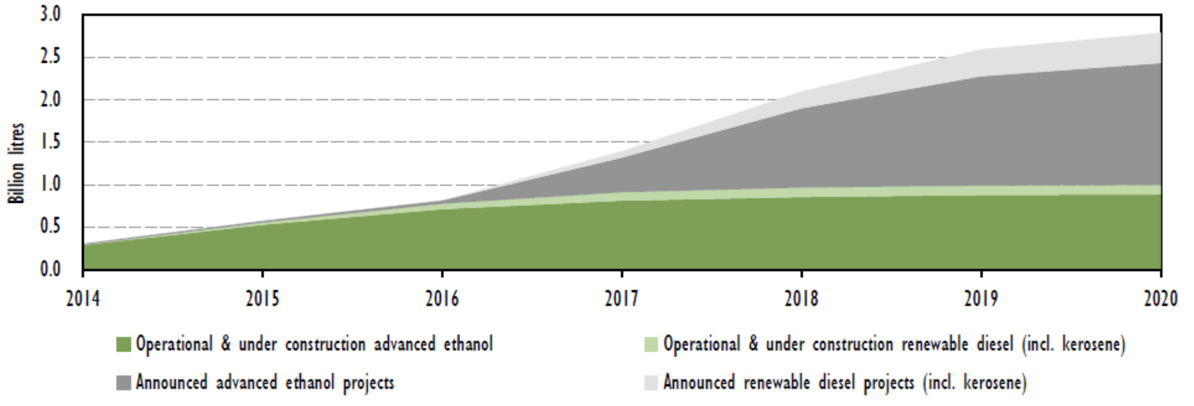
code	name	location	owner	biofuel	feedtock		status	Production capacity (kton/y)	
								2015	2020
IT	Italy	Crescentino (VC)	Beta Renewables (joint venture of Mossi & Ghisolfi Chemtex division with TPG)	Ethanol	Lignocellulosics		Operational	40	60
DK	Denmark	Holstebro	Maabjerg Energy Concept Consortium	Ethanol	Lignocellulosics		Planned (2018)		50
FI	Finland	Kouvala	Suomen Bioetanoli Oy	Ethanol	Lignocellulosics	Straw	Planned (2017)		72
FR	France	Lacq, Arance	Abengoa Bioenergy	Ethanol	Lignocellulosics	Gasified corn harvest and forest residues	Planned		62
IT	Italy	Portovesme	Beta Renewables	Ethanol	Lignocellulosics	Green waste	Planned		78
	Macedonia	Pelagonia (is region)	Ethanol Europe Renewables	Ethanol	Lignocellulosics		Planned		78
PL	Poland	Goswinowice	SEKAB	Ethanol	Lignocellulosics	Wheat straw and corn stover	Planned		50
SK	Slovakia	Strázske (Kosice)	Energochemica SE	Ethanol	Lignocellulosics	wheat straw , switch-grass, rapeseed straw and corn stover	Planned		55
FR	France	Dunkerque	BioTfuel-consortium	FT liquids	Lignocellulosics	forest waste, straw, green waste, dedicated energy crops	Planned (2017)		200
SE	Sweden	Stockholm-Arlanda	Solena/ SAS	FT liquids	Green waste	Organic MSW	Planned		100
NL	Netherlands	Delfzijl	BioMCN	Methanol	Lignocellulosics	Wood chips	Planned		413
SE	Sweden	Hagfors	Varmlandsmetanol	Methanol	Lignocellulosics	domestic forest residues	Planned (2019)		100
FI	Finland	Lappeenranta	UPM Biofuels	HVO	Tall oil		Operational	100	100
ES	Spain	Bilbao	Repsol	HVO	Oil crops& residues	Palm oil	Operational	60	60
ES	Spain	Cartagena	Repsol	HVO	Oil crops& residues	Palm oil	Operational	60	60
ES	Spain	Gibraltar-San Roque	Cepsa	HVO	Oil crops& residues	crude palm oil, animal fats and other waste products	Operational	50	50

ES	Spain	La Rabida	Cepsa	HVO	Oil crops& residues	crude palm oil, animal fats and other waste products	Operational	50	50
PT	Portugal	Sines	Galp Energia, Petrobras	HVO	Oil crops& residues		Planned		200

REF: Database on facilities for the production of advanced liquid and gaseous biofuels for transport http://demoplants.bioenergy2020.eu/, consulted February 2016. F.O. Lichts Plants & Projects database, Consulted February 2016

IEA advanced biofuel forecasts (up to 2030)

Figure 50 illustrates the advanced biofuel plants that are operational, under construction or announced to be built up to 2030. According to this, by 2020 around 2.8 Billion litres of cellulosic bioethanol can be produced. The US RFS has set a target of 60 billion litres cellulosic ethanol by 2022.



Note: The forecast above does not include hydrotreated vegetable oil and reflects a change from the *MTRMR 2014* advanced biofuels forecast, which was based on rated capacity.

Figure 50 Advanced biofuels production forecast 2014-20

ECN biofuel for road transport modelling analysis

Within a recent IEE funded project Biomass Policies, ECN has conducted a modelling analysis for the bioenergy sector in Europe using RESolve-Biomass model. The focus has been on electricity, heating and cooling and the transport sectors. The primes reference scenario (2013) has been used as the basis for this assessment.

The result related to biofuels and bioliquids for transport are illustrated in Figure 51 and summarised below:

- The reference scenario mimics the 10% renewable fuel target in 2020 and assumes beyond 2020 business as usual
- Both scenarios consider 7% cap on food crop-based biofuels up to 2030.
- The high biofuel scenario results in 13%[373] biofuels when compared with the final transport demand[374] in 2030[375].
- The 7% cap on conventional biofuels combined with high targets pushes further use of lignocellulosic ethanol followed by diesel.

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[373] According to the Impact assessment study of the 2030 climate and energy framework the role of biofuels in transport is estimated to be in the range of 14-16%.

[374] Transport demand excludes aviation and shipping

[375] It is assumed that max 25% of the new cars can run on E85, this constraint results in lower biofuel deployment. For instance if we assume that 100% of new cars can be run on E85 the biofuels share increase up to 16%.

- Share of advanced biofuels (that includes lignocellulosic ethanol and diesel, pyrolysis oil, and HVO) is calculated as 2% of total transport demand in the reference scenario whereas it is 4% in the high biofuels scenario in 2030.
- It is, however, important to indicate that an advanced biofuel that enters the market in RESolve modelling is not a guarantee that it will also enter in practice. The results provide the argumentation that specific support (e.g. sub-target) will be necessary so that they also really enter the market.
- The role of biomethane in both scenarios is comparable; comprising 0.9% and 1% of the total final transport energy consumption for reference and high scenarios respectively. In absolute terms the amounts are 103-123 PJ in 2030. Biomethane use is limited by the number of cars run on natural gas.
- Primes reference scenario projects that by 2030 the demand related to natural gas run cars will comprise 2.1% of EU28 total demand for **cars**. In the modelling it appears that almost 84% is substituted by biomethane[376].
- Utilization of biodiesel from waste is comparable in both scenarios and mainly relates to biodiesel generation from UCO and animal fat through conventional technologies. Once lignocellulosic biofuels commercialize (mainly bioethanol) significant cost reductions in in this technology makes it more competitive when compared with HVO production from UCO and animal fat.

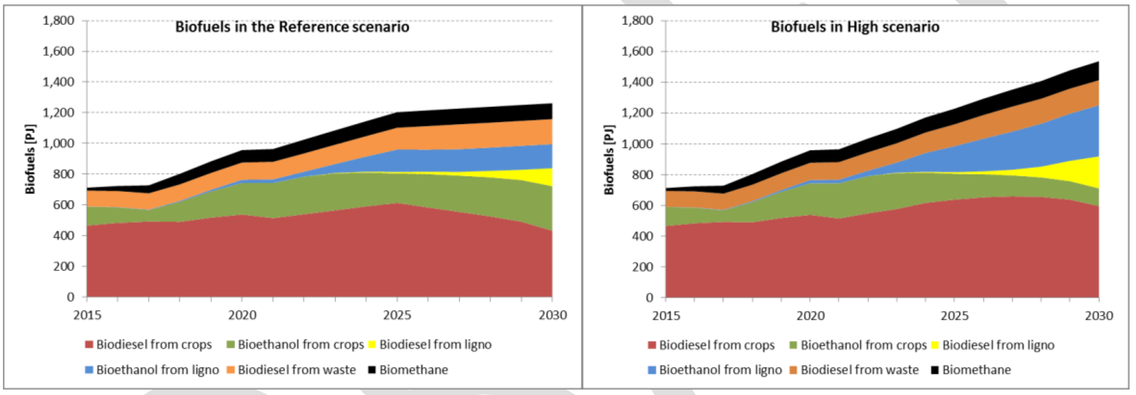

Figure 51 RESolve-B modelling results for the reference and the high biofuels scenario (Biomass Policies, 2016[377])

RESolve-Biomass

RESolve-Biomass determines the least-cost configuration of the entire bioenergy production chain through minimal additional generation cost allocation, given demand projections for biofuels, bioelectricity and bioheat, biomass potentials and technological progress, see Figure 52 (Lensink et al, 2007; Lensink & Londo, 2010; Faaij & Londo, 2010). By doing so it mimics the competition among the three sectors for the same resources. The RESolve-biomass model includes raw feedstock production, processing, transport and distribution. One of the most important features of the RESolve-biomass model is the ability to link the national production chains allowing for international trade. By allowing trade, the future cost of bioenergy can be approached in a much more realistic way than when each country

[376] Note that this doesn't have to be physically, it can be via biotickets.
[377] The publication will be available on the project website in 1 months.

is evaluated separately.

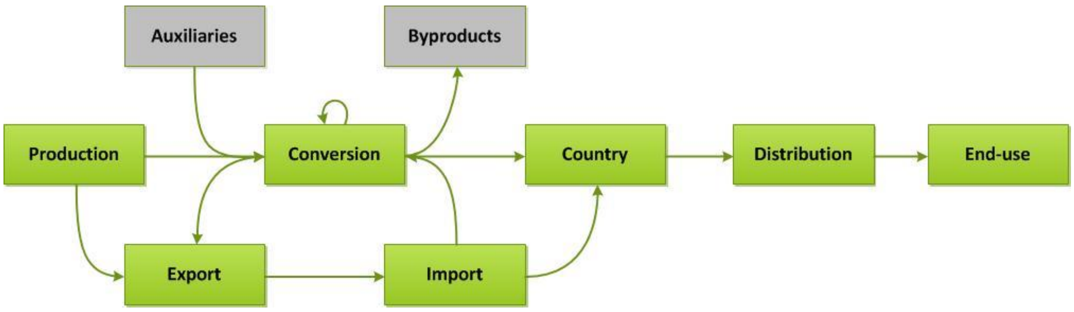

Figure 52 Supply chain in RESolve biomass (Lensink et al, 2007)

The prices for crude oil, natural gas, coal and CO_2 have been taken from PRIMES 2013. The prices for fossil energy carriers are shown in Figure 53. The CO_2 prices as used in this study are given in Figure 54.

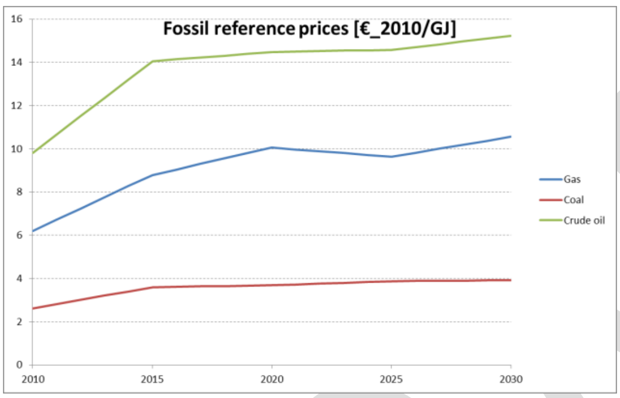

Figure 53 Prices of fossil energy carriers. Values are expressed in €_2010/GJ

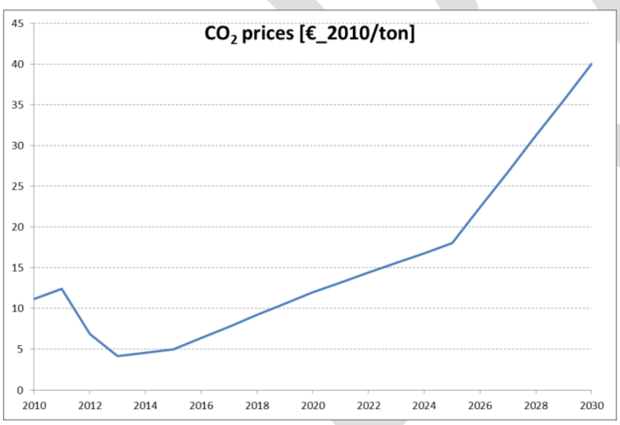

Figure 54 CO_2 prices used in this study. Prices are given in €_2010/ton.

Table 116 Main modelling assumptions

	Reference		High biofuel	
	2020	2030	2020	2030
Double counting	Up to 2020	No	Up to 2020	No
Food crop-based biofuels (max)	7%	7%	7%	7%
Advanced technologies *(lignocellulosic feedstocks & biomethane) (min)	0.5%	0.5% set min but the realization has been higher	-	-
Biogenic share	9.43%	10.48%	9.43%	16%, however realisation has been lower
Import potentials	Fritsche and Iriarte, 2016			
Biomass feedstock cost-supply figures	Elbersen et al, 2015			
E85	A gasoline car replacement rate of 10/y has been used. It is assumed that max 25% of every new gasoline car can be E85			
B10	In the model we have B07 for cars and B30 and B100 with additional vehicle costs			

ANNEX H. PtG for transportation background info (derived from Bertuccioli et al., 2014 and OECD/IEA, 2015)

Background

Water electrolysis plays a key role for the widespread roll-out of hydrogen for mobility, industry or energy storage. It is the dominant and most efficient route to hydrogen production from renewable electricity sources and hence the most proven of the options for generation of ultralow-carbon hydrogen[378].

Although originally hydrogen was produced by electrolysis, today the majority (48%) comes from reforming natural gas and refinery gas, as a by-product from chemicals production (30%) and from coal gasification (18%). Only about 4% of global hydrogen production (65 million tonnes) comes from electrolysis (IEA, 2007). The largest electrolysis plants (over 30,000 Nm3 /h) have historically been deployed for the fertiliser industry (Statoil, 2008). Apart from this industry, hydrogen from electrolysis is used in making other chemicals, food processing, metallurgy, glass production, electronics manufacturing and power plant generator cooling.

Currently, only small amounts of hydrogen from electrolysis are used in energy applications, in sustainable transport programmes, in renewable energy storage, and in some other cases. However, these energy uses are geographically fragmented, and largely dependent on policy incentives. An emerging sector is that of 'power to gas', where electrolysers are being tested in pilot stations for integration between renewable electricity generation and the production of alternative energy carriers such as hydrogen or synthetic methane, which ultimately enable greater utilisation of renewable power. Globally about 50 such demo plants have been realised or are in the planning stage, and more recent projects are often larger than one megawatt of electrolyser electrical load (Gahleitner, 2013). Those pilot projects are often driven by the interest of power utilities and other actors in the value chain looking to better understand the potential and challenges of this technology, and who are looking to gain specific experience with electrolyser operation, plant siting, permitting, and regulations, as well as with power and gas grid connections.

Hydrogen transport and distribution

Hydrogen refuelling stations can be supplied by one or two alternative technologies:

- hydrogen can be produced at the refuelling station using smaller-scale electrolysers or natural gas steam methane reformers, or
- can be transported from a centralised production plan

While large-scale, centralised hydrogen production offers economies of scale to minimise the cost of hydrogen generation, the need to distribute the hydrogen results in higher T&D costs. Meanwhile, the opposite is true for decentralised

[378] http://www.fch.europa.eu/sites/default/files/study%20electrolyser_0-Logos_0_0.pdf

hydrogen generation. While T&D costs are minimised, smaller-scale production adds costs at the hydrogen generation stage.

A number of options are available for hydrogen T&D: gaseous truck transport; liquefied truck transport; and pumping gaseous hydrogen through pipelines.

Table 117 Qualitative overview of hydrogen T&D technologies for hydrogen delivery in the transport sector

	Capacity	Transport distance	Energy loss	Fixed costs	Variable costs	Deployment phase
Gaseous tube trailers	Low	Low	Low	Low	High	Near term
Liquefied truck trailers	Medium	High	High	Medium	Medium	Medium to long term
Hydrogen pipelines	High	High	Low	High	Low	Medium to long term

Hydrogen refuelling stations

Hydrogen refuelling stations are a critical element in the fuel supply chain. They can be exclusively for hydrogen or part of a multi-fuel station. The set-up of a hydrogen station is largely determined by daily hydrogen demand, the form of hydrogen storage on board the vehicle (e.g. the pressure and the phase), and the way hydrogen is delivered to or produced at the station. While small stations could be based on gaseous trucking or on-site hydrogen production, liquefied trucking or the use of pipelines are the only options for hydrogen delivery to stations larger than 500 kg per day, if the hydrogen is not produced on-site.

The investment risk associated with the development of refuelling stations is mainly due to high capital and operational costs, and the under-utilisation of the facilities during FCEV market development, which can lead to a negative cumulative cash flow over 10 to 15 years. To cover the negative cash flow period, direct public support might be needed for hydrogen stations during the FCEV market introduction phase.

In 2014 there were 36 hydrogen refuelling stations in Europe.(Weeda *et al*., 2014). The exact number of current/recent refuelling stations across Europe are around 50 stations (Weeda, 2016[379]).

About 120 hydrogen refuelling points have been deployed across different countries to date (EC, 2013), while several member states have set national targets for the deployment of hydrogen infrastructure. Similar deployment efforts can be observed in parts of the United States (e.g., California) and Japan.

FCEVs are electric vehicles using hydrogen stored in a pressurised tank and a fuel cell for on-board power generation. Currently around 192 FCEVs are running in

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[379] Expert estimate with a clarification that it is difficult to give an exact number. The exact number depends on how one defines a hydrogen refuelling station.

several demonstration projects in Europe (Weeda *et al.,* 2014) and the individual country ambitions/plans add up to around 350000 FCEVs on the road by 2020. However, the important question, who are going to produce these numbers, is not yet clear.

- Toyota ramps-up production form 700 in 2015, to 2,000 in 2016 and 3,000 in 2017, to 30,000 in 2020.
- Hyundai is producing the iX35 in a fuel cell version, but probably not more than a total of 1,000. They are working on a new model, but it is not yet clear when this will come to the market and in what numbers.
- Honda has started series production, but is at least 1 year behind Toyota.
- Daimler has announced production of the GLC F-Cell in 2017, but the market for this car is probably not very large, so no large numbers.

The global car industry plans to roll out fuel cell electric vehicles in Europe from 2015 onwards. The German H2Mobility initiative, for example, has recently announced plans to establish 400 hydrogen refuelling stations until 2023, and similar market preparation and early market development initiatives are being developed in other European countries like the UK or France. Furthermore, several OEMs (Toyota, Honda, Hyundai, and Daimler) have signalled intentions for market introduction of FCEVs between 2015 and 2017.

Whether this will create demand for electrolysers is not yet clear. Some early hydrogen refuelling stations are equipped with on-site electrolysers for hydrogen production. However, other sources of hydrogen, such as steam methane reforming (SMR) or the off-gases of industrial processes such as chlor-alkali, may be more cost-effective. Which source is better suited or more commercially viable for each refuelling point will depend on the local circumstances.

A number of stakeholders expect that mandates will require a certain share of renewable hydrogen at refuelling stations. Such mandates are currently already in place in California where at least one third of the hydrogen at refuelling stations is required to be 'green'. Such a mandate would favour the deployment of electrolysis and other low carbon routes to hydrogen (bio-hydrogen, by-product hydrogen). Similarly, the UK H2 Mobility initiative put forward a roadmap with a 51% share of electrolytic hydrogen by 2030 (UK H2 Mobility, 2013).

Table 118 Current performance of hydrogen systems in the transport sector (OECD/IEA, 2015)

Application	Power or energy capacity	Energy efficiency*	Investment cost**	Lifetime	Maturity
Fuel cell vehicles	80 - 120 kW	Tank-to-wheel efficiency 43-60% (HHV)	USD 60 000-100 000	150 000 km	Early market introduction
Hydrogen retail stations	200 kg/day	~80%, incl. compression to 70 MPa	USD 1.5 million-2.5 million	-	Early market introduction
Tube trailer (gaseous) for hydrogen delivery	Up to 1 000 kg	~100% (without compression)	USD 1 000 000 (USD 1 000 per kg payload)	-	Mature
Liquid tankers for hydrogen delivery	Up to 4 000 kg	Boil-off stream: 0.3% loss per day	USD 750 000	-	Mature

* Unless otherwise stated, efficiencies are based on lower heating values (LHV).

** All power-specific investment costs refer to the energy output.

Notes: HHV = higher heating value; kg = kilogram; kW = kilowatt.

Sources: IEA data; Decourt et al. (2014), *Hydrogen-Based Energy Conversion, More than Storage: System Flexibility*; Elgowainy (2014), "Hydrogen infrastructure analysis in early markets of FCEVs", IEA Hydrogen Roadmap North America Workshop; ETSAP (2014), *Hydrogen Production and Distribution*; Iiyama et al. (2014), "FCEV Development at Nissan", ECS Transactions, Vol. 3, pp. 11-17; Nexant (2007), "Liquefaction and pipeline costs", Hydrogen Delivery Analysis Meeting, 8-9 May; NREL (2014), *Hydrogen Station Compression, Storage and Dispensing - Technical Status and Costs*; NREL (2012a), *National Fuel Cell Electric Vehicle Learning Demonstration Final Report*; US DOE (2010a), *Hydrogen Program 2010 Annual Progress Report - Innovative Hydrogen Liquefaction Cycle*; US DOE (2010b), *DOE Hydrogen Program 2010 Annual Progress Report - Technology Validation Sub-Program Overview*; Yang and Ogden (2007), "Determining the lowest-cost hydrogen delivery mode", *International Journal of Hydrogen Energy*, pp. 268-286.

Hydrogen production technology status and outlook

Electrolysis is a process of splitting water into hydrogen and oxygen by applying a direct current, converting electricity into chemical energy. Three different types of electrolyser technology are currently available as commercial products:

- Conventional alkaline electrolysers (liquid electrolyte),
- Proton Exchange Membrane (PEM) electrolysers and most recently also
- Anion exchange membrane (AEM, also known as alkaline PEM[380]) electrolysers

Historically, alkaline electrolysis has dominated the market and accounts for nearly all the installed water electrolysis capacity worldwide. PEM electrolysis has been commercial for close to 10 years, whereas AEM appeared on the market only very recently. Two commercial technologies, alkaline and PEM electrolysis both have efficiencies of about 65 % for production of hydrogen by electrolysis. They differ primarily by the material used as electrolyte, that is, the medium which transfers charges between the electrodes. With an electrolysis efficiency of 65 % and a methanation efficiency of 80 % the overall system efficiency from electricity to methane is around 52%.

A low price of electricity is of great importance to obtain low production costs.

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[380] With PEM standing for Polymer Membrane Electrolyte.

Electricity input (1)			Today	2015	2020	2025	2030
kWh_{el}/kg_{H2}	Alkaline	Central	**54**	**53**	**52**	**51**	**50**
		Range (2)	50 - 78	50 - 73	49 - 67	48 - 65	48 - 63
	PEM	Central	**57**	**52**	**48**	**48**	**47**
		Range (2)	50 - 83	47 - 73	44 - 61	44 - 57	44 - 53

(1) at system level, incl. power supply, system control, gas drying (purity at least 99.4%). Excl. external compression, external purification and hydrogen storage

(2) some outliers excluded from range

Costs

- At the point of production, hydrogen from electrolysis will in most cases remain more expensive than hydrogen from large SMR plants, even accounting for expected electrolyser technology and cost improvements between now and 2030 (electrolysis: 2.3–5.0 €/kgH2 in 2030, SMR 2.2–2.5 €/kgH2 in 2030).
- This is primarily due to the high cost of electricity relative to natural gas, as electricity accounts for 70–90% of the cost of a kilogram of hydrogen produced through electrolysis. The most competitive markets for hydrogen from water electrolysis will be characterised by low effective electricity prices available to electrolyser operators, through a combination of low wholesale electricity costs and low network charges and taxes.

Future Outlook

According to IEA *Energy Technology Perspectives* (*ETP*) 2°C Scenario (2DS).

- The hydrogen generation pathways shown in Figure 55 are defined to meet the 2DS emission target at lowest cost and include carbon prices for emissions occurring during the fuel production process, which gradually increase up to USD 150 per tonne of CO_2 by 2050.
- During the early years, most of the hydrogen is supplied using natural gas SMR without CCS. After 2030, no new SMR capacity without CCS is added, since SMR with CCS*** is becoming cost competitive due to CO_2 prices of around USD 90 per tonne.
- Hydrogen from renewable electricity is only cost effective if low-cost, surplus electricity is used.
- Grid electricity at future retail prices (2050) of USD 115 (United States) to USD 137 (EU 4) per MWh is assumed to be cost-prohibitive, even if T&D costs are zero.
- It is estimated that low-cost, surplus renewable power would be sufficient to supply between 12% (Japan) and 30% (EU 4) of the hydrogen used in transport by 2050[381].
- Hydrogen demand from the transport sector accounts for between **1% (EU 4** and Japan) and 3% (United States) of total final energy demand and

[381] It is assumed that around 3% to 7% of annual renewable power generation is available at prices of around USD 20 to USD 30 per MWh for 1 370 to 2 140 hours of the year, depending on the region.

between 4% (Japan) and 10% (United States) of total electricity demand in 2050.

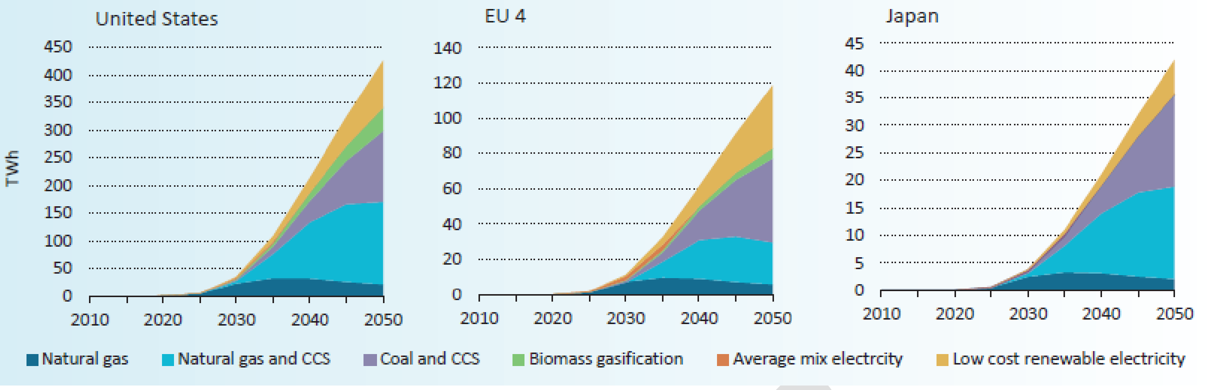


Figure 55 Hydrogen generation by technology for the 2DS high H2 in the United States, EU 4 and Japan (OECD/IEA, 2014)

ANNEX I. The US experience with the RFS2 [382]

In the US, the renewable fuel standards (RFS) has been supporting the consumption of biofuels by mandating the volume of biofuels that must be blended into transport fuels each year from 2006 through 2022. On a federal level the Environmental Protection Agency (EPA), Department of Energy (DOE), and Department of Agriculture (USDA) have offered distinct strategies and projections for meeting the feedstock demands of the RFS (Keeler et al., 2013). The RFS2 includes 4 sub-mandates that are defined by feedstock and life cycle GHG savings compared with petroleum:

- Renewable fuels (at least 20% GHG savings)
- Advanced fuels (at least 50% GHG savings)
- Biomass-based diesel (at least 50% GHG savings)
- Cellulosic biofuel (at least 60% GHG savings)

Volumes of these categories are mandated to increase over time to 2022, when the RFS targets 36 billion gallons of biofuels to be blended into transportation fuels. In its implementation of the RFS2 the EPA translates the mandated volumetric targets for 2022 into annual proportional targets, renewable fuel volume obligations (RVO). Domestic refineries and fuel importers are required to retire renewable identification numbers (RINs) in compliance with the RVO of their production level. RINs are assigned to each batch of biofuels and are only separated for trade once the final fuel product has been mixed. An advantage of the EPA's use of RINs is that they are tradable up to 80% of each firm's RVOs[383].

The Clean Air Act provides EPA authority to adjust cellulosic, advanced and total volumes set by Congress as part of the annual rule process. The statute also contains a general waiver authority that allows the Administrator to waive the RFS volumes, in whole or in part, based on a determination that implementation of the program is causing severe economic or environmental harm, or based on inadequate domestic supply (EPA, 2016).

Determining an Individual Company's Obligation

The RFS mandates (by biofuel category) are enforced on retail fuel blenders and exporters (not on biofuels producers or importers). Companies that supply gasoline or diesel transportation fuel for the retail market are obligated to include a quantity of biofuels equal to a percentage of their total annual fuel sales—the RVO. The RVO is obtained by applying the EPA-announced standards for each of the four biofuel categories to the firm's annual fuel sales to compute the mandated biofuels volume. At the end of the year, each supplier must have enough RINs to show that it has met its share of each of the four mandated standards. Failure to acquire sufficient RINs to meet a party's RVO subject to civil

[382] Schnepf & Yacobucci, 2013:Renewable fuel Standards (RFS) Overview and Issues. Congressional Research Service. 2013.

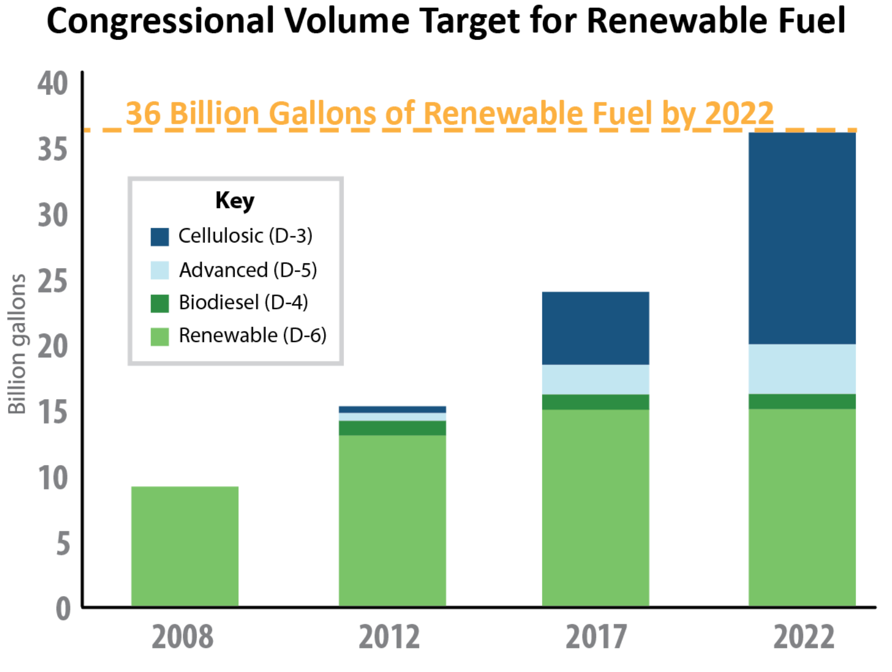
[383] http://buuea.com/assessment-of-the-renewable-fuel-standards/

penalties of up to $32,500 per day, plus the amount of any economic benefit or savings resulting from the violation.

The equivalence value (EV) of a renewable fuel represents the number of gallons that can be claimed for compliance purposes for every physical gallon of renewable fuel. Under RFS1, the EV was based on the energy content of each renewable fuel relative to ethanol. As a result, the EV for:

Table 119 The equivalence value (EV) of renewable fuels

Biofuel type	EV
Ethanol	1
Biodiesel (mono-alkyl ester)	1.5
Non-ester renewable diesel	1.7
Butanol	1.3
Cellulosic biofuel	2.5-1

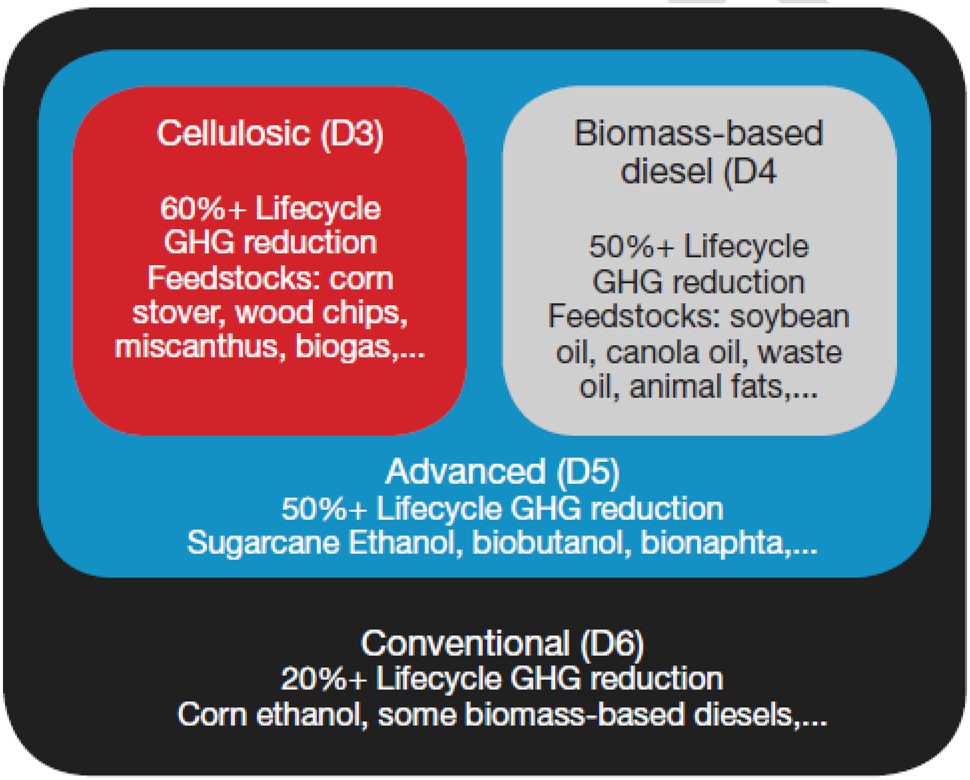


Introduction to RINS

- RINs are generated when a producer makes a gallon of renewable fuel
- At the end of the compliance year, obligated parties use RINs to demonstrate compliance
- RINs can be traded between parties
- Obligated parties can buy gallons of renewable fuel with RINs attached. They can also buy RINs on the market

- Obligated parties can carry over unused RINs between compliance years. They may carry a compliance deficit into the next year. This deficit must be made up the following year.
- The RFS program's four renewable fuel standards are **nested within each other**. In other words, the fuel with a higher GHG reduction threshold can be used to meet the standards for a lower GHG reduction threshold. For example, fuels or RINs for advanced biofuel (i.e., cellulosic, biodiesel or sugarcane ethanol) can be used to meet the total renewable fuel standards (i.e., corn ethanol).

For cellulosic standards, an additional flexibility is provided. Cellulosic waiver credits (CWC) are offered by EPA at a price determined by formula in the statute. Obligated parties have the option of purchasing CWCs plus an advanced RIN in lieu of blending cellulosic biofuel or obtaining a cellulosic RIN.



Source: ERA

Waivers to Annual Biofuel Standards

EPA Administrator has the authority to waive the RFS requirements, in whole or in part, if, in her determination, there is **inadequate domestic supply to meet the mandate, or if "implementation of the requirement would severely harm the economy or environment of a State, a region, or the United State**s."26 Further, under certain conditions, the EPA administrator may waive (in whole or in part) the specific carve-outs for cellulosic biofuel and biomass-based diesel fuel.

For example, in each of the years 2010 through 2013 EPA has waived or proposed waiving most of the original RFS mandates for cellulosic biofuels, as follows:

- In February 2010, EPA lowered the 2010 RFS for cellulosic biofuels to 6.5 million gallons (mgals), on an ethanol-equivalent basis, down from its original 100 mgals scheduled by EISA.
- In November 2010, EPA lowered the 2011 RFS for cellulosic biofuels to 6 mgals (ethanol equivalent), down from its original 250 mgals
- In December 2011, EPA lowered the 2012 RFS for cellulosic biofuels to 8.65 mgals (ethanol equivalent), down from its original 500 mgals.
- In January 2013, EPA proposed to lower the 2013 RFS for cellulosic biofuels to 14 mgals (ethanol equivalent), down from its original 1billion gallons

Unachieved Cellulosic Biofuels Mandates

After three successive years (2010-2012) where, first, EPA lowered the cellulosic biofuels mandate and, then, cellulosic biofuels production failed to achieve the lowered mandates, the American Petroleum Institute (API), in 2012, challenged the obligation under the RFS to use cellulosic biofuels that do not exist in sufficient amounts in commercial markets or pay a fee. API petitioned the U.S. Court of Appeals, D.C., charging that EPA exceeded its authority by setting unachievable standards in an effort to promote cellulosic biofuel development. On January 25,2013, the appeals court agreed with API's charge, ruling that the EPA's cellulosic biofuels mandate for 2012 was vacated and that EPA must replace it with a revised mandate. On February 27, 2013, EPA announced that it the 2012 cellulosic biofuel standard was vacated (dropped to zero)[384]. Then, on March 13, 2013, EPA also announced that it was voluntarily, retroactively lowering the 2011 RFS to zero[385].

Flexibility in Administering the RIN Requirements

RINs can be carried to satisfy the following year's RVO but can be valuable for any other years. A company can meet up to 20% of the current year's RVO may by RINs from the previous calendar year. RINs can also be used for credit trading, through selling the extra RINs to another supplier (who has failed to meet its mandate for that same biofuel standard).

Because four separate biofuel mandates must be met, the RIN value may vary across the individual biofuel categories. Since the RFS biofuels categories are nested, the price of RINs for specific sub-mandates (e.g., cellulosic biofuels or biodiesel) must be equal to or greater than the price of RINs for advanced biofuels which, in turn is equal to or greater than the RIN value for total renewable biofuels. Thus, RIN values may vary across RFS categories as well as geographically with variations in specific biofuels supply and demand conditions.

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[384] EPA, "Update—2012 Cellulosic Biofuel Standard Mandate Issued," *EnviroFlash,* mailto:enviroflash@epa.govFebruary 27, 2013. As part of the news release, EPA announced that since the 2012 mandate was zero, no compliance was necessary and any parties who had already submitted payment for 2012 cellulosic biofuel waiver credits would be issued refunds

[385] Amanda Peterka, "EPA to File Motion Taking Back 2011 Cellulosic Decision," *Greenwire*, E&E Publishing, LLC,March 13, 2013.

ANNEX J. Systems to trace the sustainability of biofuels

Introduction

This memo focuses on the systems to trace the sustainability of biofuels, and provides a brief overview/review of the German Nabisy scheme as well as similar schemes in (Austria, the United Kingdom and Ireland) (Section 2). Based on the existing web-paged central applications, we discuss in section 3 the potential implementation of similar systems in other EU Member States, including their benefits and the possible issues that may arise associated with all MSs developing similar systems, such as

- issues related to cross border trade in fuels and the exchange of data
- registration of the same fuel in different national databases
- possible frauds related to double counting biofuels, particularly UCO

Section 4 will elaborate briefly on the merits of a supplementary "book and claim" system (such as the one used for RES-E guarantees of origin) for tracing fuels from suppliers to consumers, as compared to the "mass balance" approach inherent in the current sustainability requirements.

Overview of the web-based verification systems

Table 120 introduces the current status of Member States (MS) that have web-based central verifications systems in place or that have intentions to develop one. Further details of the verification systems are elaborated in the following sub-sections, to the extent possible, in regards to

- Which operators are covered
- How the double counting biofuels is addressed
- Linkage to other national certification systems, and
- The implementation of cross border trade in the databases

Table 120 Overview of the existing central databases or plans of the MSs

Country	Name of the system	Status
Austria	**elNa** – National Monitoring System for Sustainable Biofuels	• In operation since 2013. • Obligatory to all suppliers that own an Austrian tax number.
Belgium and Luxemburg		• The two countries initiated cooperation on a database two years ago that enables biofuel trade between the two countries.
France		• There is no web application system in France helping to prove the sustainability of biofuels and bioliquids.

Germany	**NABISY** – Sustainable biomass system in Germany	• In operation since October 2010. • Obligatory for all consignments of biofuel and bioliquids distributed in Germany (if subject to apply for any kind of incentives)
Hungary		• There is the Hungarian Sustainability System (= Bioüzemanyag Üvegházhatású Gázkibocsátási Nyilvántartó rendszer (BÜHG)), but it is not yet electronic. • Since 2012 there has been the plan to install an electronic system and to develop a web-application called "**BIO-Program**". No information found regarding implementation.
Ireland		• There is NORA (National Oil Reserves Agency) that administers the Biofuels Obligations Scheme (BOS). • There is an online account where biofuel suppliers can enter their produced quantities and the agency from its part controls the sustainability criteria of each respective biofuels quantity. • Apart from the issues of an annual report, NORA issues an sustainability statement where all quantities of biofuels are thoroughly presented.
The Netherlands	**REV** –The Energy for Transport Registry	• A central registry was established in January 2015. • All suppliers with an obligation (around 60 companies) must be in the registry.
The United Kingdom	ROS – Renewable Fuels Agency -RFA Operating System	• Fuel suppliers with an obligation under the RTFO have a duty to apply for an account with the Administrator. • Any companies wishing to act as 'traders' in RTFCs must also open an account

NABISY

Nabisy is a governmental web application for sustainable biomass (Nachhaltige Biomasse System, Nabisy), operated by the Federal Office for Agriculture and Food (BLE). It serves to prove the sustainability of bioliquids and/or liquid or gaseous fuels from biomass, pursuant to EU Directive 2009/28/EC.

There is direct access to the web application Nabisy by :

- the German main customs offices, (tax relief)
- the biofuel quota body, (GHG savings obligation)
- the German Emissions Trading Authority, (ETS)
- network operators, (Renewable electricity remuneration for the supply of electricity from liquid biomass
- competent authorities of other member states of the European Union/EFTA.

NABISY facilitates the application of "mass balancing" principles. This ensures that the quantity of sustainable biomass extracted from a mixture (of biomass from various sources) does not exceed the amount of sustainable biomass that has previously been added to the mixture. The type, quantity and other important attributes of sustainable biomass are regularly documented in the mass balance system.

Which operators are covered in the system?

- Only economic operators down-stream of the final interface are involved in the Nabisy application. Final interface is defined as the point where the biofuel is produced.
- Thus, biofuel producers and suppliers are obliged to register to the Nabisy if the distributor apply for quota obligation.

Biofuel producers:

- Only biofuel producers that are participating in an EU recognised certification system or voluntary scheme[386] can register with Nabisy (producers will need to fill in the form and submit it to the certification body of the system they are participating in, the certification body will then transfer all the required info to BLE). After that the economic operator will receive the access information to Nabisy.
- Producers are obliged to enter sustainability data for their deliveries of biofuels and/or liquid or gaseous biofuels into this database **(all proofs of sustainability** with regards to type of fuel, amount, energy content, raw materials used and their origin, GHG emissions and how calculated (use of standard value, disaggregated standard values for transport, cultivation, conversion, exactly measured data or a mixture; info about use of savings from soil carbon accumulation, or of bonus in cases where biomass is obtained from restored degraded land has been made), if those data could become relevant to German market).
- **All info entered by the producer cannot be changed any more in the system by other users in the down-stream part of the supply chain, except the quantity (combining or split of proofs, switching from metric tons to cubic meters and the other way round).**

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[386] If the producer is subject to German customs supervision within the framework of § 17 Abs. 3 Nr. 2 Biokraft-NachV they may apply directly to the BLE for access to Nabisy. This is to avoid double control, i.e. by the certification system and by the customs authority. "Inverkehrbringer" (= distributors) are regularly controlled by the customs authority and do not need to be participant to a certification system. So they apply for a Nabisy account directly to BLE. Then BLE will ask the relevant customs office to confirm the accuracy of the information in the application, before the applicant will receive the Login and passwords.

Biofuel suppliers:

- Within the Nabisy system they can apply for
    - division: A proof of sustainability or a partial proof of sustainability is divided between several recipients.
    - combination: An operator has several proofs of sustainability or partial proofs of sustainability and would like to combine the respective quantities in one partial proof of sustainability.
    - transfer: The total quantity of a proof of sustainability or a partial proof of sustainability is sold unchanged.
- They have to present proofs of sustainability or partial proofs of sustainability to the **customs authority** for counting biofuels towards the biofuel quota obligation of the distributor.
- If a down-stream part of the supply chain, e.g. a supplier, decides that biofuels are to be used outside Germany, they have to retire the respective proof of sustainability to the retirement account of the MS in which the final use takes place.

The customs office:

- The customs office issues a note of consumption in the dataset of each proof of sustainability in Nabisy which is subject to an application for tax relief or counting towards the obligation (**avoiding of double use** of proofs of sustainability).

How is the double counting biofuels included in the system?

- It was possible to issue a proof of sustainability in combination with an additional proof of double counting. The proof of double counting was created by Nabisy automatically when all requirements are met.
- It was required that the entire chain of custody for waste and residues must be certified against a certification system which was recognized as suitable in the scope of more strict requirements according to 36. Ordinance (36. BImSchV) in order to be used for double counting, if the waste/residues or the final product which is made of waste/residues is sold in Germany.
- The EC has not established control mechanisms for the origin of waste and residual materials and it was not included in the EC recognised voluntary sustainability schemes to that time. German legislation did include these control mechanisms and after ISCC-DE and REDcert DE schemes had implemented this in their systems, they were recognized as suitable for this scope by BLE.[387]

- **After the change to the GHG saving obligation double counting in Germany is no longer possible.** This also means that the more stringent control system for waste and residues is no longer required.

- To the extent that voluntary systems have implemented requirements for the treatment of waste and residues, their participants can also provide proofs of

[387] Source: interview Karl-Heinz Schnau, BLE, 4 April 2014.

sustainability in Nabisy for biofuels made from these materials for the German market.

What other national certification systems of other MS are included in Nabisy?

- In 2014, data of the national certification systems of **Hungary, Slovenia, Slovakia and Austria** were available in Nabisy.
- Operations based in the territory of Austria are obliged to enter their sustainability data into the **Austrian database elNa** (Evaluation and Progress Report, 2014).

How is cross-border trade of biofuels entered into Nabisy?

Biofuels which have been marketed in Germany can only be attributed to the GHG savings obligation if the associated proof of sustainability is registered in Nabisy. (§ 37 a Absatz 4 Satz 7 Nr. 1 BImSchG iVm § 14 Biokraft-NachV [Federal Immission Control Act (BImSchG) in conjunction with the Biofuels Sustainability Ordinance Biokraft-NachV]). This is also the case for cross-border trade of biofuels. For instance, the biofuel can be produced in a third country, received proof of sustainability certification and traded in the EU and finally brought into the German market. Unless the producer in the third country is registered in Nabisy this consignment of biofuel will not be counted to the German quota regardless of the documentation related to proof of sustainability.

Initial proofs of sustainability can be issued in Nabisy exclusively by biofuel producers (last interface = conversion unit which is processing the bio(mass)fuel to the quality level of its final consumption).

This can be done online either by editing the information about sustainability one by one, or by uploading a csv file containing one or more datasets about the information of biofuel deliveries.

In order to be registered to the Nabisy web application economic operators need to be

1. participant of a recognized certification system and
2. under control of an independent third party (certification body).

In 2015, 16 943 proofs of sustainability were registered in Nabisy, issued by 275 last interfaces from all over the world. (151 located in Germany, 93 in other MS, 31 in third countries).

The sustainable liquid or gaseous biomass may be destined for another MS. In cases where the buyer of a volume is not located in Germany and doesn't have a supplier account in Nabisy the seller is obliged to transfer the proofs of sustainability to the Discharge account of the MS of the buyer's location. The buyer himself will receive this proof of sustainability in paperwork. MS authorities may have access to their discharge account and do have the opportunity to verify the paperwork in Nabisy. The control of the economic operators' mass balance-system is duty of the Certifying Body's in the frame of their annual certification audit.

Biofuels which are registered in the Nabisy database and are exported to other countries need to be retired to the account of the respective country by the economic operators.

eINa

The purpose of elNa is to collect data for the Austrian government on all sustainable biofuel movements within Austria. elNa also provides the basis for a variety of reporting obligations that Austria has to fulfil for the EC. Furthermore the mass balance of the distribution chain is ensured.

While companies (producers) may choose from different certification systems, such as the Environment Agency Austria as national subsystem, together with Agrarmarkt Austria (AMA) or one of the voluntary certification systems such as ISCC, RED Cert etc., participation in elNa is mandatory for all companies in Austria with an Austrian tax number.

Thus, in brief eINA was established for:

- Verification of data (within the system & auditing)
- Collection of data to fulfil reporting obligations (national & EU)
- Providing reliable information for tax exemptions

In accordance with Austrian legislation, AMA is the competent certification authority for companies in the first section of the chain, from the growing of agricultural raw materials to the processing of goods into semi-finished or interim products. The Environment Agency Austria is responsible for the later stages from biofuel production to the marketing of biofuels (see Figure 56) . The Fuel Ordinance gives biofuel producers also the choice of opting for other, voluntary certification systems (e.g. ISCC or RED Cert.) to obtain proof of sustainability.

Regardless of the certification system that biofuel producers use for certification, companies have to enter specific data into the web application elNa. From these data, the system generates sustainability certificates which are linked to the sustainable biofuels. Selling sustainable biofuels always entails a transaction of the corresponding certificate from seller to buyer. This is why biofuel traders and storage operators have to use the elNa system as well.

Companies for whom substitution is mandatory may put on the market any biofuel quantities in their possession through the elNa web application, provided they pay tax on these quantities (Environment agency Austria, 2016)[388].

[388] Last excess on 08.11.2016, http://www.umweltbundesamt.at/en/services/services_climate/services_climate_references/en_elna/en_elna_monitoring/

Figure 56 eINa coverage in the whole supply chain of biofuels

The functions of the web application elNa in detail include:

- registration
- generation of sustainability certificates
- dividing sustainability certificates into partial certificates of sustainability
- passing on certificates and partial certificates
- importing a sustainability certificate into the system (translating a sustainability certificate from another system = import).
- "marketing" of sustainability certificates,
- evaluating the following data (or potential data exports):
  + list of owned certificates (active certificates),
  + certificates that have been passed on (inactive sustainability certificates) and
  + certificates that have been placed on the market (inactive sustainability certificates),
- automatic quarterly notification,
- automatic generation of sustainability certificates via csv import function.

Which operators are covered in this system?

The following economic operators that have an Austrian tax number have to register with the Environment Agency Austria:

- producers of sustainable biofuels
- (energy) traders of sustainable biofuels,
- storage operators and
- marketers of biofuels for whom the achievement of substitution targets is mandatory.

The operators have to undergo a simplified registration procedure with the Environment Agency Austria in case they are certified with another system. Biofuel producers may also choose to have the sustainability of their products certified by the national sustainability system. In this case full registration will be necessary. At present all operators in Austria undergo a simplified registration procedure which requires them to provide documentation related to the type and amount of biofuels and all relevant voluntary certification documents to receive a login name and password to the system.

In contrast to the NABISY, the registry is obligatory to operators that are located in Austria and not to, for instance, biofuel producers in other countries. The registration can be done directly by the economic operators in Austria (no need for the certification body to register them as it is the case for NABISY).

How is the double counting biofuels included in the system?

Under the national certification scheme the Austrian Environment Agency provides companies with the possibility to use a national scheme. This is a voluntary service – companies have a free choice to use other voluntary certification systems although for the special aspects of the "double counting" issues, companies are obliged to use the national system.

At present there are no double counting biofuels in the Austrian market, however, if they arrive to the market they will require sustainability certification only from ISCC **DE**[389].

What other national certification systems of other MS are included in eINa?

eINa accepts national schemes through bilateral agreements from Germany and Slovakia.

How is cross-border trade of biofuels entered into eINa?

Each movement of a biofuel produced, traded or marketed within Austria**, as well as imported to or exported from Austria,** needs to be represented in the system.

- Operators with a substitution obligation in Austria are obliged to register the biofuel consignments they bring to the Austrian market. They will have to provide all the sustainability certification documents (according to mass balance) to the database.
- If the biofuel is destined to other MS the data related to the biofuel amount and the proof of sustainability will be deactivated in the system so that they are not used for the Austrian target. If the country, where biofuel is traded, doesn't accept eINa papers, the operators will have to use the proof of sustainability of a voluntary scheme in additional.

REV

The Energy for Transport Registry (REV) is an online system where Renewable Energy Units (HBEs) are created and traded by participants in the Renewable Energy for Transport (HEV) scheme. The system is comparable to Internet banking. The Dutch Emissions Authority (NEa) is legally obliged to publish reports

[389] Communication with Thomas Eckl from U,weltbundesamt,2016.

of the data in the Registry. One such report is the HBE (Renewable Energy Units) Report, which offers periodic information (5 times per year) to support the market regarding the total HBEs saved or credited to all accounts in the relevant calendar year (or part thereof).

Who are covered?

There are mandatory and voluntary participants that fall under Renewable Energy for Transport (HEV) laws and regulations these are:

- Companies with an annual obligation under HEV that must be fulfilled via the Registry;
- Companies that participate in order to claim delivery of renewable energy (claiming operators); and
- Companies who have no annual obligation and are not claiming operators, but conduct voluntary trade in Renewable Energy Units (HBEs).

Companies claiming delivery of liquid biofuels or gaseous biofuels in the Registry must demonstrate that the fuels satisfy the sustainability requirements.

Cross border trade

- The registry system in the Netherlands focuses only on the supply side to the market (not the production). Thus, it is directly linked to documenting the fulfilment of the Dutch obligation under RED.
- There are huge volumes of trade/transaction of biofuels taking place at Rotterdam harbour and a lot is not brought into the Dutch market but exported further. The registry ignores these, due to the difficulties of incorporating these administratively, and focuses only on the fuel that is used in Netherlands internally, directly linked to the Dutch obligation under RED.
- At present there are no links to other MS registries, however, there is an exchange of information between regulators on relevant information pertaining to sustainability issues.

ROS

In the UK, the Administrator uses an online database called the RTFO Operating System (ROS) for recording volumes of fuel supplied, information on the sustainability of those fuels, calculating a company's obligation and issuing RTFCs. The system also enables suppliers to transfer RTFCs to each other and to redeem them to meet their obligation, and to surrender RTFC's to gain a portion of the buy-out fund[390].

Thus, suppliers of biofuels in the UK wishing to claim RTFCs must report to the Renewable fuel agency (RFA) through the online 'RFA Operating System (ROS)' the volume of biofuel they supply, and its carbon and sustainability characteristics. The RFA ensures that the data is verifiable and robust, and has a continual program of testing and reviewing its systems to ensure that they are resilient to the possibility of fraud.

[390] https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/301072/part-1-process-guidance-yr7.pdf

Which operators are covered in the system?

Fuel suppliers:
Those with an obligation under the RTFO have a duty to apply for an account with the Administrator. Fuel suppliers that do not have an obligation but that wish to apply for RTFCs, must also apply for an account. Suppliers will be required to declare that a claim has not, and will not, be made under other renewable energy support schemes for the fuel upon which they are claiming RTFCs.

Traders:
Any companies wishing to act as 'traders' in RTFCs (i.e. those who wish to own the RTFCs for onwards sale), must also open an account with the Administrator in order to be able to access ROS. Companies that wish to facilitate RTFC trade, but who do not wish to own the RTFCs at any point, do not need to open an account.

How is the double counting biofuels included in the system?

Traceability of wastes and residues are left to voluntary schemes, indicating however, that traceability of wastes and residues needs to cover the whole chain of custody, going back to the origin of the material, i.e. where the waste or residue material arises.

What other national certification systems of other MS are included in ROS?

RTFO Administrator has developed a process to confirm whether a particular Member States' systems are relevant to exported fuels and, if so, what documentation the Member State issues as evidence of compliance. Consignments of biofuel verified as sustainable by other Member States are treated in the same way as consignments of fuel supplied through voluntary schemes that have been recognised by the European Commission.

Other existing systems

There are currently other databases/systems developed by third parties to verify the origin of biofuels to be considered as advanced biofuels, such as the trace your claim (TYC) database and the Register of Biofuels Origination (RBO) consortium. Both tools aim to address any possible fraud and fragmented requirements of MS.

While both efforts seem very useful they have a voluntary nature and their success will depend on the economic operators willingness to participate to these system.

Some MS, i.e. Austria, Germany, the United Kingdom, the Netherlands, have already set obligatory databases to economic operators and other MS are planning to set up such systems. The likelihood of economic operators registering to such databases, next to the obligatory national databases, seem less likely. Next to that these databases will charge each registry to make it a business case, which in return may further reduce the operators willingness to register and share their data.

Prospects for implementing similar databases in all MS

MS developing central databases can ease the administrative efforts to trace the sustainability of biofuels and prepare the obligatory reports for the Commission. At the same time there may be some issues emerging. Below we address some of the possible issues.

i. **Same consignment being registered in more than one MS**: Suppliers may consider registering the same consignment in a number of MS with the same sustainability certification document. For instance in Germany biofuel producers will have to register into NABISY through the (voluntary) certification body they are covered by. In Austria, however, biofuel suppliers can simply upload the sustainability certification into eINa. In a system, where all of the MS have comparable databases there are two possible solutions for such risk of multiple registries of sustainability claims and/or accounting the same consignment against obligations in several MS:
   - All databases set a control system, in which the claims are cross-checked by the certifying body. In case they see a sustainability claim is registered to more than one databases they inform the relevant administrations of the MS.
   - All databases are periodically controlled by a competent authority to detect and avoid such fraud.
   - All databases are harmonized and have an interface that can communicate among each other. In case of double registry the software immediately recognizes this and informs the administrators. This option can detect any fraud not only related to registry of the same sustainability claim in several databases but also registry of the same consignment that may have received two different sustainability claims (i.e. through a simplified cross checks of the biofuel type, production date, amount ,the place and the name of production etc.) .

ii. **Fraud related to double counting biofuels, particularly UFO**: Voluntary schemes have had shortcomings related to the sustainability certification of biofuels from wastes and residue materials. The detected risks of fraud related to waste and residues are (European Court of Audit, 2016):
   - the operator could classify as waste or residues something that it is not (or was adulterated). The financial incentives can result in swapping the classification of non-renewable and/or single-counting raw materials to double-counting raw materials.; or
   - the operator may attempt to get the same double counted product certified twice, by different voluntary schemes.

As a response, in October 2014, the Commission acknowledged that voluntary schemes were not providing sufficient evidence of the origin of waste (e.g. restaurants in the case of UCO). A guidance note has been addressed to all recognised schemes that suggested they develop specific auditing procedures covering the origin of waste and residues, 'i.e. the economic operator where the waste or residue material arises'[391].

Some recommendations to reduce susceptibility to fraud is summarised below (NEa, 2016).

[391] See https://ec.europa.eu/energy/sites/ener/files/documents/2014_letter_wastes_residues.pdf

- Limiting the incentives that make flows susceptible to fraud or revoking the current double- counting scheme for fuels and replacing it with a regulation that eliminates or diminishes the incentives for the flows most susceptible to fraud (UCO and blended fats) can avoid such risks.
- Strengthening the cooperation within national authorities and between government enforcement and private controls can help avoiding such risks and central (web-based) registries can play an important role.
- Increasing the accountability of companies claiming delivery of double-counting fuels by introducing 'supply chain liability' for these companies can also help reducing such risks.

iii. **Cross border trade:** Most Member States' national systems, like the RTFO, operate at the duty point i.e. obligations take effect when fuel passes the duty point. This means that fuel assessed as being compliant with the RED under their national system will not be used in other Member States. However, some Member States have national systems that operate in a similar way to voluntary schemes and checks are carried out that biofuel is RED-compliant prior to the duty point. In this scenario it is feasible the biofuel could then be imported or exported.

Comparison of "book and claim" system for tracing fuels from suppliers to consumers, to the "mass balance" approach

This section compares the two options and presents recommendations in the context of an EU-wide quota obligation for fuel suppliers in the EU.

Economic operators are required to use a mass balance chain of custody according to the RED, Article 18(1) and the Member States and the certification schemes have established the mass balance systems, accordingly.

Nevertheless, there are examples of end users that apply book and claim in one way or another, such as:

- RINs in the US,
- Some of the Voluntary Schemes also apply book and claim outside the EU (The Roundtable on Sustainable Palm Oil (RSPO), The Round Table on Responsible Soy (RTRS), Bonsucro)
- The Dutch bioticket system

- The Renewable Fuel Standard (RFS2) allows a mass balance approach to be taken within the US, and requires a physical segregation approach for fuels produced outside the US . RINs are already generated by the producer or importer. From that point, fuel can be blended and RIN trade is decoupled from the physical fuel.

- Several of the voluntary schemes recognized by the European Commission have also developed book and claim systems that can be used by non-EU biofuel participants (Ecofys, .

    - The Roundtable on Sustainable Palm Oil (RSPO) was the first to offer participants the option to use a book and claim approach.

- The Round Table on Responsible Soy (RTRS) and Bonsucro (focusing on sugar cane) have both launched book and claim systems more recently.

- Biotickets in the Netherlands : Obligated registered parties in the Netherlands may also meet their target through purchasing biotickets. Comparable to the guarantees of origin for renewable energy, biotickets are contracts between market parties regarding the purchase and sale of biofuel rights, and are not attached to the physical biofuel consignments[392]. Any excess of the target may be sold as biotickets to obligated registered parties.

Table 121 compares book and claim and the mass balance approaches according to their advantages and disadvantages. Since the mass balance approach has been implemented in the voluntary schemes and in all MS their continuation would be a logical choice beyond 2020.

- ➢ a similar approach to the US RFS2 can be followed– the mass balance approach can cover the supply chain up to the production of biofuel (if it's within the EU) or to the import point (if imported from outside the EU) . From these points onward a book and claim approach can be preferred that enables certificate trading. The biofuel producers or importers can register their biofuel consignments to the central database in their territory and receive a proof of sustainability certificate that is tradable. The certificate trading can be left to the MSs preferences. In case a number of MSs opt for certificate trading among each other they will have to accept the certificates of the other MSs and possibly connect the databases to ease certificate trading and data exchange.

Table 121 Comparison of book and claim and mass balance approaches (modified from Ecofys, 2014)

	Advantages	**Disadvantages**
Book and claim	• Maximum flexibility to claim the benefits in an EU-wide quota obligation • Any financial incentive for supplying biofuel or for being certified can go more directly to the party producing the tradable units and is not spread through all parties in the supply chain	• Not permitted in EU RED • Question on public perception • Not all supply chain parties need necessarily be involved, so claim could be made about certified products while maintaining some bad sustainability practices within the supply chain • No guarantee that products *physically* contain raw materials with the characteristics being claimed • Harder to calculate actual GHG savings if intermediate parties in supply chain are

[392] Suppliers of biogas or renewable electricity for transport may voluntary open an account at the NEA-register to profit from the sale of biotickets.

		not involved • Not an available chain of custody option for most biofuels voluntary schemes • **Requires a central database, registry or trading platform** to control all claims
Mass balance	• Inclusive approach as all supply chain parties are involved • Closer conceptual (physical) link between what is being claimed and what is physically supplied • Enables any required supply-chain specific data, such as GHG data, to be collected and passed along the chain • In line with existing rules in EU RED • Compatibility with most biofuel voluntary schemes	• No full assurance of origin • Many control points compared to book and claim • Still no guarantee that products *physically* contain raw materials with the characteristics being claimed

ANNEX K. Distance self-consumption scheme in the Netherlands

The distance self-consumption (Verlaagd Tarief bij collectieve opwek – reduced rate in collective generation) is based on the Energy Accord for Sustainable Growth (Energieakkoord voor duurzame groei):
http://www.energieakkoordser.nl/energieakkoord.aspx

- P.19

English Version: http://www.energieakkoordser.nl/doen/engels.aspx

The exact arrangements of the scheme are regulated in:

1. the Environmental Tax Law (Wet belastingen op milieugrondslag): http://wetten.overheid.nl/BWBR0007168/2016-05-01#HoofdstukVI
   - Articles 59a, 59b, 59c

2. the executive decision on the Environmental Tax Law (Uitvoeringsbesluit belastingen op milieugrondslag): http://wetten.overheid.nl/BWBR0007178/2016-01-01
   - Article 21b

3. the executive regulation on the Environmental Tax Law (Uitvoeringsregeling belastingen op milieugrondslag): http://wetten.overheid.nl/BWBR0007159/2016-01-01
   - Article 19b

Since 1 January 2014, private small producers organised in cooperatives or associations are eligible for the distance self-consumption scheme in form of a tax rebate (Verlaagd Tarief bij collectieve opwek - Postcoderoos). The term "Postcoderoos" originates from the Energy Accord for Sustainable Growth, which was agreed in 2013 between the Dutch government and different Dutch social actors.

Under the distance self-consumption scheme, members of cooperatives or associations of owners are incentivized for investments in renewable energies (wind, solar, geothermal wave and tidal hydropower, biomass, landfill, sewage and biogas) in the vicinity of their home location. The vicinity is defined by a post code model, the so called postcode rose (Postcoderoos), i.e. the installation, respectively the homes of the cooperative member or the association owners have to be located in the same postcode zone or in one of adjacent postcode zones. The installation is sold by the cooperative or association to the competent utility.

Between 1 January 2014 and 1 January 2016 the rebate on the energy tax amounted to 7.5 cents/kWh. Since 1 January 2016, the rebate has been further raised to now 9 cents/kWh. The rebate can be claimed on the self-consumed share of electricity of the cooperative or associations members up to a maximum of 10,000 kWh per year. The individual share of claimable kWh per member or owner is defined in relation to the individual share of this owner on the cooperative or association. The cooperative informs the utility of the share based on membership certificates. The utility then applies the reduced rate to the indicated share of the individual member/owner.

By 14 December 2015, the distance self-consumption scheme had limited success:

- 34 applications;
- 18 decisions;
- 13 rejections / withdrawals;
- 3 pending.

With the raised reduction rate raises the attractiveness of the scheme; resulting potentially in a higher application rate.

The Postcoderoos model generally allows investments into renewable energy installations by private individuals even if the installation itself is not located on the house or building of the individual. In addition, it also allows joint investments by cooperatives or associations. This approach broadens substantially the number of potential investors for renewable energies.

Yet, beside the positive factors, there are also a number of critical points for the scheme:

A first one addresses the general financial attractiveness of the scheme: stakeholders argue that the reduced rate applied until the end of 2015 (7,5 cents) was financially not going far enough to create sufficient incentive for private individuals to invest in such cooperatives or associations. The critics focuses equally on the level of compensations as well as on the return period, being currently 5 years.

A second point of criticism addresses the postcode model itself: critics argue that the model is too arbitral in its selection of addressees. Firstly, the model does not join people based on their common ideology, desire or ideal but based on the rose pattern, being an accidental connection between people within a geographical area. In addition, and especially for those renewable technologies of larger capacities such as wind, the locations of these installations exclude a large share of potential investors as they do not live in the areas around; the postcode model thus being a limiting factor. The last point however was addressed by the 2016 reform of the scheme; now, the installation has not to be located in the center of the postcode rose but can also be located in the peripheries ("the leaves") of the rose. It is to see which effect this further extension of the zones will have on the attractiveness of the scheme.

A third elements of criticism addresses the administrative and organizational burden for the cooperatives and associations under the "Postcoderoos" scheme. Energy utilities play a crucial role in the model as they will have to balance the generated power by the cooperative members against their individual consumption. In the most favorable scenario, cooperatives will only deal with one energy supplier; in practice however, there are often several utilities with whom the cooperative has to interact as members are nor all contracted to the same utility. In addition, utilities may introduce a fee for the balancing of generation against consumption and the related administrative and organizational burden. A further complicating element might arise if members of the cooperative or association move to a location outside the postcode zone.

Finally, it is to note that the Postcoderoos model cannot be combined with other national tax regulations relating to sustainable generation. In other words, there may not be used for the Energy Investment Allowance (EIA), Environmental Investment Allowance (MIA) or Promoting Sustainable Energy Production (SDE +).

ANNEX L. Multi-consumers self-consumption in Switzerland

The self-consumption regulation is defined in the Energy Law and the Energy Regulation:

Energy Law (Energiegesetz: https://www.admin.ch/opc/de/classified-compilation/19983485/index.html#fn-#a7-2):

- Chapter 2, Par. 7, § 2bis and Chapter 2, Par. 7a, § 4bis: Producers may entirely or partly consume the self-produced energy at the place of production. If a producer of this option is exercised, only the energy actually fed into the grid may be treated and charged as fed.

Energy Regulation (Energieverordnung: https://www.admin.ch/opc/de/classified-compilation/19983391/index.html):

- Chapter 2, Par. 2a: The grid operator is required to pay a producer's surplus production who consumes some of the energy he produced at the production site itself or provided to third parties.

The self-consumption regulation was debated in Parliament in 2013 and introduced into law in 2014 (for details, see Energy Law and Energy Regulation). Before that, self-consumption was an undefined grey area which has been interpreted differently by the utilities.

The fact that at first technical requirements were not initially considered caused confusion. In order to solve this problem, the Swiss Federal Office of Energy (SFOE) has published guidelines (SFOE, 2015), which however led to resistance in the electricity industry.

In Switzerland, there is no full electricity market liberalisation (at least for consumers of less than 100 MWh per year). That means, that the competent DSO is allowed to measure the power consumption of every end-user. If the billing of electricity in the case of multi-consumers self-consumption is conducted centrally at the house's connection point instead of individually for each apartment, the non-liberalised market is bypassed according to a statement of the utilities. This issue is currently the focus of the discussion in Switzerland.

The electricity industries reaction is the release of an own industry document including their ideas on how to conduct multi-consumers self-consumption (VSE, 2014). According to this document, every apartment should be equipped with two separate meters for measuring both the power received from the grid and the self-produced power. Due to the occurrence of high costs in this case resulting from high fees for the meters (the utilities have a monopoly for electricity meters), this case is not practicable in Switzerland.

In general, there are *three variants* for the conduction of self-consumption in multi-family houses.

1) Verband Schweizerischer Elektrizitätsunternehmen (VSE) suggestion: Every consumer is charged separately. In this case, each apartment would have two separate meters. One for the electricity received from the grid and another one for the self-produced electricity. The meter management in Switzerland is not liberalised, which has the consequence that the

monopoly lies at the utilities, who claim horrendous fees for the meters, especially for the load profile measurement (Lastgangmessung) (compulsory from 30 kW output). The yearly costs are in this case approx. CHF 1,000 (approx. EUR 903).

2) The Swiss Federal Office of Energy (SFOE) suggestion: Each self-consumption collective (Eigenverbrauchsgemeinschaft) makes its own billing and costs to an internal key (costs distributed independently from the utility). Hence, the utility receives only the electricity flows measured at the connection point of the apartment building. However, in this case various tenancy issues need to be considered, including for example the dealing with tenants who refuse to participate in the self-consumption collective. In a new building, new tenants may be required by the tenancy agreement to join the collective, while in an existing lease commitment this is not an option.
3) The utility is offering self-consumption as a service. For example, the utility purchases the electricity to a certain tariff from the self-consumption collective and resells it to the tenants at a rate that corresponds to what the utility has paid plus clearing allowance. However, in this case it remains to consider how the distribution of the solar energy is conducted. A complicated way would be the installation of an additional meter for the solar power supply in each apartment (high costs occurring). In the case of Elektrizitätswerk Zürich (ewz), the calculation is based on the energy reference area of each apartment. Since the tenants are aware of this issue, this approach is accepted by them.

Multi-consumers self-consumption is not yet widespread in Switzerland, as there are less than 100 examples known. However, a clear trend towards a future increase can be observed as the utilities begin to recognize that resistance against multi-consumers self-consumption does not make sense and cooperation must be sought. Regarding a full electricity market liberalisation taking place in the near future (probably 2020), a customer-friendly positioning is sought.

However an assessment on the future development of the conduction of multi-consumers self-consumption in Switzerland is difficult, it is estimated that option three (see above) will prevail[393].

According to the Managing Director of the Swiss Solar Association (Swissolar), the best way to increase the number of multi-consumers self-consumptions in Switzerland is that self-consumption collectives face utilities as a whole (Stickelberger, 2016). The settlement should be left entirely to the collectives (see option two). The problem in this case is that the utilities would not agree to this variant. The liberalisation of the electricity market would definitely simplify multi-consumers self-consumption. However, there are still many political obstacles,

[393] Example 1: Romande Energie: An agreement is made between the self-consumption collective and the utility for the sale of the total amount of self-produced electricity with a fixed remuneration rate of CHF 0.16 per kWh (approx. EUR 0.144 per kWh). The electricity is then subsequently resold to the tenants as a special solar power product.
Example 2: Elektrizitätswerk Zürich: The utilities account the self-consumption of PV installations directly with the tenants. The price of the self-produced electricity is fixed by the housing corporation (price is equal to the one paid for the electricity coming from the grid). Each tenant receives a certain proportion of solar power on his account based on the distribution key, which is calculated on the basis of the energy reference area of the respective apartment.

inter alia Switzerland’s relationship with the EU which leads to the fact that the liberalisation cannot be realised in the near future.

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