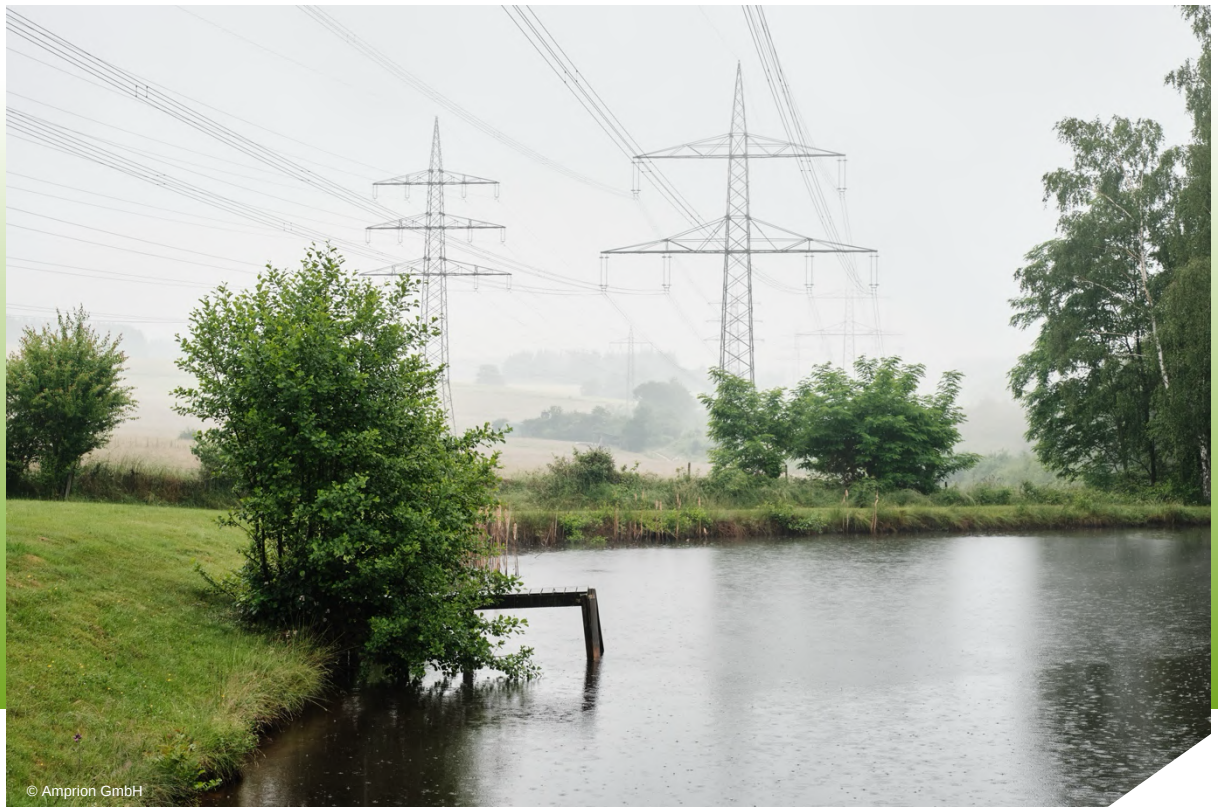


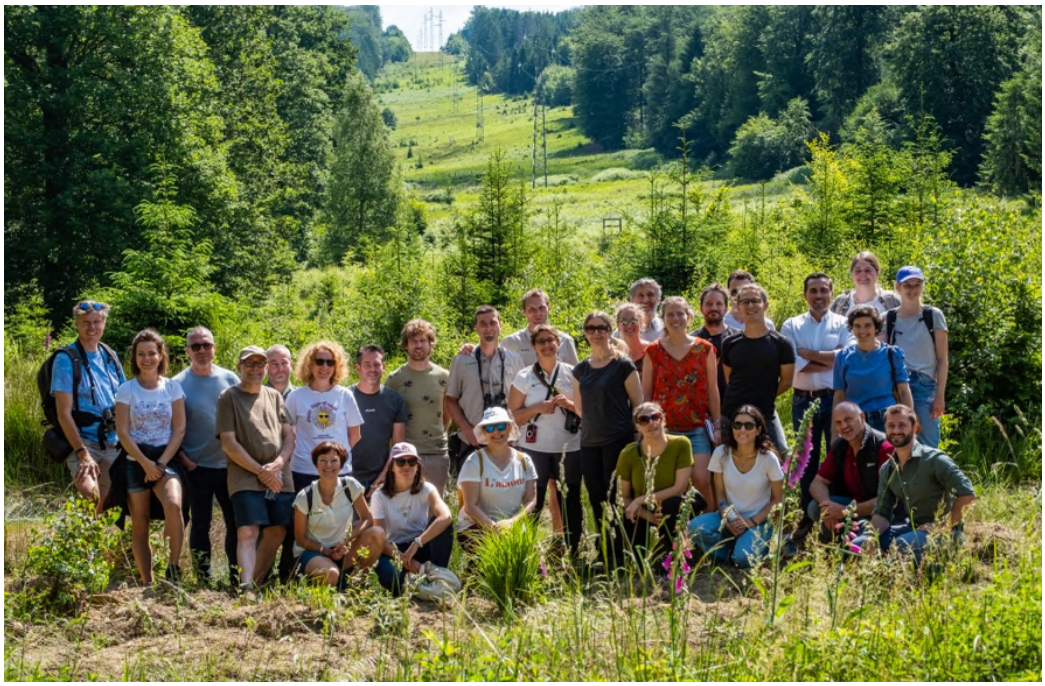
ENERGY & NATURE | *Best Practice Guide*

Integrated Vegetation Management
Best practices from across Europe

September 2024

Renewables Grid Initiative

Contents



IVM Working group in a Life Elia-RTE project green corridor, 2023.
Photo: © Elia Transmission Belgium

Executive Summary

As we strive to tackle the triple crisis of climate change, biodiversity loss and energy security, the most promising solutions are those which simultaneously integrate responses to all crises in one approach. Integrated Vegetation Management (IVM) in electricity grid corridors presents such an approach.

Historically, the prevailing logic of conventional vegetation management has been to eliminate risk of interference with power transmission through periodic, indiscriminate removal of all vegetation in a defined corridor around power lines, often at the expense of the environment and without the involvement of local stakeholders. In contrast, IVM takes a more holistic strategy by promoting the growth of low-impact vegetation ensures safe operation of energy infrastructure, while supporting habitats for biodiversity, connecting ecosystems at landscape scale, and creating socio-economic benefits for local stakeholders.

In our work as the Renewables Grid Initiative (RGI), we regularly encounter and promote practices by grid operators across Europe and beyond, which demonstrate the benefits of a more nuanced approach to managing the areas around power infrastructure. In recent years, we have recognised a marked increase in recognition of IVM's merits and, therewith, increasing interest in uptake. This has often been coupled with a desire on behalf of grid operators to learn about other practitioners. In response, we have intensified our work on IVM, including through public events, professional exchanges, working groups and best practice communication.

This document should be considered a Best Practice Guide to IVM implementation. It is based on our extensive discussions with grid operators and a questionnaire answered by 14 grid operators (both transmission system operators, TSOs and distribution system operators, DSOs) who engage in our ongoing IVM Working Group. The grid operators are from across the European continent, managing infrastructure from mediterranean ecosystems to boreal forests. While some grid operators are early in their IVM 'journey', others consider ecological corridor management as a standard or are in the process of rolling out IVM across their grid areas. Readers will find the cases organised alternatively in alphabetical and reverse-alphabetical order.

It is our hope that this report, with the success stories and challenges it includes, will provide inspiration and guidance for other grid operators who are considering implementing IVM in their grid area. If you would like to engage with RGI and other grid operators on this topic, we would be glad to hear from you. Please contact Liam Innis, Senior Manager – Energy Ecosystems at liam@renewables-grid.eu.[1]

[1] More resources on IVM, including a summary of our 2023 IVM Workshop and our 2019 collaborative Briefing Paper are available on our website here.

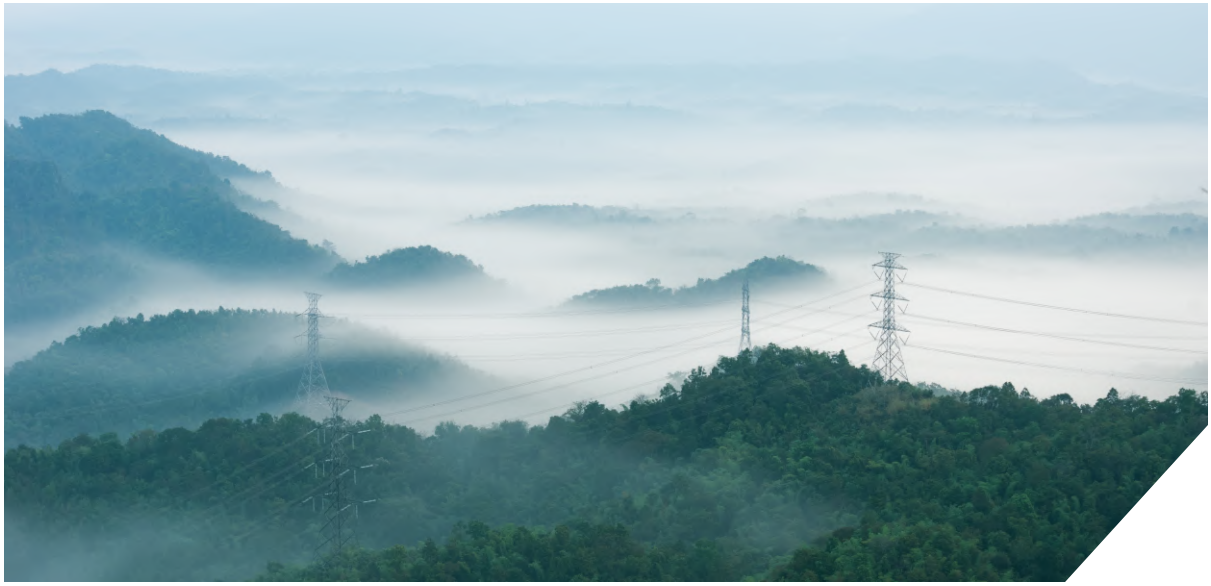
Acronyms & Definitions

Acronyms

- **CapEx**: Capital expenditure
- **ECM**: Ecological corridor management, synonym for IVM
- **ESG**: Environmental, social, and governance
- **DSO**: Distribution system operator
- **GIS:** Geographic information system
- **HV**: High voltage power lines
- **IVM:** Integrated vegetation management
- **LV**: Low voltage power lines
- **NbS:** Nature-based solutions
- **NRA**: National regulatory authority
- **OHL:** Overhead power line
- **OpEx**: Operational expenditure
- **RoW**: Right of Way, synonymous with grid corridors or safety corridor
- **TSO**: Transmission system operator
- **UGC**: Underground cable

Definitions

- **CapEx**: Expenditures for major, long-term investments.
- **OpEx:** Expenditures for ongoing every-day business.
- **Sinus and meandering mowing**: These techniques follow a random pattern and leave patches of meadow unmown to increase biodiversity.
- **ESG**: Governance pillars that companies are expected to report on as sustainability indicators.
- **Hectare**: A unit of measurement that is equivalent to 10,000 square meters.
- **RoW**: Utility providers can access this area to fix a utility-related problem or agree to access infrastructure placed there by utility providers. Synonymous with grid corridor.
- **Integrated Vegetation Management**: An approach to managing the vegetation in the spaces beneath power lines that focuses on the ecological health of the affected area, while still removing vegetation which could interfere with system security by touching a line.



1 | Biodiversity: Actions, Monitoring, & Reporting

When the vegetation in grid corridors is managed with ecological concepts in mind, these areas have the potential to become important habitats and provide opportunities for biodiversity to flourish, at local, regional and even continent scale.

Conventional vegetation management relies mainly upon indiscriminate, periodic clear-cutting of all vegetation in a corridor using mechanical and chemical processes, such as gyro-grinding and herbicide use. Instead, IVM offers natural and cultural methods which require fewer intensive inputs, such as selective removal of fast-growing and invasive species, and create more stable, climate resilient corridors wherein vegetation is less likely to interfere with grid infrastructure. The actions available depend on the ecosystems in question and should work symbiotically with natural processes to protect and restore native species. In cases where endangered species are present, grid operators can work with conservation experts to design specific actions to support them to thrive and reconnect them with populations elsewhere, thus overcoming ecosystem fragmentation. In the following pages, readers will find several case studies of such actions, such as invasive species removal, nature-inclusive design around substations, the creation of flowering meadows and ponds, innovative mowing techniques and more.

The creation of digital vegetation maps is often an instrumental step in IVM implementation. By mapping out vegetation and classifying ecosystems present, grid operators can identify and track the progress of 'problematic' trees in corridors. Based on this information, grid operators can select site-appropriate IVM actions and identify species which are appropriate for the respective ecosystem. For example, in countries where rural wildfires are a major threat, some grid operators develop 'catalogues' of species which are slow-growing and fire-resilient, which bring benefits for local stakeholders and thus encourage joint management by local actors (see for example page 10). In creating the maps, geographic information systems (GiS) and

technologies such as laser mapping (LiDAR) are often used. Mapping can be carried out as part of the planning process of new power lines or indeed as grid operators develop IVM plans for existing power lines corridors.

Monitoring the evolution of biodiversity in grid corridors over time is also important for grid operators to be able to track the 'successes' of their actions, which can also be reported in sustainability reporting processes. This can be a complex and costly task which implies complex questions regarding the definition of baseline ecosystem values for comparison, study area delineation, meticulous monitoring and data processing. As with mapping, grid operators often work with experts (e.g. ecologists, biologists, consultants) for monitoring processes.

In this chapter, readers will find case studies where collaborative monitoring efforts provide important indicators and inspiring stories regarding the development of biologically valuable habitats in grid corridors.

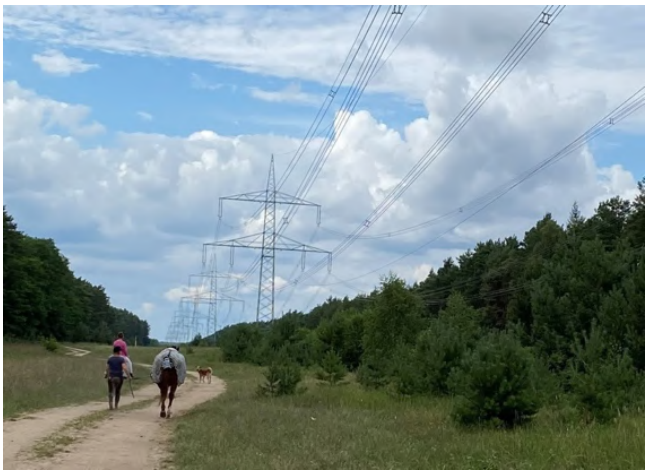
1.1 IVM for biodiversity and resilient grid corridors in Germany

Biotope mapping, wildfire management, grazing, endangered species, sustainability reporting, local economic opportunities

50Hertz (TSO)

50Hertz (German TSO) conducts its detailed mapping efforts in IVM corridors primarily on a case-by-case basis, focusing on areas requiring restructuring. In this respect, their approach mirrors their broader IVM strategy, which relies heavily on existing vegetation and initial soil composition to guide interventions. Typically, these interventions involve the removal of invasive or fast-growing woody plants, achieved through grazing or selective tree cutting. These actions aim to support native, slow-growing species and, in some cases, protect endangered species and ecosystems through collaboration with forestry and other associations.

One such species which benefits from 50Hertz's efforts is the protected Smooth snake *(Coronella austriaca)*. A study conducted in the Dubringer Moor nature reserve along the Streumen-Bärwalde line (RZ Ost, Lübbenau site) identified threats to the Smooth snake population and developed protective maintenance measures. With over 117 individuals recorded in the region, Dubringer Moor hosts the largest population in Saxony along the Elbe Sandstone Mountains. The study revealed the snakes' preference for multi-use areas like blue spruce *(Picea pungens)* 'Christmas tree' plantations in grid corridors over neighbouring forest cover, likely due to the open areas in grid corridors.



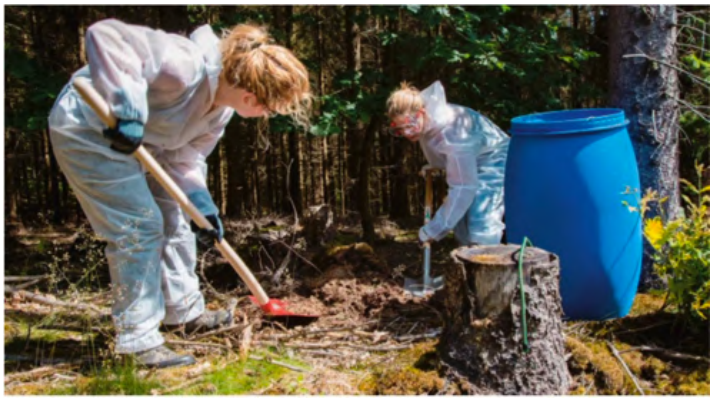
Locals walk along a grid corridor that benefits from IVM, 2023. Photo: ©50Hertz Transmission GmbH

50Hertz's sustainability report documents all actions that have been undertaken, and they serve as a vital indicator for its strategic sustainability program. Indeed, accurate reporting on their IVM actions in their reporting processes contributed to 50Hertz being able to secure a green bond.[2]

1.2 IVM to enhance biodiversity, sustainability and research in Germany

Biotope mapping, sustainability reporting, endangered species, collaboration with academia, underground cables, insect habitat, wildflower meadows

Amprion (TSO)



Conservation actions to protect the Great Notch Ant and foster other insect populations, 2019 ©Amprion GmbH

Amprion's (German TSO) repertoire of IVM actions includes measures such as selective removal of fast-growing trees that could potentially interfere with power lines, targeted coppicing of deciduous trees, regular removal of emerging woody plants instead of intensive clearcutting, and regular mowing of meadows to preserve existing plant species. In the IVM planning process, service providers map flora in the grid corridor two years after construction. These actions help reduce maintenance costs in the long run and create a higher level of biodiversity simultaneously. Overall, IVM is an important aspect of Amprion's sustainability approach and is reflected in the ESG rating process. Some noteworthy projects from Amprion's IVM actions include:

- **Refuge for the Great notch ant** – colonies of the Great notch ant *(Formica exsecta)* were discovered in 2019 and have since been marked and protected. Mowing and mulching practices have since been adapted to encourage other insect populations.
- **Flowering Jewel** – Rare wild orchids in Rhineland-Palatinate, such as Broad-leaved helleborine *(Epipactis helleborine)*, are protected through IVM actions and population monitoring.
- **Flower Line** – Launched in Autumn 2023, this five year long joint research project will support flowering meadows by monitoring species in corridors and comparing them with control areas. The project is between Kulturstiftung Rheinland-Pfalz and the University of Koblenz and Amprion.

[2] A green bond is a tool for financing the low-carbon transition. Applicants for a bond voluntarily follow a detailed criteria from the EU taxonomy that defines what are green economic activities to ensure transparency that is line with best practices at the EU level. All applicants and recipients are supervised by external reviewers. From: European Commission (2023). *The European green bond standard – Supporting the transition*

Amprion also collaborates with universities and experts on ecological research programs since 2006 until today. For example, a collaboration with the Universities of Freiburg and Trier examines the potential effects of underground cables (UGC) on the thermal and hydraulic soil properties – also regarding agricultural crop yields and earthworm activity. A wide range of crops were grown above and next to underground cable systems, including potatoes, corn, winter wheat, spring barley, winter rape seed oil, sugar beet and grassland.[3] The results of the experimental sites in Freiburg, Osterath, Raesfeld and along the ALEGrO transmission line show that installation and operation of underground cable systems do not cause any losses in agricultural crop yields or influence the earthworm activity. The cable installation depth and distance to each other have been optimised site-specifically, and cables are embedded in thermally optimised bedding material to minimise the dissipation of heat loss from the cable operation to the surrounding soil. However, to ensure that the transmission operates without any problems, no buildings, deep-rooting trees or shrubs are allowed to stand on a defined protective strip above nor to either side of the UGC trench. There are no restrictions on grazing or tilling.

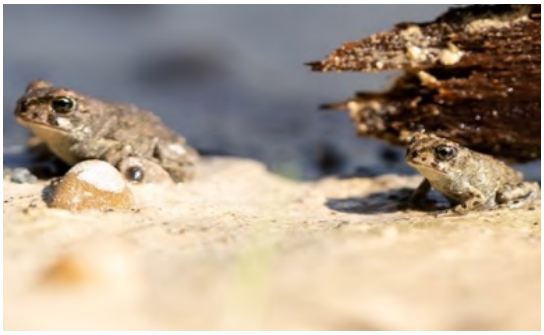
1.3 Targeted actions to promote biodiversity in Bavaria, Germany

Grazing, endangered species, biotope mapping, mowing, pond creation

Bayernwerk Netz GmbH (DSO)

Bayernwerk's approach to IVM is centred on mowing, grazing and selective tree removals. It aims to maintain corridors with minimal tree and bush density while enhancing ecological diversity. They have identified a range of activities which create a mosaic of habitats for various animals and plants beneath their power lines, including:

- **Selective plant care:** Perseveration ecological value in tree species, such as old oaks with nesting possibilities.
- **Extensive mowing:** In Bayernwerk grid corridors, this covers approximately 250 ha. These areas are mowed only once per year, so that more plant species produce seeds, in turn fostering the growth of flower-rich vegetation. Protected species that benefit from this approach include for example the Lady's slipper orchid *(Cypripedium calculus)*, Military orchid *(Orchis militaris)*, and Round-leaved sundew *(Drosera rotundifolia)*.
- **Pond creation:** Bayernwerk coordinates with regional NGOs to create small ponds within grid corridors for the locally endangered European green toad *(Bufotes viridis)*.



Young green toad in north Tümpel, 2022
Photo: Adriane Lochner, ©Bayernwerk Netz, GmbH

[3] Amprion (2024). Underground Cables and the Environment

Following these successes, Bayernwerk partnered with external biologists in 2023 to monitor and map 200 hectares of grid corridors. The exercise identified species, habitats and crucial ecological periods of the flora and some fauna in the power line corridors. The study results also showed that ecologically managed grid corridors are far more biodiverse than the surrounding monoculture forests or fields. These findings continue to move Bayernwerk's practice forward and contribute to its annual ESG goals and targets.

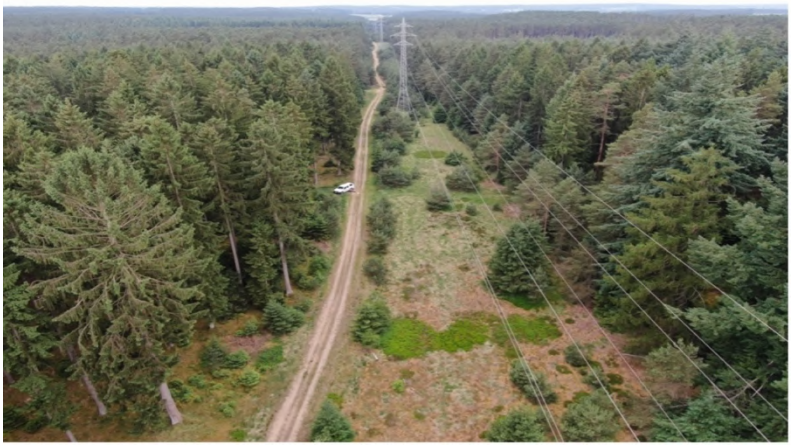
1.4 Biotope mapping for tailored IVM measures across Europe

Mapping, sustainability reporting, endangered species, LiDAR

E.ON (DSO)

To develop locally adapted plans which incorporate their IVM principles, European distribution system operator, E.ON maps each distinct biotope through digital shape files based on maps, technical line data, and geographic data from trained biologists. These maps, focussing on their flora species inventory, aid in identifying biotopes. Once the area has been accurately mapped, appropriate recommendations can be made for specific maintenance activities from an E.ON-wide standardised library of measures. This depends on factors such as current field conditions and overall growth rate. Should unique or particularly valuable biotopes be identified, special IVM design measures may be tailored together with external partners. Moreover, innovations, like the one developed in-house by E.ON Sweden, include LiDAR, weather data, geology and species observation data to build better maps, identify risk areas (where trees pose a risk to system security) and optimise clearing schedules.

As the rollout of their IVM measures continues, E.ON is investigating standardised, science-based methods to measure the long-term impact of IVM across all geographies and at scale. In the grid corridors of E.ON's German subsidiary, Westnetz GmbH, where IVM has been applied for over 30 years, multiple practical examples have shown positive changes for biodiversity, for example, the return of several red-listed species.[4] Their experiences with IVM clearly demonstrate how it can positively contribute to sustainability – a consideration which is duly reflected it in E.ON's ESG reporting processes.



Perspective view of a grid corridor with well-maintained forest edges, 2023. Photo: ©E.ON SE

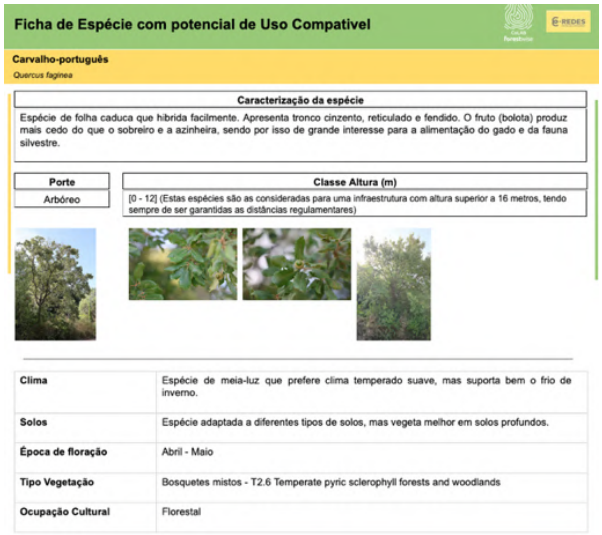
[4] Various species of reptiles, birds, mammals, & insects: Dice snake *(Natrix tessellata)*, Smooth snake *(Coronella austriaca)*, Aesculapian snake *(Zamenis longissimus)*, Sand lizard *(Lacerta agilis)*, European stonechat *(Saxicola rubicola)*, Hazel grouse (*Tetrastes bonasia)*, partridges, European wild cat *(Felis silvestris)*, Eurasian lynx *(Lynx lynx)*, & Blue-winged wasteland grasshopper *(Oedipoda caerulescens)*.

1.5 Enhancing forest management through nature-based solutions, collaboration, and monitoring in Portugal

Biotope mapping, wildfire management, sustainability reporting, monitoring, collaboration with NGOs, local economic opportunities

E-REDES (DSO)

In 2022, E-REDES (Portuguese DSO) began collaborating in a partnership with the non-profit forestry organisation ForestWise to generate more effective solutions in terms of integrated forest and fire management through research and innovation and the development of Nature-Based Solutions (NbS) within the scope of their vegetation management.



Compatible occupations database webpage, 2024. Photo: ©E-REDES - Distribuição de Electridades, S.A

A key piece of work in this collaboration is the study by ForestWise entitled "Compatible Occupations on Fuel Management Lanes (FGC) - Support for Species Selection". Compatible occupation is a concept defined as land uses which diverge from the legal decree on fuel management but is a concept in rural fire law to be equivalent and still reduce the availability for ignition and progression of fire that can generate value for owners or communities.[5] The study identified 107 plant species which should be prioritised in IVM actions because they can generate local socio-economic benefits (e.g. through harvesting of fruit by landowners, sale of wood), have low flammability, and combustibility risk, benefit biodiversity and deliver ecosystem services, such as soil formation, erosion prevention, etc. These include species such as Hazel *(Corylus avellana)*, Olive *(Olea europea)*, Strawberry tree *(Arbutus unedo)*, Almond *(Prunus amygdalus)*, Walnut *(Juglans regia)*, Cherry *(Prunus avium)*, Holm oak *(Quercus ilex)*, Cork oak *(Quercus suber)* & Sweet chestnut *(Castanea sativa)*. The findings of the study have been input into a digital species database that sorts each of the 107 plant species by maximal height, a fundamental criterion for guaranteeing the safeguarding of safety distances to lines. Each entry shows the plants' preferred climate, soil type, flowering time, vegetation type, cultural significance, potential socioeconomic and ecosystem services, and maintenance requirements. This digital tool also allows users to explore the different projects around regions and municipalities, listing the economic opportunities from compatible occupation species such as olive oil, resin, fruit, and nut production.

In terms of monitoring and reporting, E-REDES is currently working to identify indicators which can demonstrate the impact, both positive and negative, of their vegetation management actions on biodiversity according to the requirements of the Corporate Sustainability Reporting

[5] Diáro da República (2021). Law-Decreeno 82/2021, Art.3

Directive (CSRD). Their current development of a monitoring scheme breaks down into a step-by-step process:

- Municipal level mapping of prospective IVM areas and incorporation of scientific & technical information.
- Habitat and species classification including species distribution.
- Selection of monitoring indicators based on:
    - Footprint on the landscape (i.e. proximity to biodiversity hotspots)
    - Species (i.e. the number or threated species.)
    - Ecosystem (i.e. identification of ecosystem services)
- Validation of mapping area and indicators.

The monitoring scheme and indicators will also be a part of a biodiversity assessment and performance tool for continuous evaluation and monitoring of biodiversity in the project's area of influence. They expect to see results from IVM actions after implementation of the baseline with in five years. This exercise will also feed into a unique database of existing habitats with potential ecosystem services and identify potential threats to those systems.

All results related to vegetation management are reported in EDP Group's annual sustainability report, accountable E-REDES report, and biodiversity report and, will in the future play, a part in the EDP Group's ESG strategy.

1.6 Nature-inclusive design around grid assets in Ireland

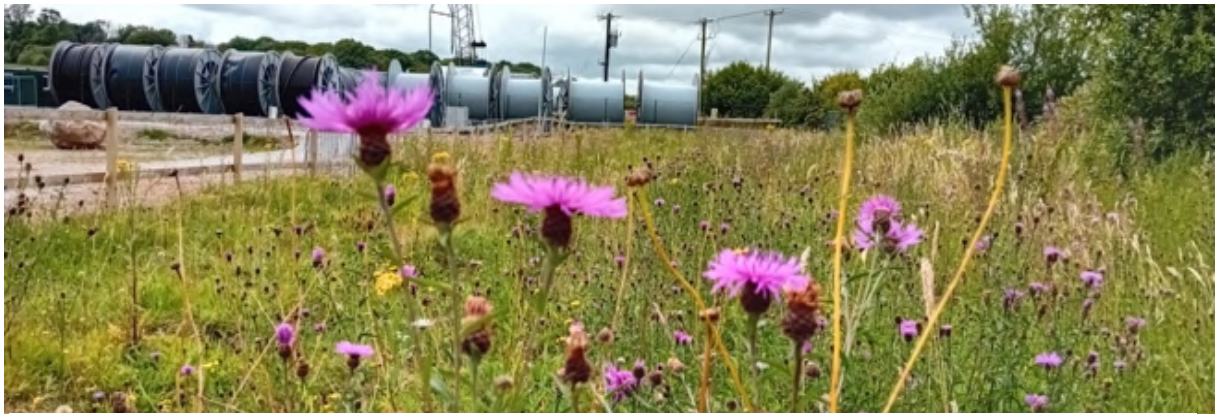
Nature-positive actions, wildflower meadows, hedges, underground cables, substations, no pesticides, collaboration with stakeholders

EirGrid (TSO)

Given that the Electricity Supply Board (ESB) constructs and owns the onshore grid, EirGrid (Irish TSO) collaborates closely with ESB on eco-landscaping design and vegetation management proposals. This collaboration delivers multiple benefits. For asset security, EirGrid and ESB agree on vegetation proposals that do not pose a risk to the electrical apparatus or introduce physical security risks to stations (e.g. climbing opportunities via trees over fences). At the same time, EirGrid and ESB work to enhance existing habitats or create new habitats at suitable locations that do not already have pre-existing semi-natural habitats. To do this, EirGrid's ecologist oversees all proposed habitat creation locations to ensure they are improving on farmlands or brownfield habitats.

Since 2019, EirGrid has secured commitments from ESB to plant over five hectares of native woodland and establish three hectares of species-rich meadow, all in low-value habitats, and retrofit over 25 kilometre of bird flight diverters to reduce legacy collision risk with existing overhead lines. These commitments help direct actions in the partnership that include nature-inclusive design implementation, such as:

- Supplementary planting of existing (gappy) hedges and native, species-rich woodland wherever visual screening is needed and elsewhere away from the constraints posed by OHLs or UGCs
- Low intervention establishment of semi-natural meadow over underground cables, incl. through reduced mowing, use of 'green hay', hand-pulling of tap-rooted perennial weeds, and no use of commercial seed.[6][7]
- Establishment of scrub habitat below existing or proposed overhead lines on non-semi-natural habitats.
- Stopping herbicide use in existing parkland areas.
- Creating scrapes for nesting bees.
- Leaving dead wood lying within existing woodland plantation areas for insects, fungi, and bats.
- Installing a nesting bird box with a hinged lid to monitor bird breeding success.
- Partnering with the charity 'Trees on the Land' to plant over 200 native and Irish-grown trees, including a native orchard of Irish heritage varieties.



Translocated near-threatened Greater knapweed (Centaurea scabiosa), 2022. Photo: ©EirGrid Plc

Moreover, EirGrid is working with and in consultation with other partners to protect different species, such as the National Parks & Wildlife Service (NPWS), local authorities, electronic designers and operators, including Siemens, Nexans, and Hitachi Energy. For instance, Siemens has reconfigured the Ballyadam converter station in County Cork to avoid an Annex 1 Calcareous grassland and successfully translocated near the Greater Knapweed plants on the same site.

[6] An exception is made for native-certified yellow rattle (Rhinanthus minor), a hemi-parasitic herbaceous wildflower which is used to control grass growth in newly established meadows.
[7] EirGrid (2022). Nature Inclusive Design Pilots

1.7 Working with ecologists to map, monitor and report IVM's benefits in Belgium

Monitoring and studies, biotope mapping, sustainability reporting

Elia (TSO)

Biological monitoring has been continuously carried out in the Belgian green corridors to track the development of habitats and ecosystems and measure the 'success' of IVM actions. Ecofirst, contracted by Elia (Belgian TSO), carries out the monitoring according to scientific standards while leaving room for pragmatism. For example, precise surveys are carried out of several taxonomic groups (e.g., flora, butterflies, dragonflies, bats), but expert opinions on the progress of structure, diversity, and vegetation development are also included in the reports.

Prior to the monitoring actions, surveying and mapping were undertaken to validate the contours of the map proposed in the application, characterise habitats using the EUNIS classification 1 method and the EU Habitats Directive,[8] and identify priority zones and other key indicators.[9] The monitoring itself implies:

- Site visits once per season to compose a basic protocol of most taxonomic groups.
- Extensive site monitoring during the 'high period' (June/July) with skilled ecologists.
- Before/after survey (where feasible), or a short-after vs. long-after survey.
- Regular photographic documentation of sites with geo-localisation.
- Work with classifications of habitats according to the EU Habitat Directive.

From 2018 onwards, Ecofirst produced one report per year on biological monitoring. In March 2023, they launched a '10-years after report'[10] which contained comprehensive coverage and evaluation of IVM's impacts on biodiversity. Results have proven very positive. For example, 'biological gain' on 82% of the LIFE sites was rated as 'good' or 'exceptional'.[11] Indeed, many of these sites are now classified among the Annex I habitats of the EU Habitat Directive as Special Areas of Conservation, whose conservation status elsewhere in Belgium is 'bad'.

---

[8] "The EUNIS habitat classification is a comprehensive pan-European system for habitat identification. The classification is hierarchical and covers all types of habitats from natural to artificial, from terrestrial to freshwater and marine. The habitat types are identified by specific codes, names and descriptions and come with cross-walks to other habitat typologies." **From**: European Environmental Agency (2021). EUNIS habitat classification

[9] The preparatory actions also included locating invasive species and other threats, chart elements linked to the hydrological regime of forest corridors, and identifying cadastral parcels upon which the project has an impact by combing the mapping layers in the GIS. **From**: Life-Elia (2024). Preparing and updating maps

[10] J.F Godeau et al. (2023). Creating green corridors under overhead lines – Biological evolution: 10-year after report

[11] 111 hectares out of 136 hectares of grass- and heathlands in the Elia corridors are recognised as Natura 2000 habitat types. Calculated for the biographic region of Belgium, the Elia corridors represent 1-10% of the overall surface areas of their kind and thus contribute significantly to the Natura 2000 network.

IVM significantly contributes to nature conservation in Belgium. The figures are reflected in Elia's ESG reporting and contribute to the company's overall goals under their ActNow Sustainability Programme, integrating this goal into decision-making to limit the grid's impact on nature.

1.8 Site-specific IVM plans to support endangered species in Finland

Biotope mapping, endangered species, nature-positive actions, insect habitats, bird habitats

Fingrid (TSO)

Before building new power lines, Fingrid (Finish TSO) undertakes the effort of mapping different species and ecosystems. This mapping is integrated into their environmental impact assessment (EIA) processes and is integral to their IVM practice. Based on the findings, site-specific guidance is developed and updated regularly over the following years. The guidance provides instructions on reducing the disruption of important natural sites and their various life-cycle phases. This is then applied to the grid site planning, construction, and maintenance. Existing grid corridors also benefit from the guidance, as registers are continually checked, and nature-friendly cutting processes are implemented on older sites.

Fingrid reports its IVM efforts and findings in the form of short case studies to analyse the impact of IVM adaptation compared to other sites. As a company, they set goals for protecting biodiversity, reporting its benefits, and welcoming ideas and knowledge from other external stakeholders concerning IVM. In this way, Fingrid has increased the number of meadows in their operation area by supporting landowners to manage the traditional environments by grazing animals or mowing, or by compensating landowners for leaving decaying wood in edge zones as nesting sites for birds, insects and wood-rotting organisms. Furthermore, coordination with local stakeholders enables specific actions to protect endangered species, such as the Siberian flying squirrel *(Pteromys Volans)*.

1.9 Mapping, monitoring and evaluating IVM for biodiversity in Spain

Biotope mapping, GIS, LIDAR, wildfire management, collaboration with academia, monitoring, local economic opportunities

Red Eléctrica de España (DSO)

For the mapping of vegetation in their grid corridors, REE – Red Eléctrica de España (Spanish TSO) has an aeronautical recognition coverage geographic information system (ArcGIS) software for the management of the vegetation under power lines called VEGETA.[12] Elewit, the technological platform of the Redeia Group, developed it. In contrast to the prior method of vegetation identification via photointerpretation, VEGETA takes data from satellite images and

[12] Renewables Grid Initiative (2020). SAGA

3D data captured via a remote sensing method called detection and ranging (LiDAR) and field inspections to create a 'Forestry Map'. VEGETA's algorithms then generate an optimised pruning and felling plan which minimises fire risks and environmental impact in surrounding habitats. The map includes data on the growth rate, maximum height for species, maximum height of vegetation according to laws, type of action to be carried out, year of the next cut and more.

REE is currently devising a process to empirically monitor impacts across their IVM areas, which should be ready to share in 2026. However, previous and ongoing collaborations with universities have provided very interesting indicators which demonstrate the value of well managed grid corridor areas for biodiversity. Examples include:

Naturaleza en RED

In collaboration with the University of Barcelona and ecological consultancy, Bufalvent, REE launched a research project, Naturaleza en RED[13], to identify the role of managed grid corridors which transect forested areas for biodiversity. Their findings show how the grid can function as a biodiversity reservoir in forests and as a refuge for local fauna in open areas affected by human activities. Between July 2020 and October 2021, surveys were carried out on three sites in a) dense forest, b) open areas and c) under power lines three years after the previous cutting period. Ecologists conducted biweekly surveys of butterflies, pollinators and floral density; bimonthly surveys of micromammals and macrofauna; and seasonal bat surveys. A range of monitoring techniques was used to design an index for how to create indicators of biodiversity in grid corridors. Some results include:

- In dense forest: Far higher butterfly species diversity (one thousand per cent higher) and abundance (7,8 thousand per cent higher) in grid corridors compared to surrounding forests. For pollinators, this figure reached between one to two thousand per cent increase in pollinator abundance and up to two million per cent for floral abundance.

- In open habitats: No difference in pollinator presence between grid corridors and open habitats without grid infrastructure, suggesting that the mere presence of power lines does not influence species composition (with a focus on pollinators).

Bio Transport

REE funded a research project, Bio Transport[14], from the Doñana Biological Station (EBD) of the Spanish National Scientific Research Council (CSIC), analysing if vegetation management within the transmission grids' bases (shelter rocks, native shrub seedlings) can benefit ecosystems by creating new habitats for certain species. Their findings show positive, transferable and exponential potential of pylons to reconnect ecosystems and support biodiversity, with little

[13] Red Eléctrica (2021). The safety corridors of our lines, spaces for biodiversity and a refuge for fauna
[14] Ferrer et al. (2020). Transporting biodiversity using transmission power lines as stepping-stones

management and low costs. Furthermore, considering that 15% of Spanish transmission towers are in the EU Natura 2000 network, the findings have important implications for nature protection goals.

In two 27 kilometre stretches of 400 kV transmission lines in cereal farmland steppe, two actions were taken within the pylons' 10 x 10 metre base. Firstly, piles of medium to large stones (avg. 15 kg) were placed as refuges for small mammals and invertebrates. Secondly, native shrub seedlings were planted, protected from herbivores using nets, and irrigated for the first four months. Samples were taken over three-and-a-half years, with five sampling days per season each year (80 sampling days in total), inside each of the six modified towers, control towers, and surrounding farmland. Pitfall traps were used to determine the presence of invertebrates, and Sherman traps for small mammals. A parallel bird census was also carried out. Results include:

Digging traps and planting saplings as a part of the BioTransport study, 2022. Photo: ©Red Eléctrica de España

- After one year, all biodiversity KPIs showed a significant increase and remained high after four study years.
- Aside from planting saplings and irrigation in the first four months, no further maintenance or investments were needed.
- Ten times more small mammals compared to other control sites.
- Number of birds near the modified tower bases were 7.5 times higher than surrounding areas.

The cost was €450 per tower or €1,700 investment per kilometre with no maintenance costs after implementation. Importantly, results point to the potential of the electricity grid to be adapted as stepping-stones for small fauna, not only to increase local biodiversity but also to connect fragmented populations and aid in migrations, and perhaps build up a continental scale network of connectivity for limited dispersal animals.

1.10 Wildfire management through IVM-based reforestation in Portugal

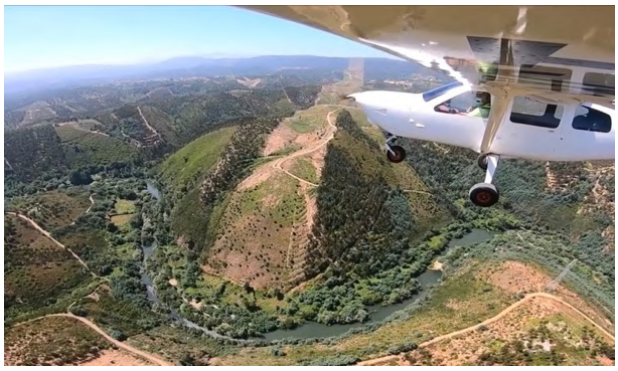
Biotope mapping, wildfire management, reforestation, invasive species management, biodiversity values, sustainability reporting

REN (TSO)

The high risk of wildfires in Portugal makes vegetation management, especially of invasive species, a crucial topic for REN. They have drawn up technical specifications for the management in their grid corridors in different phases of implementation (i.e. planning, execution, and monitoring). The methodology considers the species, age, type of intervention (initial and reinforcement), control techniques (physical, chemical and mixed), management of plant remnants (to remove potential wildfire fuel), & biosecurity.

In 2014, before implementing IVM, REN (Portuguese TSO) first carried out a preparation with a process named COSREN - cartography of land use/occupation of the REN group's grid corridors. The mapping exercise showed land use and what activities are taking place in their grid corridors REN then continues to use the data to inform their IVM approach to improve biodiversity, which includes planting native trees and shrubs, such as Strawberry tree *(Arbutus unedo)*, Cork oak (*Quercus suber)*, Stone pine *(Pinus pinea)*, and European olive *(Olea europaea)*. Between 2010 and 2022, REN reconverted over 4,000 hectares of forested area, mainly occupied with eucalyptus trees. This process involved more than 22,000 landowners and some planting actions with primary and lower secondary education students.

Moreover, REN has studied the biodiversity present in their grid corridors to diagnose and evaluate the potential biodiversity values within each area. Specifically, this included the creation of:



REN Aerial mapping of grid corridors, 2021
Photo: © Redes Energéticas Nacionais - REN

- A georeferenced catalogue based on the occurrence of natural habitats, semi-natural lands and flora in grid corridors, using pre-existing occurrence data through photointerpretation of orthophoto maps.[15]
- A numerical index to quantitatively express natural value along the grid corridor, based on the information from mapping and the georeferenced catalogue and field validation.
- Various reports on the evolution of invasive species in the grid corridors were conducted per an EIA's recommendation or when deemed necessary.
- Monitoring studies on the impact of power lines on birds when sensitive species are identified. Biologists with experience in monitoring avifauna carry out these studies. Such studies usually use a Before-After-Control-Impact or Before-After-Impact-Gradient approach.

Since the beginning of IVM implementation, REN reports seeing positive results in biodiversity values. Monitoring results are primarily used for further development and planning and are mentioned in REN's Sustainability Report.

[15] An orthophoto map is a photographic map with a uniform scale. It can be laid directly over other maps and vice versa, as it removes the distortion effect that shows up on a regular aerial photograph. **From:** US Geological Survey (2024). Aerial Photograph vs. Orthoimage

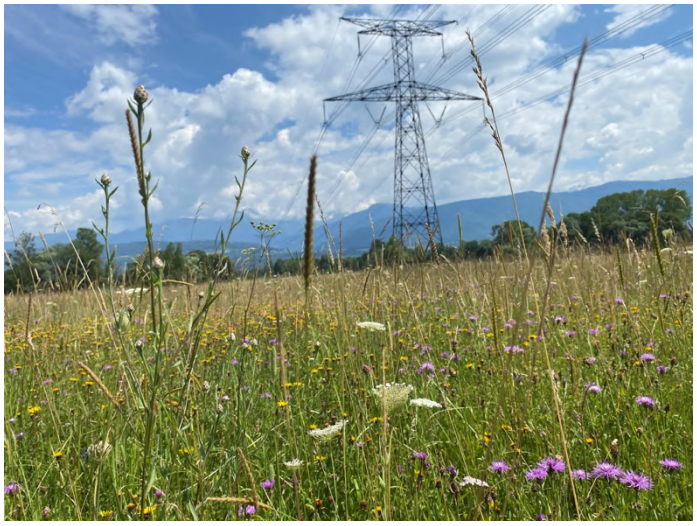
1.11 Enhancing biodiversity and ecosystem connectivity in France

Biotope mapping, sustainability reporting, grazing, no pesticides, bird habitat, collaboration with NGOs

RTE (TSO)

RTE (French TSO) considers their IVM practices to impact biodiversity on local, national and international levels. Locally, they support endangered species and ecosystems through different partnerships. Nationally, IVM prevents the growing-over of open landscape habitats like meadows, which are constantly decreasing in France. These levels of implementation affect RTE's overall impact on biodiversity and strengthen the links between habitats in their grid corridors, improving RTE's contribution to international biodiversity protection goals.

One of the specific steps in RTE's IVM practice involves mapping tree species that have the potential to interfere with power lines. The resulting maps define the cutting frequency of each population based on the species, altitude, and latitude. Sometimes, the presence of protected species or habitats of interest are included in the mapping. Most often, species information is provided by an expert 'natural area manager'. However, RTE is developing an internal plant indicator as part of their vegetation maintenance, a tool which will allow non-specialists to assess the biodiversity at each site and help analyse the overall impact of IVM beneath power lines.



Species rich flower meadow underneath a power line in France, 2022. Photo: ©Réseau de Transport d'Électricité (RTE)

In addition to mapping, scientific studies provide important insights into RTE's overall IVM process. A biodiversity study is underway to assess bat activity before and after IVM implementation. It explores the effects of forest grid corridors clearings on biodiversity by studying the activities and richness of bats and bush crickets, as well as potential benefits from IVM as alternatives to clear-cutting. Their results suggest that grid corridor clearings represent increased movement opportunities for bats, particularly edge-foraging species. They also provide suitable habitats for bush-cricket species, with communities in the grid corridor appearing richer, more acoustically active and statistically distinct from adjacent forest clearings, likely due to their preference for the secondary vegetation typical of IVM.

One example, RTE has run a project in collaboration with the French branch of BirdLife, LPO (League for the Protection of Birds), to create a mosaic of nesting sites favourable to the Western marsh harrier *(Circus aeruginosus)* within the grid corridor. To nest, the birds prefer a location with dense vegetation, micro-openings, and perches nearby. LPO manages the implementation actions (e.g., creation and maintenance of micro-openings, installation of

perches). In turn, RTE ensures the maintenance of vegetation under and around the lines while respecting the arrangements made by the LPO. This management involves limiting the growth of woody plants, maintaining a dense vegetation of heathland or scrub of sufficient height, avoiding clear-cutting of heathland and scrub habitats, and refraining from intervening during the breeding season.

Another noteworthy initiative is RTE's "zero synthetic herbicide" approach. As of 2019, they aim to forgo the use of herbicides in electrical substations. At two pilot sites in the regions of Ain and Nord, RTE collaborates with local shepherds to bring sheep onto substation land to keep vegetation down and thus remove the need for chemical weedkillers. RTE includes summaries of findings in its annual environmental report that indicate the number of hectares with a positive biodiversity impact — however, this is often done without specific biological indicators.

1.12 Balancing security of supply with environmental stewardship in Norway

Biotope mapping, GIS, monitoring, collaboration with academia, no pesticides
Statnett (TSO)

Statnett (Norwegian TSO) considers IVM to be in line with national and international political goals to minimise environmental impacts, restore nature, and support the creation of habitats, migration corridors, and targeted biodiversity.

Their current approach is to apply general principles of IVM to ensure both security of supply, the landscape, and the environment are taken care of in the best possible way. To do this, they create their maintenance plan through a digitalised GIS system. Forest clearing is done through manual and mechanical felling, with no use of pesticides or other chemicals. Low-growing trees and bushes are left alone.

Statnett is still developing its IVM practice and has not yet established regular monitoring protocols. Instead of intensive monitoring, it uses R&D projects to learn more about the interactions between power lines and the natural environment. One such project, which occurred between 2009 and 2015, monitored birds, animals, insects, and plants in a restricted study area, employing visual monitoring techniques like game cameras, insect traps, and vegetation surveys. Another report from 2012, drafted together with the University of Life Sciences,[16] showed the effect of IVM two years post-implementation. It highlighted shifts in vegetation composition within grid corridors, such as an increase in grasses, deciduous shrubs, and lichens, alongside a decrease in moss cover. Regarding insect populations, the study stated an increase in herbivorous species, pollinating insects, and a greater presence of beetles associated with deadwood. These positive findings continue to inform Statnett's IVM practices and other digital mapping efforts.

[16] K. Eldegard et al. (2012). Kraftgater som habitat : effekter av bredde, alder, skjøtsel og plassering på biologisk mangfold.

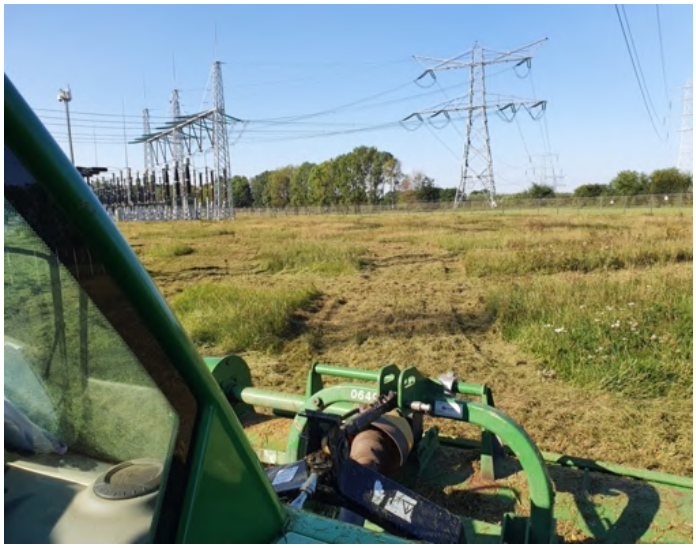
1.13 Nature-friendly mowing techniques and butterfly conservation in the Netherlands

Endangered species, collaboration with civil society, insect habitat, innovative mowing techniques

TenneT (TSO)

TenneT (TSO in the Netherlands and parts of Germany) recognises IVM as a tool to contribute to broader conservation goals and promote biodiversity within its operational areas, often in collaboration with other stakeholders such as local municipalities and nature conservation organisations. For example, as part of a joint initiative to conserve critically endangered butterfly species like the Ilex hairstreak (*Satyrium ilicis*), they worked together with the Dutch Butterfly Conservation Association - De Vlinderstichting - which carried out the monitoring.

Furthermore, TenneT initiated a pilot project at three high-voltage substations five years ago, employing nature-friendly mowing techniques such as 'sinus mowing' or 'meandering mowing'. These mowing techniques follow a random pattern and leave patches of meadow un-mowed. The alternative pathway leaves the development of different stages of growth that benefit insects and other fauna in the area. The mowing pilot project has laid the foundation for broader implementation across its extensive network of around 350 HV substations across the Netherlands and Germany. At the time of writing, this practice is applied to 70 HV-substations. By prioritising adjustments in mowing management, they successfully cultivated flowering grasslands, fostering an environment conducive to insect survival and thereby contributing to preserving vital elements for biodiversity. Results until now have demonstrated a significant impact, with nature-friendly maintenance leading to a remarkable 72% increase in insect populations.



Sinus mowing or mowing to leave patches of grasses un-mowed to increase insect and plant life biodiversity, 2020. Photo: ©Tennet Holding B.V

1.14 Committing to Invasive Species Management and Ecosystem Restoration in Slovakia

Grazing, invasive species management, collaboration with universities, sustainability reporting, grazing, ponds, hunting

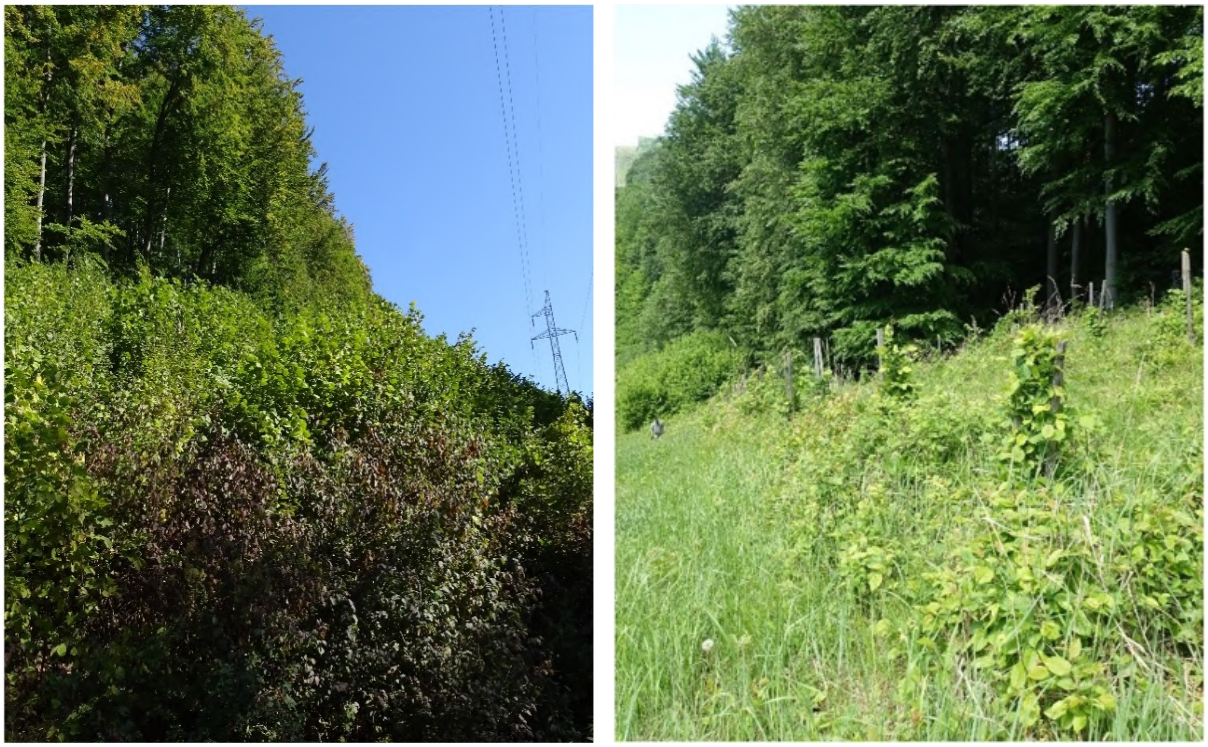
VSD (DSO)

VSD's (Slovakian DSO) extensive set of IVM practices includes methods such as grazing, revitalising small water ponds, and promoting hunting conditions in some corridors. Where

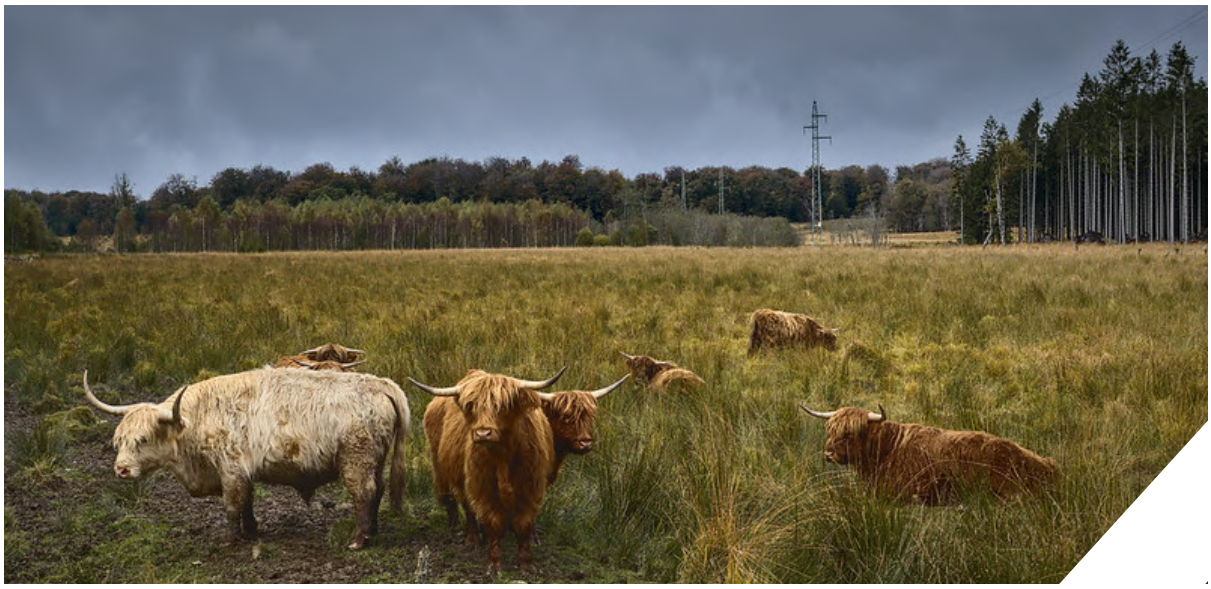
valuable habitats are found, they coordinate with the state nature protection agency to conserve these habitats.

Recently, VSD launched a project to manage the invasive tree species Black locust *(Robinia pseudoacacia)*. The 'Robinia' project will see VSD collaborate with universities and the National Forestry Centre to choose localities to monitor and evaluate the impact of management on biodiversity. The project aims to identify the different effects of various management interventions on habitats and choose the most effective and biologically safe method to remove Black locust trees from their grid corridors.

Moreover, VSD has joined the E.ON Group's commitment to the UN Decade on Ecosystem Restoration by executing ecological vegetation maintenance. Their commitment is to maintain 680 hectares of high-voltage grid corridors according to IVM principles until 2029. VSD also advocates for the enforcement of IVM across the region within the framework of the Carpathian Convention, an agreement launched in 2003 among seven member countries in the region of the Carpathian Mountains to promote environmental protection in the region. Information on IVM is included in their annual report and as a standard part of their ESG reporting.



Before (left) and after (right) of invasive species removal in a Zamutov grid corridor,2024. Photo: © Východoslovenská distribučná, a.s. - VSD



Highland cows, 2021. Photo: Gilles San Martin © CC BY S.A 2.0, Source

2 | Socio-Economic Considerations: Partnerships, Engagement, & Rural Livelihoods

The devolved, dynamic, and participatory nature of Integrated Vegetation Management (IVM) offers countless opportunities to local stakeholders, the public, and grid operators.

In general, grid operators do not own the land underneath the power lines they operate. Landowners are often paid a fee when the line is built as a compensation measure; however, the responsibility for the vegetation in the corridors remains with the respective grid operator. Under conventional vegetation management, periodical clear-cutting has been favoured. This constant cycle of indiscriminate clear-cutting and forest recolonisation often leads to the creation of a kind of 'no-man's land' beneath power lines, where the landowners have no interest in utilisation and the grid operator must regularly invest large sums in intensive management.

Alternatively, site-specific approaches of IVM open the way to collaboration with many new stakeholders, including landowners and other rural actors who may have a stake in being able to access the land. These stakeholders are diverse, and can include farmers, shepherds, hunters, beekeepers, natural park administrators, civil society organisations, local communities, and many more. IVM demonstrates that there are indeed a host of activities which can be carried out in grid corridors, which both keep vegetation at an acceptably low level (thus reducing the costs for the grid operator) while simultaneously create benefits for those involved – a real 'win-win' situation.

In this chapter, readers will find many examples from across Europe of the benefits that come when grid operators enter into agreements to co-design and devolve corridor management responsibilities to actors on the ground. Importantly, as this process requires coordination (to identify and contact the right people) and negotiation (to define the terms of the partnership), this chapter also includes details on the contractual and logistical processes involved in such arrangements.

The benefits of such collaborations go beyond creating socio-economic benefits for those directly involved and can also harness more public acceptance for infrastructure projects. Indeed, IVM demonstrates the genuine interest of the grid operator to work together with local people and enable some benefit creation. Therefore, this chapter also includes cases of communication by grid operators and collaboration with civil society and academia to spread awareness of the multiple benefits which IVM can bring for people and nature.

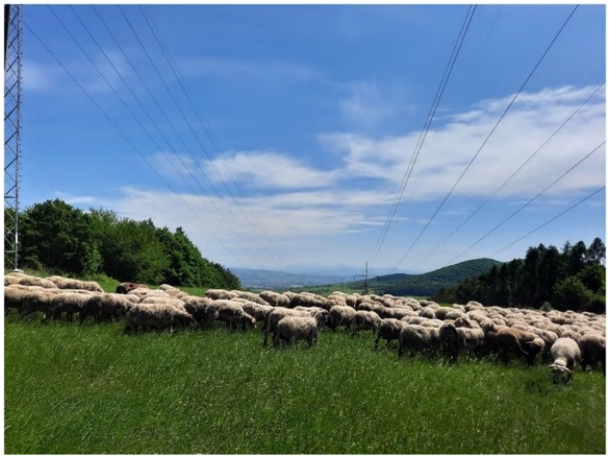
2.1 Enhancing landowner collaboration and bird protection in Slovakia

Devolved management, collaboration with academia & NGOs, grazing, bird habitat, communication, public acceptance, engaging landowners, local economic opportunities

VSD (DSO)

Slovakian DSO Východoslovenská distribučná (VSD) considers that strong relationships with stakeholders on the ground is a vital precondition for IVM implementation. Therefore, the Slovakian internal team has established active communication with external stakeholders such as landowners, universities and government authorities.

VSD discusses landowners' preferences and uses their knowledge to design an efficient and environmentally appropriate vegetation plan. In cases where landowners are not interested in active cooperation, VSD often carries out vegetation management in cooperation with external suppliers. Often, these initial modifications help convince landowners of the benefits that IVM provides to them and to the environment. Specifically, landowners can use the space for economic activities such as grazing, planting agricultural crops, etc., and can also apply for government subsidies.



Beneficial economic activity of grazing sheep underlines in Zamutov, 2024. Photo: © Východoslovenská distribučná, a.s. - VSD

While IVM can improve public perception of their grid, VSD notes that public perception of overhead lines can still be negative if they are perceived as a threat to birds. Therefore, in addition to their IVM activities, VSD implements measures to reduce the risk of collisions and electrocution. They also create nesting sites on their pylons for endangered species, such as

the Peregrine falcon *(Falco peregrinus)*. All these efforts benefit the relationship between VSD and local communities.

2.2 Balancing local interests, conservation, and socio-economic benefits in the Netherlands

Local economic opportunities, devolved management, communication, public acceptance, engaging landowners, educational opportunities, contracts

TenneT (TSO)

Young people visit one of TenneT's insect hotels that help boost biodiversity. Photo: Vivara Pro, ©TenneT Holding B.V

For TenneT, successfully executing IVM implies aligning with local interests and conservation priorities and navigating complex land ownership structures. For this, they actively pursue partnerships and contractual agreements with external stakeholders. In cases where partnerships involve the delegation of management responsibilities, management agreements are made, where around 60% of tasks are outsourced to external partners, while TenneT retains control over the remaining 40%. Their strategy aims for a balanced distribution of costs in joint projects, striving for a 50-50 sharing arrangement. This collaborative approach ensures not only financial sustainability but also encourages local participation and commitment to shared conservation objectives.

Shared community interest in IVM makes project implementation easier and, additionally, generates socio-economic benefits for local stakeholders, in terms of landscape enhancement, reduced risk of fire, and recreational and educational opportunities. In the case of recreational and educational opportunities financing of the projects is taken over by the landowners and TenneT without additional funds.

Moreover, the magnitude of these benefits hinges on stakeholder engagement and implementing recommendations outlined in TenneT's 'Inspiration Guide'.[17] TenneT contributes to preserving cultural landscapes and promoting sustainable tourism and recreation by integrating nature-friendly practices and dialogue with local communities.

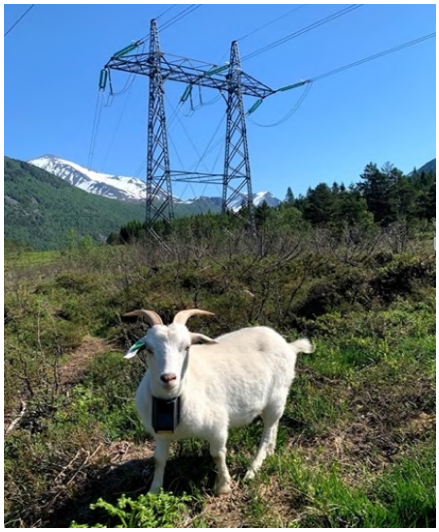
[17] TenneT (2023). Inspiration Guide: Nature-inclusive building

2.3 Enabling local economic interests in Norwegian Grid Corridors

Grazing, hunting, engaging landowners, local economic opportunities, subsidies

Statnett (TSO)

Statnett's approach to IVM also considers the interests of local people in the areas around the grid infrastructure, including for economical use of the grid corridors. For instance, Norwegian TSO Statnett has initiated trials involving grazing goats within grid corridors in collaboration with landowners, employing GPS fencing to monitor grazing locations. They also tailor their IVM practices to facilitate optimal grazing in areas with a substantial population of hunting game like elk and deer. Furthermore, Landowners can be offered funding for removing high-risk trees outside of the grid corridor and compensation for land loss. They may also obtain permission to cultivate economically productive, low-growing species such as Christmas trees within the grid corridor. These practices are additionally recognised for either their positive impact on biodiversity or their ability to create multi-use areas that benefit landowners and their communities.



Picture of goat grazing trails under power lines, 2024. Photo: ©Statnett SF

Effective coordination among stakeholders is also crucial as it directly influences discussions with authorities regarding licensing demands and supporting landowners interested in utilising the grid corridor area. While Statnett does not own the land in its grid corridors, it does own land around transformer substations, granting it authority to take certain actions without landowner approval.

2.4 Stakeholder engagement and local integration for IVM implementation in France

Devolved management, engaging landowners, local economic opportunities, grazing, communication & public acceptance, contracts, hunting

RTE (TSO)

French TSO, Réseau de Transport d'Électricité (RTE) has been working with diverse stakeholders for IVM management since the beginning of its implementation, including local authorities, hunters and farmers. Key partners in this regard are 'site managers' – external partners familiar with the local terrain and who seek tailored solutions for effective site management. Such partnerships are particularly important due to the ownership structure in France, where about 75% of forests are privately owned and land is highly fragmented. Moreover, site manager partnerships can help avoid the difficulty of identifying various landowners. This is one reason why, for over 90% of their IVM cases, RTE delegates management through partnerships either with site managers, contractors, or landowners. When landowners are reached, RTE explains the approach's benefits and works to obtain their approval for IVM implementation. In this situation, a tripartite agreement is often established between the owner, the external stakeholder, and RTE. Local authorities can also be interested in implementing IVM, as they often own and manage the land.

Communication with local stakeholders is an important part of RTE's approach. It is possible for local people to express their wishes on how they wish to use the grid corridors to benefit their community through a dialogue process moderated by site managers. In such cases, partnerships often emerge with agricultural, forestry, and rural work contractors, whose interest in collaboration for IVM projects often rests on the potential economic benefits of land utilisation. This includes, for example, creating orchards, planting Christmas trees for sale, or utilising the remaining vegetation in the form of vegetation mulch, compost, wood chips or pellets.[18] In these cases, sustainable management of the vegetation maintenance is entrusted to a third party, thus promoting connections to the local area and improving landscape perception. Furthermore, RTE communicates about the benefits of IVM through on-site billboards, press releases, their website and during engineering work, where they recognise that it can enhance the acceptability of its projects.

The economic valuation of ecosystem services enabled through IVM and the benefits for hunters and grazers were subject to a master thesis study in recent years. One key finding showed that farmers who grazed their cattle under high-voltage lines saved between 390€-875€/hectare/year.

The benefits of IVM were further demonstrated in the evaluation of RTE's BELIVE project, which proceeded the Elia-RTE-LIFE project. The project showed high acceptance from local stakeholders, with 92% of them agreeing to work with RTE again in each of the three regions surveyed. Indeed, IVM has proven capable of improving the acceptability of the creation of new power lines in France by focusing on aspects that are important to the public, such as landscape integration. In some cases where traditional vegetation management work had been blocked due to opposition from residents, a focus on IVM has lessened and unblocked this opposition.

2.5 Integrated fire management and economic empowerment: rural resilience and sustainable agriculture in Portugal

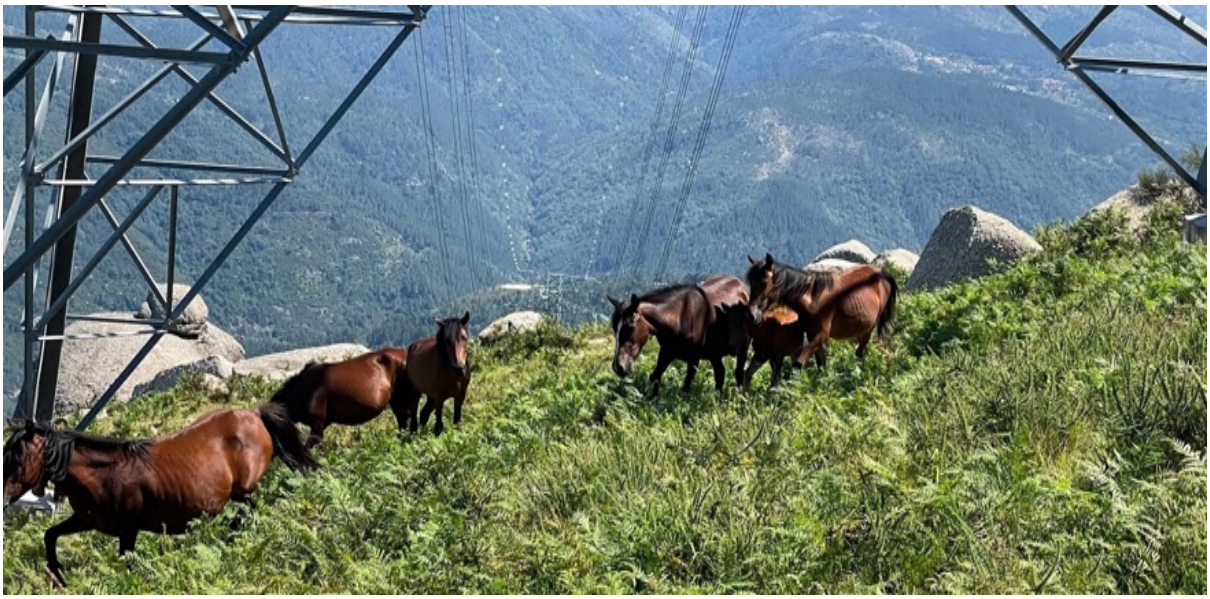
Wildfire management, engaging landowners, local economic opportunities, endangered species, communication, public acceptance, grazing, cultural heritage

REN (TSO)

More than 90% of Portuguese forests are small, privately owned parcels. Under current legislation, Portuguese TSO Redes Energéticas Nacionais (REN) must inform the respective owners in advance before entering the property. On average, they contact up to 25,000 landowners annually.

[18] Audoin, E (2018). Valoriser l'additionnalité des services écosystémiques fournis par le mode de gestion des terres sous les lignes à très haute tension

Given the high risk of rural fires in Portugal, REN must ensure safe fire management practices for infrastructure and communities in the area. For this, a high degree of coordination takes place between institutions in Portugal, including the Institute of Nature Conservation and Forest (INCF), the Integrated Rural Fire Management Agency, the National Emergency and Civil Protection Authority, the Portuguese Environment Agency and many more. Within the scope of an 'Integrated Rural Fires Management System', REN can ensure that their grid corridors are integrated into the Secondary Networks of Fuel Management Lanes. The planning of IVM actions must be analysed, approved, and monitored in by a commission for integrated rural fire management. Altogether, this promotes increased resilience to rural fires in the territories surrounding REN's infrastructure, guaranteeing the continuation of the ecosystem services provided in those territories.



Endangered garrano horses grazing under power lines as part of an agreement with local conservation groups and REN, 2023. Photo: ©Redes Energéticas Nacionais - REN

Moreover, REN partnerships enable rural landowners to obtain annual economic benefits from native forest plantings. Notable examples include Strawberry trees (*Arbutus unedo)* and a native variety of '*Eremlo'* oranges.[19] The strawberry tree is a low-growing shrub, whose fruit can be used to produce alcohol and other food stuffs, thus bringing an economic benefit to those who grow it. Since 2022, REN has planted around 1453 ha of Strawberry trees and other native plants and hardwoods. Additionally, REN encourages education about the native plants and ecosystem in Portugal as they carry out native-plant plantings with first and secondary cycle schools.

In the case of the native orange trees, 2024 saw REN implement a project to revalorise *Ermelo* oranges, a local variety of the village of *Ermelo*. Ermelo oranges are currently threatened, with a producing population of around 500 trees. Following an initial proposal by local authorities in 2019, a partnership was established to plant of 1355 *Ermelo* orange trees in three hectares of

[19] Renewables Grid Initiative (2022). Webinar: Grids for Life: Innovative approaches to Vegetation Management from the Iberian Peninsula

grid corridor. This culminated in a launch event in May 2024 that featured the symbolic planting of the last trees by 4th-grade students and the tasting of two dishes (prepared by a Chef) made with *Ermelo* oranges. The event included over 100 children, local authorities, governmental organisations, and local community members. In the future, this partnership will follow a line of action, promoting the product in local markets and fine products (jellies, chocolates, etc.) to add value to this product.

Another example of REN's commitment to long-term partnerships is its initiative to protect the endangered Garrano horses. The company established a protocol with the Association of Garrano Equine Breeders (ACERG), the Association of Planning of Serra da Cabreira (APOSC), and the Municipality of Vieira do Minho for the shared management of an area of 100 hectares of grid corridor. The protocol, signed in 2022, states that REN will provide fencing, watering troughs, improved pasture areas, and GPS tracking of herds to ensure species protection in some regions of the Cabreira mountain, while the horses will provide extensive grazing to reduce fire risk.

The benefits of these partnerships are further communicated to local and regional stakeholders, as infrastructure construction can have political implications. REN addresses these challenges by developing tailored communication plans, meeting with local authorities and other stakeholders, and coordinating closely within operational areas. Their approach varies with each project, considering unique community characteristics and political dynamics. Central to their strategy is a commitment to transparency, ensuring that all pertinent information is shared and communities are involved and engaged in the process.

2.6 Nature-based grazing solution for fire risk reduction & rural benefits in Spain

Grazing, wildfire management, collaboration with academia & NGOs, local economic opportunities, monitoring, government subsidies

Red Eléctrica de España (TSO)

Spanish TSO Red Eléctrica de España (REE) is another grid operator that has benefitted from partnerships that encourage grazing under power lines. In 2019, REE launched a collaboration 'Pastoreo en Red'[20] (network grazing) using herds of sheep as a nature-based solution (NbS) for vegetation management in a 13 hectare area beneath a 220 kV grid corridor in La Rioja. A primary objective was to combat forest fire risk by suppressing the growth of trees such as the prominent Aleppo pine *(Pinus halepensis)* without the need for mechanical intervention. The pilot's success has since motivated replication the project in five other regions. For the collaboration, the TSO entered partnerships with a local shepherd; a small, specialised consulting company, Agrovidar; local and regional authorities; and the Universities of Alcalá and Barcelona, for the evaluation of impacts on ecosystem services and cultural benefits.

[20] Redeia (2024). Pastoreo en Red

For 20 days over a one-year pilot period, 700 sheep grazed on the area for seven hours at a time. The coverage and volume of vegetation before and after the presence of the livestock was measured using drones. Field visits were also made to make inventories of the most abundant vegetative species in the area. The studies found that the practice contributes to healthier soil ecology and structure, improved water and nutrient retention, increased presence of pollinating insects, and lower greenhouse gas emissions. Crucially, the sheep were effective in reducing forest fire risk by suppressing problematic vegetation, generally reducing plant height and number of leaves, and trampling and manuring behaviour. In total, it was calculated that the sheep consumed 28,000 kilograms of organic matter and returning 14,000 kilograms as manure.

Shepherd grazing his flock under power lines as a nature-based solution, 2020. Photo: ©Red Eléctrica de España

Furthermore, by creating new income streams for the rural actors, the practice supports the local culture of shepherding through generational learning and can contribute to counteracting rural depopulation. In the case of the pilot project, remuneration for grazing services contributing to the maintenance for firebreak strips in public forests is calculated by local councils according to an algorithm. The algorithm considers livestock units, distance from livestock's sleeping pen, site inclination and difficulty of access, as well as state of vegetation before and after grazing in its calculation. In the pilot project, the shepherd was paid a total of €1,700 (130€/hectare x 13 hectare).

A final assessment with the University of Alcalá concluded that this practice improves the cultural, regulatory, and natural conditions, increases the resilience of power lines, and fosters biodiversity along the grid. In order to foster replication of the practice elsewhere, REE created a 'Practical Guide'[21] and a manual on 'Benefits of networked grazing: Services for Human Welfare' and promoted these materials in electricity grid sectoral forums, in training activities (e.g. shepherds' schools, and in the press. Interviews were carried out with both the shepherd and Agrovidar, and perception surveys with external actors suggest high levels of interest in carrying it out in their territories.

[21] Grupo Red Eléctrica (2021). Guía Práctica de Pastoreo en Red

2.7 Collaborative IVM: Engaging landowners and the public in Finland

Communication, engaging landowners, public acceptance, devolved management, collaboration with academia

Fingrid (TSO)

In Finland, land rights vary between private and state ownership, thus requiring close communication between stakeholders. The dialogues and collaborations with landowners provide the necessary permissions to implement IVM and enrich the grid operator's knowledge of biodiversity in the area. As Finnish TSO Fingrid uses contractors to implement their IVM measures, guidance is given to the landowners on how to use the grid corridor to benefit nature values, for example, on methods for grazing, mowing, and removal of invasive species. Moreover, landowners who allow decaying wood to remain standing for biodiversity benefits receive financial incentives.

Fingrid uses different strategies to communicate its IVM approach to the public. One method involves sending informational letters detailing the timing of selective clearing and cutting and asking permission to leave decaying wood, ensuring community members stay informed about vegetation management activities. Additionally, the company actively collaborates with universities and students, contributing to thesis work and surveys focused on demonstrating the benefits of IVM. These collaborative efforts aim to highlight the advantages of IVM to public stakeholders. Further details about these initiatives are accessible through Fingrid's regularly updated website[22] and annual newspaper.

2.8 Enhancing landowner collaboration and positive environmental impact strategic partnerships in Belgium

Engaging landowners, devolved management, communication, public engagement, contracts, local economic opportunities, government subsidies

Elia (TSO)

Partnerships with local stakeholders are vital for Elia's IVM implementation. As such, Elia often negotiates agreements with contractors, landowners, or site managers, such as forestry administrations, hunters, and farmers, to delegate the management through contractual agreements. To do this, Elia creates IVM plans that specify the types of action to be taken and stipulations on the commitment not to damage installations of restored habitats. They then bring the plan to prospective landowners, allowing them to negotiate how the area is used and who is allowed to manage it.[23] In some cases, the landowner is not the site manager and must agree to have a third party conduct the IVM plan laid out by the TSO. Once everything has been

[22] Penttilä, M. (2024). Land Use and Environment

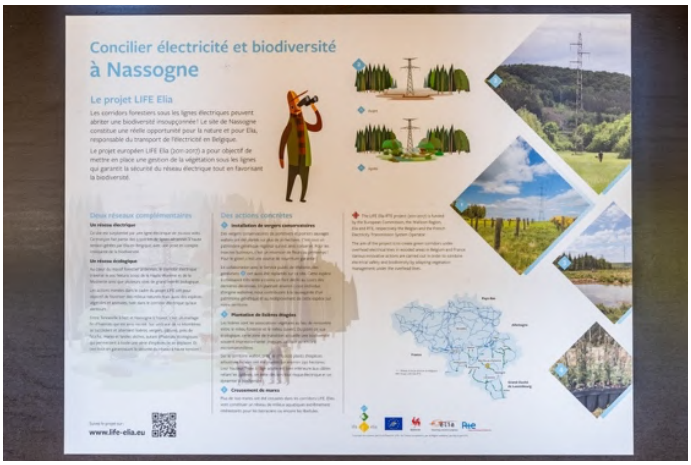
[23a] Life-Elia (2019). Transmission of Electricity Management of Vegetation in Forest Corridors: Negotiations and Agreements. Pages: 5-6

[23b] In the case of public land ownership, a bidding process may take place on who will provide a new management approach.

agreed upon, the two- or three-party contract is signed (usually five years in length), and the manager is assigned permission to conduct actions with a 'free of charge' use of the land. Once the contract expires, owners can decide to continue with site management as is or delegate to another party.[24] These agreements can be verbal, but written agreements between the landowner and the TSO, and the landowner and site manager are preferred to ensure smooth processes and a holistic understanding of the agreements.

Crucially, a strong incentive for landowners/external actors with Elia to 'partner up' is the availability of public financial compensation. Provided that the management contributes positively to nature restoration and the landscape, tax benefits, financial compensations, and subsidies are available at regional, national, and European levels (e.g., Natura 2000 funding). For example, farmers in the region of Wallonia have received subsidies under the Common Agricultural Policy (CAP) to manage the ecological corridors.[25] Furthermore, direct benefits exist for rural actors, such as access to more pasture or open land for deer hunting.

Moreover, Elia reports IVM's positive impact in terms of improved relations with local administration and municipalities, as grid corridors cease to be a 'no man's land' and become an attractive place to visit with concrete benefits for rural actors. This has led to stronger relations with residents and a greater understanding of Elia's mission. Elia has also begun to provide information about IVM (and its replicability) to other TSOs, municipalities, and other linear infrastructure managers (e.g., gas grids, railways, and highways). To share the lessons with the public, Elia built didactic learning panels on several sites, a public viewing platform, and an education session for schools and community planting or pruning actions.



Information board for public education on integrated vegetation management practices and their benefits, 2023. Photo: © Elia Transmission Belgium

2.9 Collaboration across the IVM 'value chain' in Europe

Collaboration with academia and NGOs, engaging landowners, communication, public acceptance, education

E.ON (DSO)

[24] Renewables Grid Initiative (2023). Implementing Integrated Vegetation Management across Europe

[25] Life-Elia (2019). Transmission of Electricity Management of Vegetation in Forest Corridors: Negotiations and Agreements. Pages: 5-6

When their IVM concept was initially developed, one of E.ON's (European DSO network) German subsidiaries, Westnetz collaborated with the University of Freiburg to refine its approach. Over time, maintenance measures were coordinated with the local authorities, NGOs, forest administrations, and large-parcel landowners. E.ON now collaborates with external stakeholders and suppliers throughout the entire IVM 'value chain'. For example, E.ON works with biologists to map biotopes and plan IVM measures and with forestry companies to implement actions. In cases where particularly special biotopes are encountered, often separate, collaborative projects are launched in response. An example of this is in Eastern Germany, where two DSOs (e.dis & Mitnetz) are collaborating with three external partners, including the local branch of Rewilding Europe, to develop refined IVM plans.

IVM also requires considerable coordination with and approval from respective landowners. As landownership structures and approval processes vary widely across and within the six countries of E.ON's subsidiaries. For instance, in Germany E.ON must align all specific cutting measures with landowners, who, in turn, also have a say in what happens to biomass after removal. In other countries, such as Sweden, there is no need to align individual measures with landowners. Even with these extra steps, E.ON reports that many landowners are cooperative. In general, a benefit of IVM for residents is that it brings less severe interventions in the landscape and contributes to a more intact ecosystem. From the suppliers' perspective, IVM brings the development of new fields of sustainable business activity.

In terms of external communication of IVM, Westnetz began in 2005 to collaborate with NGOs on marketing campaigns in print, educational materials, and TV media. One example is their education initiative called 3MalE,[26] which offers teachers and parents educational material related to energy, science, maths, and environmental education. In the context of these many marketing publications, NABU (BirdLife Germany) and DUH (German Environmental Aid) became aware of the project and pushed the IVM program further in Germany. At E.ON, their ambition has been publicly announced and included in communication campaigns linked to the UN Decade on Ecosystem Restoration.[27]

2.10 Engaging landowners and NGOs for sustainable land management in Portugal

Engaging landowners, collaboration with NGOs, communication and public acceptance

E-REDES (DSO)

In Portugal, more than 97% of land is private, which means that any intervention to promote the IVM objectives implies the identification of solutions and long-term commitments with the support of landowners. Portuguese DSO Distribução de Eletricidade (E-REDES) collaborates with environmental NGOs and local associations and has established several formal protocols with these actors to delegate management for some IVM actions and to identify economic benefits and conditions for engagement in pilot projects. Additionally, E-REDES holds an annual

[26] Lernpaket Ökosysteme (2024). Bildung mit Energie

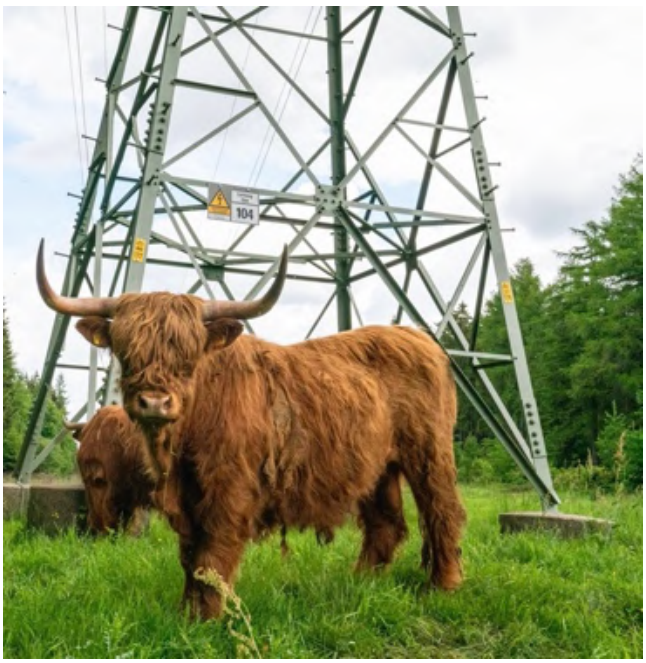
[27] E.ON SE (2023). E.ON: Rewilding - Giving space back to nature (episode 9)

conference on vegetation management and biodiversity where they invite specialists to share their knowledge on practical and technological improvements to enhance their IVM approach.

2.11 Collaborative grazing contracts and IVM in Bavaria, Germany

Grazing, devolved management, endangered species, local economic opportunities, contracts, health and safety

Bayernwerk Netz (DSO)



Grazing cattle under powerlines, 2024.
Photo: Adriane Lochner, ©Bayernwerk Netz GmbH

Bayernwerk (German DSO) operations require coordination and the drafting of contractual agreements with local landowners and stakeholders like agencies, forest engineers and farmers. One example of these partnerships for Bayernwerk is the creation of grazing contracts with livestock owners. Bayernwerk provides mobile fences which span around 200 to 400 square metre and static fences for larger grazing areas. Furthermore, Bayernwerk supports the livestock owner with a certain fee per hectare. The livestock owner is then responsible for the general animal welfare, drinking water, and maintenance of the fence. The livestock involved include cattle, goats and sheep (including regionally important and endangered species such as the Coburg Fox Sheep and Tyrolean Mountain Sheep) with plans for horses and chickens. Grazing is a primary management tool that ensures maintaining vegetation levels and benefits corridor biodiversity.

Financially, IVM actions are collaborative. Bayernwerk covers fencing expenses, with partner companies handling fence care and maintenance. Partners are also remunerated for grazing services, and contracts are negotiated to ensure fair compensation for project success. While grazing is assumed to bring socio-economic benefits, regional studies have yet to be conducted. Some benefits that Bayernwerk provides are increased access to grazing areas within grid corridors and direct payments in return for grazing to shepherds. For the DSO, benefits include increased work safety (because animals now graze in steep areas that technical colleagues used to maintain with chainsaws), partially reduced maintenance costs, and improved public relations. Communication of these benefits occurs through social media, websites and flyers.

2.12 Engaging landowners and local stakeholders in Germany

Communication & public acceptance, collaboration with NGOs and academia, devolved management, engaging landowners

Amprion (TSO)

In Germany, the land under the power lines belongs to local landowners. Consequently, it is critical for landowners to actively participate and provide consent at the IVM process. By leveraging local knowledge, Amprion (German TSO) enhances its ability to map and implement IVM through external service providers. Some IVM projects may also involve volunteers and environmental associations.

To ensure stakeholders stay informed, Amprion shares project updates through easily accessible brochures and flyers on its website. To inform authorities and landowners, Amprion mostly uses IVM plans, which contain maintenance measures and habitat types. Continuously working together and developing the IVM plans with local authorities, NGOs, forest administrations, landowners, and universities can boost public acceptance of corridor maintenance.

2.13 Integrating wildfire prevention and grazing with IVM in Germany

Sustainability reporting, communication, public acceptance, collaboration with academia and NGOs, government subsidies, local economic opportunities, monitoring

50Hertz (TSO)

50Hertz considers close work with landowners and regional authorities as instrumental for IVM actions' success. In particular, the company has had successful experiences through partnerships for grazing within grid corridors and are currently further exploring its potential. Some examples are illustrated below:

Countering Forest Fires with Forest Grazing

In 2022, intense forest fires burning only a few hundred metres from the town of Beelitz (Brandenburg, North-Eastern Germany), were a shocking reminder of the advancing pace of the climate crisis, the sensitive state of forests in the region (largely monoculture pine plantations), and the need for solution strategies. In response, the regional authorities are drafting an alternative forest fire protection concept, which should include a "forest fire protection strip" close to the town.

For 50Hertz, the relevance of IVM in reducing forest fire risk was clear. Based on their "ActNow" sustainability programme, 50Hertz decided to explore with the old technique of forest grazing (or woodland pasture), whereby animals graze in wooded areas and thereby remove combustible biomatter. Although regional forest law prohibits this form of management, it makes an exception if forest grazing "serves to maintain the biotope in the forest".[28] Thus,

[28] Landes Brandenburg (2004). Waldgesetz §37 (2), 8

50Hertz and other local actors, including the regional nature protection and forestry authorities, fire brigade and a local shepherd are planning to reintroduce the practice of forest grazing. Under the plans, a 20-kilometre grazing corridor will be introduced, offering a "win-win" situation for all parties, namely protection for the town through a fire protection strip; boost to biodiversity through an open land biotope network; improved economic viability of the shepherd's activities, due to a larger access area; ecological vegetation management in the grid corridor.

Sheep Under Power

A major example of collaboration came in 2020 within the framework of the project 'Sheep Under Power' (*Schafe unter Strom'*) [29] between 50Hertz; DSO Mitnetz Strom; the Technical University of Dresden, and the Landscape Conservation Association of West Saxony (*Landschaftspflegeverband Westsachsen e.V.*). By opening new pastures under the high-voltage routes to local shepherds, a continuous network of habitats for rich species near power grids with clear economic benefits for local actors.

Sheep under power lines, 2024. Photo: ©50Hertz Transmission Gmbh

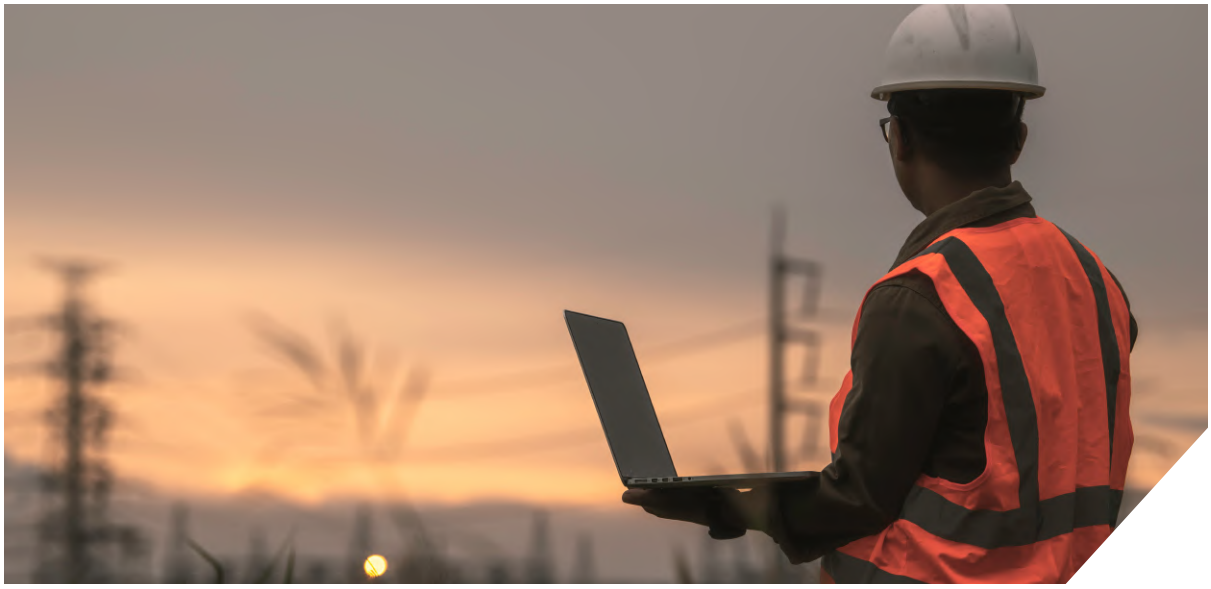
The Technical University (TU) of Dresden, was responsible for the scientific documentation of the project, to ensure that its results are measurable and comparable, and can feed into recommendations for future land management, including in other regions. Their involvement included a preliminary ecological inventory before the measures and at recurring annual intervals. Birds and butterflies were also monitored throughout the project. While delays due to the COVID-19 pandemic have so far precluded findings related to the presence of the sheep, the monitoring team spent a considerable time on the project areas during the mapping exercises and were thus able to give a series of recommendations based on their scientific observations. For example:

- Low-growing woody plants such as various species of dogwood, rowan, elder or raspberries can form permanent, low-maintenance stands in grid corridors.
- The edge-effect of grid corridors is important for many birds for foraging, breeding and courtship, including Red-backed shrikes *(Lanius colurio)* and Tree pipits *(Anthus trivialis)*.
- Individual trees, hedges and lower-growing trees - such as European rowan *(Sorbus aucuoaria)* and Field maple (*Acer campestre)* enable a structured and diverse corridor which benefits a variety of species, including as stepping stone biotopes.

[29] Landschaftspflegeverband Westsachsen e.V. (2020). Schafe unter Strom

- The presence of small bodies of water, including temporary ponds is very beneficial to many species, especially in periods of drought. It is recommended to consider which areas of a site could support temporary water bodies without extensive maintenance measures.
- The presence of deadwood brings many benefits to biodiversity. In areas of low wildfire risk, land managers could consider leaving behind felled trees in piles.
- Open ground areas benefit many plant species, birds and reptiles.
- This practice promotes of rare profession of shepherding and provides economic opportunities.
- Excursions and lectures provide educational and leisure opportunities for the people in the district of Zwickau, allowing them to learn about environmental protection and the benefits of sheep farming.

Communication and promotion of such projects is done through print and online media in conjunction with project partners. This has shown to have positive interactions with local newspapers, which has benefitted 50Hertz's IVM implementation. Additionally, 50Hertz's sustainability report documents contain all actions and serve as a vital indicator for its strategic sustainability program. Indeed, accurate reporting on their IVM actions helped 50Hertz to secure a green bond for continued IVM work.



3 | Regulation & Funding

Well-planned integrated vegetation management in grid corridors can bring numerous benefits for biodiversity and local people, while at the same time also reducing long-term operational costs for corridor management. Implementation at scale is, however, only possible if a strategic commitment by asset owners and a supportive regulatory framework are in place. At the company level, IVM implementation requires enabling structures and dedicated capacity, including staffing and contracting processes. At regulatory level, the recognition of the required investment costs supports and facilitates grid operators to initiate IVM and mainstream its design and deployment.

In this chapter, readers will find case studies from grid operators demonstrating that IVM is a win-win approach: for nature, people, and cost-efficient grid operation. In particular, many grid operators describe how they face and overcome two key challenges: namely the current economic environment and the struggle to demonstrate non-financial benefits of IVM.

The case studies in this brochure demonstrate the challenges grid operators face in receiving approval from regulators for the relatively high initial investments needed to get IVM 'off the ground', e.g. to hire biologists and undertake mapping processes. However, experiences show that over the operational lifetime of the corridors, the cost of IVM implementation can be substantially less than conventional operational costs. This is because IVM relies less on intensive human, mechanistic and chemical inputs, and instead allocates a stronger role to natural, self-regulating processes in the ecosystems in question[30]. Indeed, a cost-benefit analysis carried out under the landmark LIFE project by Elia in Belgium and RTE France (LIFE-Elia-RTE) calculated that IVM is 1.4 to 3.9 times less expensive for than conventional management over 30 years[31].

[30] This shift also brings greater health and safety for technicians.
[31] LIFE Elia-RTE (2017) "A Cost-Benefit Analysis of an Alternative Vegetation Management". Source

Furthermore, it is challenging to measure and therefore quantify the non-financial value of IVM, such as biodiversity protection, ecosystem integrity, local socio-economic opportunities and public acceptance. Indeed, the work of RGI & IUCN's 'Global Initiative for Nature, Grids and Renewables' (GINGR) will develop a framework to allow for quantification of these factors. In the meantime, several grid operators confirm that IVM is already perceived positively within their ESG processes. As such, when deployed at scale, IVM can contribute in a major way to a company's sustainability scores and credit ratings. This is more relevant than ever, considering that the new Corporate Sustainability Reporting Directive (CSRD) places sustainability on a level playing field with financial reporting and requires grid operators to report on the link between their operations and biodiversity for the first time. Moreover, as Europe's Nature Restoration Law brings binding obligations for all Member States to restore 20% of terrestrial (and marine) areas by 2030, IVM can present a tool for grid operators to contribute to national and EU targets. Finally, experiences show that IVM contributes to a better public perception of grid infrastructure and thus can create more public acceptance and, in turn, reduce the cost and delays brought about by public opposition to projects.

On balance, it seems clear that the marginally higher investment costs of IVM are more than outweighed by the countless advantages it can bring, both in terms of tangible and non-accountable benefits throughout the operation period. A future-oriented and holistic regulatory approach could support scalability and speed of IVM implementation and standardise its application so that it becomes a minimum benchmark in appropriate grid corridors, rather than a project-by-project decision.

3.1 50Hertz's regulatory interactions in Germany

Regulatory considerations, IVM expenditure classification, permit allocation

50Hertz (TSO)

Interactions between TSO 50Hertz and German regulators mainly involve the forestry regulatory body and the lower nature conservation authority. In general, there is no difference between IVM and general vegetation management from a regulatory point of view, as 50Hertz does not conduct replanting or add more vegetation to sites. In the cases of tree cutting, they require a permit this can impact the landowner's economic interests. 50Hertz gains easements with the landowners to be allowed to cut trees for security reasons. Grazing requires permission from the forestry regulator and in some cases, the permitting process can hinder grazing in the wooded areas.32 For example, in Brandenburg, regional law only permits grazing in wooded areas when it is clearly for the purpose of biotope protection.

In general, IVM is classified as OpEx because it is related to network management over a long period of time, not only to the initial investment costs. Moreover, IVM is done voluntarily without legal obligation, and implementation costs depend on the existing vegetation.

[32] See page 35 for more information on 50Hertz's grazing practices.

3.2 Amprion's regulatory interactions in Germany

Regulatory considerations, funding and expenditure classification, internal resource needs

Amprion (TSO)

German TSO Amprion's main interactions with regulators generally involve the lower nature conservation authority and the Federal Agency for Nature Conservation (BfN). As a rule, no permits are required for measures that serve the safe operation of the line, as these will have already been obtained as part of the project approval and are generally authorised by law. However, the maintenance measures carried out as part of the line maintenance are regularly coordinated with the landowners and the nature conservation authorities. Legal requirements, such as the ban on pruning during certain periods, are observed.

Amprion has been using IVM techniques since 1994, the practice is now integrated into their operational expenditures as a part of their nature conservation strategy.

Amprion's commitment to legal requirements sheds light on its enduring regulatory challenge in implementing IVM programs efficiently and hiring service providers who are well-versed in IVM. IVM is generally classified as OpEx as it has been integrated into their nature conservation projects for several decades. The initial IVM plans for new grid projects can be classified as CapEx.

3.3 Bayernwerk's regulatory interactions in Germany

IVM funding, IVM business case requirements

Bayernwerk Netz GmbH (DSO)

Bayernwerk considers interaction with regulators to be integral at all levels of the IVM process, from municipal to federal. Permitting processes are crucial, especially those dictating the timing of implementation, as they significantly impact project budgets and staffing.

A yearly budget is allocated to IVM, which is continually reviewed and gradually increased as required. The current environmental pressures, such as the biodiversity crisis, have bolstered internal support for IVM, and the E.ON Group's support has also been a positive influence in increasing approval for more IVM projects. While some IVM practices can be less expensive than conventional vegetation management – such as mowing and grazing rather than extensive tree removal – they are not always entirely less expensive. Indeed, some practices do require more effort or cost, such as contracting biologists. However, IVM's other key advantages bring additional benefits that outweigh the costs.

3.4 E-REDES's regulatory interactions in Portugal

Regulatory considerations, IVM funding, IVM expenditure classification, Wildfire management, IVM business case

Distribução de Eletricidade, S.A. – E-REDES (DSO)

As is the case for the Portuguese TSO, REN, DSO E-REDES must comply with the forest fire

and nature conservation regulations of the ICNF. As described on page 10, it is in this context that E-REDES challenged ForestWise to develop the catalogue of species for 'Compatible occupations' in rural fire law. The implementation of compatible species must also be proposed and approved in sub-regional rural fire commissions.

E-REDES internally funds its forest fire and vegetation management work, for which it has a budget of around €20 million annually. Conventional vegetation management is classified as CapEx, which is subject to review every three years. Issues of proximity to trees and subsequent corrections are classified as OpEx. To assist in future project implementation, E-REDES has carried out a theoretical cost-benefit-analysis of certain IVM actions, which demonstrated that specific actions, such as grassland restoration and pastures, have lower costs after ten years than conventional management and bring a return on investment within 18-24 years respectively.

In addition to their IVM actions, E-REDES has worked within the scope of several LIFE-funded projects on bird-related topics and are now looking to further promote IVM through a new LIFE call proposal in 2024.

3.5 E.ON's regulatory interactions in Europe

Regulatory considerations, IVM funding, IVM expenditure classification

E.ON SE (DSO)

For IVM implementation, the approval process to (re-)build assets and corridors is a vital consideration, wherein the lower nature conservation authorities and regulators play a key role. For example, in the case of one country where European network of DSO's E.ON is active, the local regulator does not permit any vegetation to be higher than three metres, which restricts the number of actions available. In terms of funding approval, regulators across E.ON's grid network generally recognise IVM as OpEx, and funding is managed centrally. However, there have been occasions where E.ON has received external funding under the EU LIFE or INTERREG programmes.

Additionally, an ongoing concern for E.ON is the concept of 'Nature for a Time' (*Natur auf Zeit)*. This is a dilemma faced when grid operators need to rebuild or upgrade grid corridors, which are managed according to IVM. In these cases, biodiversity in the IVM areas may be temporarily disturbed or reduced. If the authorities recognise this temporary disturbance as unacceptable – even though ecological management would resume post-construction - it could slow down the approval process and be counterproductive to the goals of the energy transition. This issue is subject to ongoing discussion by many grid operators.

3.6 Elia's regulatory interactions in Belgium

IVM funding, IVM expenditure classification, IVM business case requirements
Elia Transmission Belgium SA (TSO)

The overall budget of the LIFE project which launched Elia's IVM journey (LIFE-Elia-RTE, 2011-2017[33]) was €3.2 million, of which 36% was covered by the European Commission, 25% by the Walloon Region, 24% by Elia and 15% by the French TSO, RTE. The Belgian National Regulatory Authority (NRA) was supportive of Elia's participation in the LIFE project, and it was willing to grant the funds on the condition that they actively seek subsidies and fulfil annual reporting duties.

Since 2018, Elia's continued IVM implementation is 100% self-funded and considered OpEx. To be granted funds, the NRA required Elia to explain why IVM initially requires greater operational costs (in the beginning) but lower costs in the long run. The cost-benefit analysis[34] from the LIFE project was a useful illustrative tool in this regard. The NRA appreciated the extensive reporting of benefits for biodiversity and local communities, along with anecdotal evidence of improved relationships with stakeholders as a further reason for Elia's continuation of IVM. Following this, the NRA approved the project for every subsequent tariff period. Funding for communication and biomonitoring were included in the new IVM plan. Currently, Elia has received a European green bond to continue and expand their IVM work.[35]

3.7 REN's regulatory interactions in Portugal

Regulatory considerations, IVM expenditure classification, wildfire management
Redes Energéticas Nacionais, SGPS, S.A. – REN (TSO)

Due to the heightened threat of wildfires in Portugal, in compliance with the National Integrated Fire Management System, the planning of IVM is coordinated in a collaborative setting.[36] TSO REN's intervention plans are integrated into the Sub-regional Action Programs, which are prepared with institutions such as the Institute of Nature Conservation and Forest (ICNF), the Integrated Rural Fire Management Agency (AGIF), the National Emergency and Civil Protection Authority (ANEPC), municipalities, other public utility infrastructure managers and more.

---

[33] As described in the introduction to Elia on page 56-57 or see Ecofirst (2024). Life Elia-RTE Project
[34] Life-Elia (2024). Brochure n°2 Cost-benefit analysis
[35] A green bond is a form of financing the low-carbon transition. Applicants for a bond voluntarily follow a detailed criteria from the EU taxonomy that defines what are green economic activities to ensure transparency that is line with best practices at the EU level. All applicants and recipients are supervised by external reviewers. From: European Commission. (2023) *The European green bond standard – Supporting the transition*
[36] The licensing bodies REN works with are the Institute of Nature Conservation and Forest (ICNF), the Integrated Rural Fire Management Agency (AGIF), the National Emergency and Civil Protection Authority (ANEPC), the Portuguese Environment Agency (APA), the Energy Sector Regulatory Entity (ERSE), General Directorate of Energy and Geology (DGEG), Intermunicipal Communities, and other Municipalities.

Moreover, the ICNF must authorise the felling and pruning of protected cork and holm oak. They must also authorise, in coordination with local municipalities, the general implementation of reforestation projects, especially near waterways.

Community tree planting under power lines, 2024
Photo: ©Redes Energéticas Nacionais - REN

The regulator classifies integrated vegetation management actions as both OpEx and CapEx. OpEx operations are characterised by continual compliance with the safety distances between vegetation and conductor cables as per the terms set out in their power line safety regulation. The CapEx classification considers all other measures related to vegetation management, namely the compliance with fuel management criteria within the scope of the Integrated Rural Fire Management System, such as reforestation actions and actions to increase the resilience of electrical lines to extreme events.
In terms of cost reduction, the reconversion of land in the grid corridors through the reduction of fast-growing species (e.g., eucalyptus) has decreased need for maintenance visits to IVM areas. This increases the efficiency of work implemented, which is reflected in the cost per area of fuel management interventions.

3.8 RTE's regulatory interactions in France

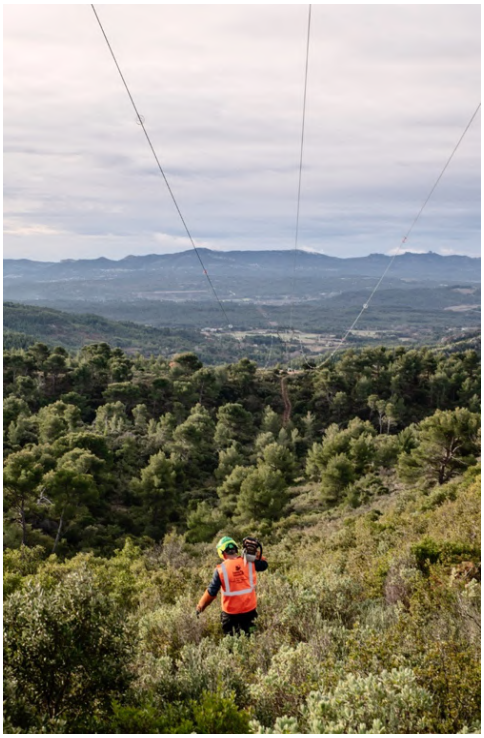
Permit allocation, IVM funding, IVM expenditure classification, IVM business case
Réseau de Transport d'Électricité – RTE (TSO)

French TSO Réseau de Transport d'Électricité (RTE) must manage forest clearing with in the strict regulations defined in the Forest Code (articles L341-1 to L341-21). This code specifies the conditions under which tree cutting can be authorised and the procedures to obtain authorisation. Permits depend on the area to be maintained, the associated forest area, and the type of land (agricultural, forest, natural). Additionally, an environmental impact assessment & subsequent public consultation may be required in the permit application. Property law is another key consideration, as landowners have the right to block any project that does not suit them. Due to this blockage ability on IVM, except in the case of selective cutting, RTE seeks to implement IVM where barriers are low. This avoids permitting that involves relatively long processing and sometimes compensation.

IVM is self-funded by RTE and is mainly considered as an operational expenditure (OpEx). An exception is made when it is carried out as part of engineering projects, it is then considered a factor for project acceptability and is financed as a capital expenditure (CapEx). An important factor in receiving the regulatory 'green light' for IVM initiatives is the expected return on investment. When managed internally, a project is expected to become profitable within eight

to twelve years. In areas where OpEx maintenance costs are already low, RTE is sometimes constrained because they do not achieve this level of profitability. For the implementation of IVM in the context of CapEx rehabilitation projects, the timeline for this return on investment can be stretched to up to twenty years, thus making it possible to finance external consultants for IVM implementation, such as for the ecological design of corridors.

One way in which RTE is looking to improve its IVM capabilities is to increase internal resources to manage service providers who work on studies, find solutions, and monitor the power line corridors. To do this, they are in discussions with their regulator to increase funding.



Selective cutting in France, 2023. Photo: Benjamin Bechet, ©Réseau de Transport

3.9 TenneT's regulatory interactions in the Netherlands

Regulatory considerations, IVM funding, IVM expenditure classification, permit allocation

TenneT Holding B.V. (TSO)

For TenneT, regulatory oversight is conducted by municipalities and provinces or the state forestry organisation. TenneT's initiatives are subject to various legal considerations and financial dynamics, focusing on compliance with the permitting processes and budget allocation. Felling trees, for instance, requires permission or permits from municipalities. TenneT's annual vegetation plan falls under OpEx. This also includes their agreements with landowners to convert fast-growing vegetation to slower-growing vegetation types. As the slower vegetation types require less management, there is generally a return on investment within a few years.

TenneT does not receive external funds for IVM activities and relies on internal budget allocations and landowner support. This reflects TenneT's strategic commitment to environmental sustainability and biodiversity conservation as integral components of its operational priorities.

3.10 VSD's regulatory interactions in the Slovakia

IVM expenditure classification, IVM funding, human resource needs

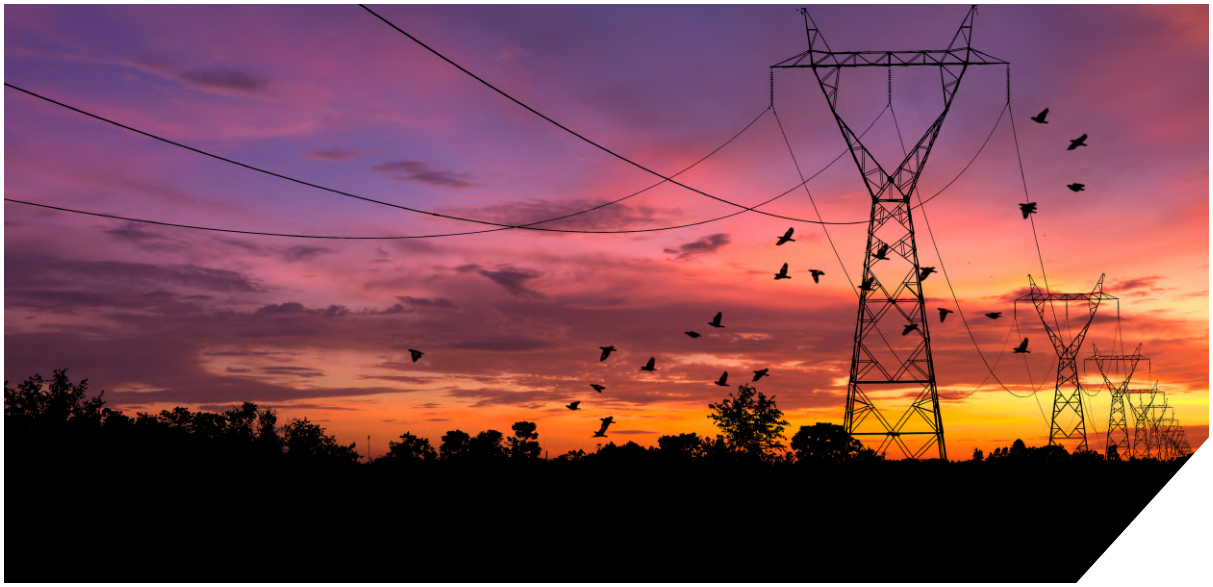
Východoslovenská distribučná, a.s. – VSD (DSO)

Slovakian DSO Východoslovenská distribučná, a.s. (VSD) manages IVM practice and implementation costs in consultation with regulatory bodies such as the state nature protection agency, district offices, and the state water management enterprise. The regulatory bodies in

Slovakia recognise IVM as an eligible operating expense (OpEx) and do not distinguish it from other conventional vegetation processes. This classification is helpful to IVM uptake as most IVM implementation costs are built into projects' budgets. The only exception to this was in 2018-2022, when VSD received a LIFE Programme grant to implement the project "Conservation of the eastern imperial eagle by decreasing human-caused mortality in the Pannonian Region."[37] The grant covered 3-4% of its annual IVM budget.

The OpEx classification also means that IVM is only more demanding regarding internal administration and communication activities. To streamline these processes, VSD brings certain activities 'in-house' (to their team of biologists), enabling them to reduce costs and ensure that IVM expenditures, on average, are the same as for conventional vegetation management.

[37] European Commission (2023). Conservation of the eastern imperial eagle by decreasing human-caused mortality in the Pannonian Region



4 | Implementation: Challenges & Opportunities

The pathway to IVM implementation in electricity grid corridors is not a linear one. Many of the grid operators with whom we engaged report having faced challenges which once seemed insurmountable but turned out to be manageable and led to surprising new opportunities. All of them describe having learnt important lessons along the way, which they were keen to share with others to help them along the way.

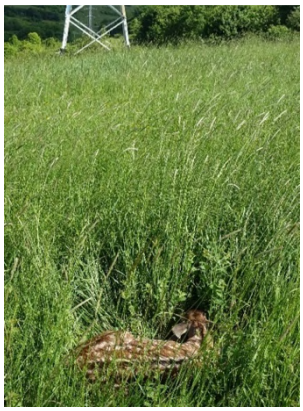
In the following and final chapter, readers will find case studies wherein grid operators describe the main challenges and opportunities of their own IVM implementation journey. These experiences are as diverse as the landscapes in which they are active, including legislative matters, landowner support, cost, digitisation, asset ownership structure.

4.1 Implementing IVM in Slovakia

Public acceptance, regulatory needs, human resource needs

Východoslovenská distribučná, a.s. – VSD (DSO)

One of the biggest challenges for Slovakian DSO Východoslovenská distribučná, a.s. (VSD) in successfully planning and executing of IVM is its communication to the public, who might not be well versed with the technical aspects or benefits of the process. Moreover, they recognise that different stakeholders might be hesitant to adopt a new strategy that could be costlier or could take longer. Therefore, VSD considers it vital to have a communication strategy that informs the benefits of IVM and its role in protecting biodiversity.



Faun under power line in Slanské Nové Mesto, 2024. Photo: © Východoslovenská distribučná, a.s. - VSD

Simplifying administrative processes can help improve IVM implementation and communicate its importance to stakeholders and residents. Because of its various benefits, VSD is determined to

continue to spread awareness by expanding areas with applied IVM, prioritising the preservation of biodiversity, and increasing the resilience of power lines.

4.2 Implementing IVM in Norway

Regulatory needs, environmental values

Statnett SF (TSO)

One key challenge to Statnett's IVM implementation is the need to enhance the understanding of ecosystem values within and adjacent to their grid corridors. Norway boasts numerous unexplored natural areas, which highlights the importance of increased availability of information about environmental variables. Such variables would encompass landscape types, habitat classifications, and species distributions across the country and provide valuable insights for Statnett's IVM practices. A national evaluation in this area would be beneficial.

Further actions, such as internal collection on ecosystem values in and around their grid corridors, are being discussed. Statnett hopes this will enable them to find areas of special interest for further IVM implementation.

4.3 Implementing IVM in Portugal

Regulatory challenges, human resource needs

Redes Energéticas Nacionais – REN (TSO)

Grid corridor with the placement of trees that fulfils Portuguese fuel management criteria, 2024. Photo: © Redes Energéticas Nacionais - REN

The main challenge for implementing Portuguese TSO REN's IVM strategy is compliance with fuel management criteria defined in current legislation. The compatibility of actions promoting biodiversity and ecosystem restoration must be carefully balanced with the fuel management criteria responsibilities determined in the legislation and ensuring infrastructure protection. Additionally, the traditional property regime in Portugal always implies the involvement of many landowners, which can complicate actions and interventions at a larger scale. IVM in Portugal has a further confounding factor due to the high demand and low availability of human resources for preventive forestry work. Also, it is frequently seen that forest operations have low productivity, commonly due to a mismatch between the machinery used and the specific conditions of the site to intervene.

This means that any IVM practice to promote natural values must also ensure (1) compliance with the legislation, (2) infrastructure protection, (3) allow a management at a strategic and tactical scale. Despite these challenges, REN will continue IVM to promote biodiversity and restore ecosystems compatible with fuel management criteria to create shared value.

4.4 Implementing IVM in France

Stakeholder acceptance, human resource needs, investment challenges

Réseau de Transport d'Électricité – RTE (TSO)

French property law gives strong veto powers to landowners regarding land management practices, which further underlines the importance of getting landowners on board with alternative management practices and signing agreements for IVM implementation. Indeed, IVM has proven capable of improving the acceptability of the creation of new power lines in France by focusing on aspects which are important to the public, such as landscape integration. Some traditional vegetation management work that had been blocked due to opposition from residents has since been unblocked thanks to IVM.

To streamline the process, French TSO Réseau de Transport d'Électricité (RTE) has established a framework agreement for the implementation of IVM through specialised service providers. Additionally, they have requested additional human resources from their regulator to manage, design, and oversee these projects. This framework aims to facilitate all steps for IVM implementation such as the initial study to identify promising areas, project design, searching for interested partners (e.g., for grazing), agreement signing, work supervision, and data management in their tools.

Another difficulty is the realisation that specific biodiversity-enhancing projects require a higher financial investment. To further develop IVM and carry out more ambitious (and therefore perhaps more expensive) biodiversity actions, RTE is in discussions with their regulator to discuss the potential to finance more IVM projects with a profitability period of twenty years. In general, increased support and simplification of the IVM permission process in France would help achieve RTE implement each site plan faster.

4.5 Implementing IVM in Finland

Stakeholder acceptance, internal challenges

Fingrid Oyj (TSO)

Finnish TSO Fingrid sees two main challenges to IVM implementation. The first challenge is getting landowners on board, specifically where local stakeholders do not understand its benefits. The second challenge is balancing Fingrid's primary mission, security of supply, with nature conservation actions. It can be challenging to secure internal buy-in for nature protection measures. However, they are hopeful that by showcasing the outcomes and benefits of IVM and their collaboration with stakeholders, they can garner increased support for IVM internally and externally.

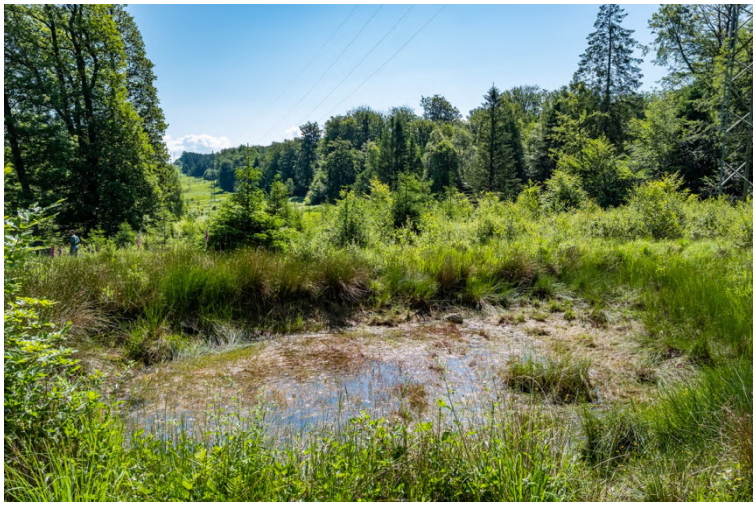
To continue and improve their vegetation management strategies in the future, Fingrid is planning a pilot project to examine the effects of the shorter cutting cycle on biodiversity. For this purpose, they aim to define the company's biodiversity goals and examine how IVM can play a role here.

4.6 Implementing IVM in Belgium

Regulatory challenges, regulatory needs, government support

Elia Transmission Belgium (TSO)

Belgian legislation regarding forest management varies between the federal regions of Flanders and Wallonia. Flemish legislation is more restrictive and takes a far more protective stance whereby every act of cutting must be authorised in a lengthy bureaucratic process, whereas Walloon legislation is generally permissive of cutting, so long as it is limited and takes place outside protected areas. Indeed, the stringent requirements for permitting and legal impositions (e.g., regarding invasive species) in Flanders were a factor in the LIFE-Elia-RTE project, which was only active in the region of Wallonia.



Life Elia-RTE project outcomes under Elia powerlines, 2023. Photo: © Elia Transmission Belgium

Over the course of the LIFE project, engagement between project partners and the authorities cultivated an understanding of the myriad benefits of IVM within the latter, to the point that authorities came to promote and expect IVM alongside overhead lines (OHL) as an alternative for underground cables which make the grid corridors more acceptable and valuable. Against this background, the Flemish authorities and Elia's operational services in Flanders became more receptive to IVM in the region. Furthermore, the Flemish Government has since developed "Criteria for Integrated Nature Management", under which the Agency for Nature and Forests (ANB) and forest owners draft 'Nature Management Plans' to show compliance. These plans, once accepted, act as planning permission and last for 24 years. Recognisant of the benefits of IVM, the ANB has included ecological corridors in these plans and collaboration with Elia is ongoing to accomplish a 'general' management plan for all ecological corridors in Flanders. This process will remove the need to request specific cutting permits in the future and allow more freedom in executing actions but could conceivably bring a risk that certain owners will not accept such long-term agreements.

4.7 Implementing IVM in Ireland

Stakeholder collaboration, innovative opportunities

EirGrid Plc (TSO)

Irish TSO EirGrid sees more than a few opportunities to expand its IVM practice. Since 2022, EirGrid and ESB have been developing a 'Strategy for Planting Over High Voltage Cables', which is currently undergoing a design risk assessment. This assessment includes input from a contracted arboriculturist and EirGrid's electrical engineers to advise on maximum root depths

and provide potential cable rating impact assessments. The risk assessment is being informed by iterative engagement with the ESB, other European TSOs via RGI, the Irish Department of Agriculture, Food and the Marine on proposed candidate shrub species, and suppliers of root barrier membranes. Most recently, in 2024, EirGrid established a working group to progress the strategy. EirGrid and ESB are currently exploring a pilot project to test the impact of laying a root barrier membrane on an energised underground cable (UGC), which includes distributed temperature system (DTS) fibre optic cables. Moreover, EirGrid has also identified a ground penetrating radar (GPR) supplier who can verify root depths in the scientific literature using root radar technology. EirGrid will share the findings of these studies with the RGI IVM Working Group to advance the understanding of risks at a European level.

Looking further to the future, EirGrid's designation by the Irish government as an offshore asset owner presents a significant opportunity to integrate marine habitats into future offshore grid infrastructure. To this end, and as committed in EirGrid's document on Nature Inclusive Design (NID) Pilots, EirGrid is taking its nature restoration ambition offshore. Through ongoing work packages by expert consultants and leading NID designers, including Arc MARINE, EirGrid is currently conducting a design risk assessment on various integrated and add-on measures to cable protection and offshore substation scour protection. This project will be to promote the establishment of marine habitats on EirGrid's offshore grid infrastructure. Additionally, EirGrid will use environmental DNA, video monitoring, and remote sensing technologies to monitor the presence and diversity of native and invasive species on all NID proposals.

4.8 Implementing IVM in Portugal

Stakeholder acceptance, investment challenges, regulatory needs

Distribução de Eletricidade, S.A. – E-REDES (DSO)

Portuguese DSO Distribução de Eletricidade, S.A (E-REDES) has identified several challenges and solutions they face in IVM implementation. First, they consider the challenge of securing acceptance from landowners and authorities as instrumental to IVM's success and thus consider it highly relevant to demonstrate the co-benefits of IVM for biodiversity and local stakeholders. Secondly, in terms of financing, the landscape of several complementary financing mechanisms is complicated, especially when looking at investment on a medium-term basis with different implementation agents. The third challenge is tied to the second, as IVM's high initial investment cost implies taking on economic risks, with certain risks in the medium term. However, as mentioned above, cost-benefit analyses have demonstrated that some IVM actions have lower costs than conventional management. Finally, in terms of legislation, E-REDES recognises an inertia at the political level to change the status quo regarding vegetation management, considering the different evaluations of the results of applying the current criteria that have remained almost the same since the legislation was created.

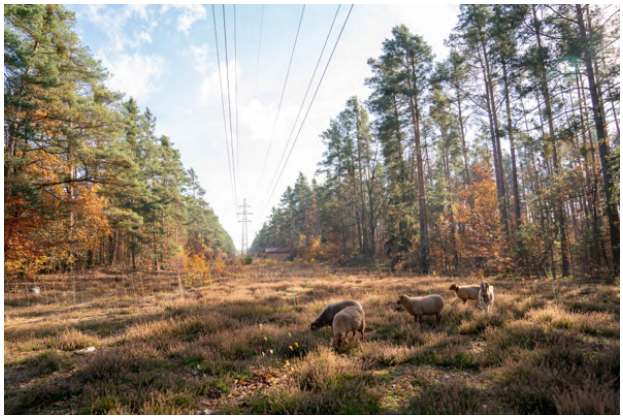
In overcoming these challenges, they hope for recommendations and incentives from regulators and a baseline development to assess the negative impact of conventional vegetation management compared to the positive impact of IVM. Furthermore, E-REDES is participating in a think tank initiative with other relevant entities and enterprises to help accelerate the conservation and restoration approach to biodiversity through IVM.

4.9 Implementing IVM in Bavaria, Germany

Stakeholder collaboration, digitalisation, human resources, regulatory needs

Bayernwerk Netz GmbH (DSO)

Bavarian DSO Bayernwerk has observed that often when landowners with forest property show interest in IVM, it is because the areas around the power lines are otherwise seen as unusable. In these cases, landowners are more likely to positively perceive Bayernwerk's offers to, for example, implement IVM in flowering meadows and increase biodiversity value. This arrangement benefits the DSO and reduces the risk of obstructions to the power line due to landowner actions. However, negotiating with landowners whose open fields intersect power lines proves more challenging and requires additional persuasion.



Grazing in Bamberg's main moorland forest, 2024. Photo: Adriane Lochner, ©Bayernwerk Netz GmbH

In the future, Bayernwerk plans to expand IVM and develop digital tools for implementation. The pace of expansion hinges on budget allocations and the availability of skilled personnel. Increased funding for IVM projects would enable Bayernwerk to enhance the level of detail and ecological impact of their IVM practice. Bayernwerk also states that more legislative guidance on reporting and bio-monitoring standards would be beneficial to their work.

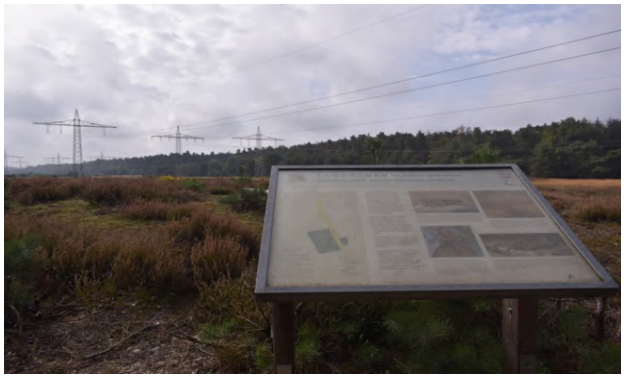
Furthermore, Bayernwerk notes that the consequences of climate change, such as more intense storms and a greater risk of forest fires, should be met with more flexibility in terms of the permitting width of the corridors. Wider corridors would remove all risk of trees falling onto the line and would provide firebreaks within grid corridors.

4.10 Implementing IVM in Germany

Stakeholder collaboration, digitalisation

Amprion GmbH (TSO)

German TSO Amprion's biggest challenge so far has been the digitisation process. When the company started working with IVM plans, each one was printed on paper. Thanks to the progressive digital mapping processes of recent years, staff can now access plans on a tablet in the field and make comments or updates while on site.



Community information board, 2021. Photo: ©Amprion GmbH

To further refine their IVM approach, Amprion aims to implement more targeted projects to promote species of interest in

collaboration with relevant stakeholders. Local stakeholders are vital in executing this strategy because of their experience and knowledge of the region. In the future, Amprion is interested in initiating a grazing project involving local stakeholders on their sites. This would improve vegetation practices in the area and increase communication with locals, achieving greater acceptance for their projects. Amprion reports that supportive policies could help garner more external appreciation of the issue and harmonise internal acceptance of the value of IVM.

4.11 Implementing IVM in Germany

Stakeholder acceptance, regulatory needs

50Hertz Transmission GmbH (TSO)

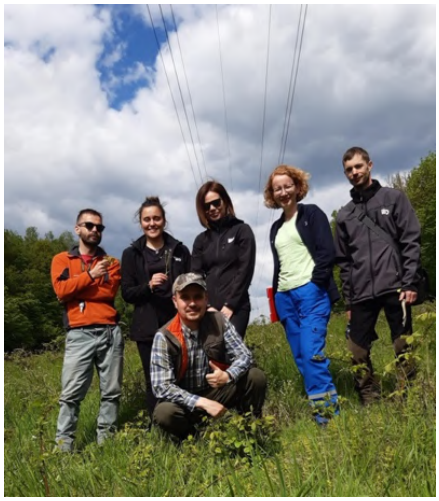
The most important wisdom gained from German TSO 50Hertz's IVM practice in the last nine years is that implementation depends on the landowner. Therefore, convincing arguments and financial compensation (i.e. funding) are crucial. 50Hertz believes that more funding mechanisms to compensate for the loss of productive land in the forest sector could increase IVM uptake.

Furthermore, more flexibility around the concept of "Nature for a time" *(Natur auf Zeit)* would be beneficial, whereby grid operators can allow biodiversity to expand in areas of low use yet still be able to access sites for necessary developments from time to time without getting into conflict with the nature conservation law in Germany (see page 40-41 for E.ON's discussion of this concept). Moreover, they state that allowances by forestry regulations for grazing in wooded areas in general, would be supportive. Regarding financial opportunities, accurate reporting on the benefits of their IVM actions has helped 50Hertz secure a green bond for continued IVM work.

Meet the Grid Operators Implementing IVM

Východoslovenská distribučná, a.s. (VSD) – Slovakian DSO

VSD is a DSO in Slovakia. They are committed to implementing IVM in the corridors of their overhead lines and assessing every corridor individually for the possibility of IVM application. A key motivational factor for their approach was their participation in a 2018 LIFE project which clearly demonstrated the potential of IVM in ensuring sustainability, promoting biodiversity, reducing the impact on the landscape, and long-term cost reduction. Since then, they realised that every corridor has the potential to function in this way.



VSD's team of biologists, 2024 Photo: © Východoslovenská distribučná, a.s. - VSD

To efficiently implement their IVM strategy, VSD has a central team of biologists who map and assess every corridor for its suitability for IVM. This analysis is based on factors such as nature protection, landowners' preferences, and types of biotopes present in the area. They regularly work together with stakeholders such as local farmers, landowners, universities, and state bodies.

Tennet Holding B.V. – Dutch TSO

TenneT, the TSO for the Netherlands, embarked on a transformative journey in 2019 to realign its vegetation management strategy with broader biodiversity objectives while also aiming to reduce maintenance costs.

Central to their approach is a strong emphasis on collaboration with landowners, underscoring their dedication to shared responsibility and sustainable practices. One such tool for collaboration is Tennet's 'Inspiration Guide'.[38] To facilitate the planning of habitat-friendly substations, the guide provides different options for communities and landowners to discuss what actions they are willing to take outside the regular vegetation management. Another integral part of the success of TenneT's IVM initiatives is its internal structures, which provide robust and seamless support for development and implementation.

Statnett SF – Norwegian TSO

Norwegian TSO Statnett's approach to vegetation management applies general principles to ensure security of supply, while caring for the landscape, reducing their footprint on the environment and restoring natural areas. They coordinate their actions in partnerships with landowners and regulatory authorities.

To plan maintenance activities, Statnett utilises a GIS system for digital mapping, considering protected areas and areas of special concern. Forest clearing is planned and controlled by dedicated staff and then performed by contractors with a mix of manual and mechanical felling methods and entirely without the use of pesticides and other chemicals. Statnett's approach aims to retain low and slow-growing trees and bushes in their grid corridors where possible, and retain vegetation in edge zones, especially along waterways. Furthermore, special considerations are taken near residential areas and hiking trails, such as removing logging waste and keeping hiking paths clear. Research and development within IVM are planned and performed by an R&D group within the company in cooperation with forest clearing staff.

Réseau de Transport d'Électricité (RTE) – French TSO

Réseau de Transport d'Electricité (RTE) is the French TSO. Their ambition regarding ecologically based vegetation management grew following a study in the late 2000s, which showed the richness of biodiversity around their power lines in semi-urban areas. At the same time, stakeholders approached them to ask for a more nature-friendly maintenance approach. Thus, they began to launch external calls to collaborate with managers of natural areas.

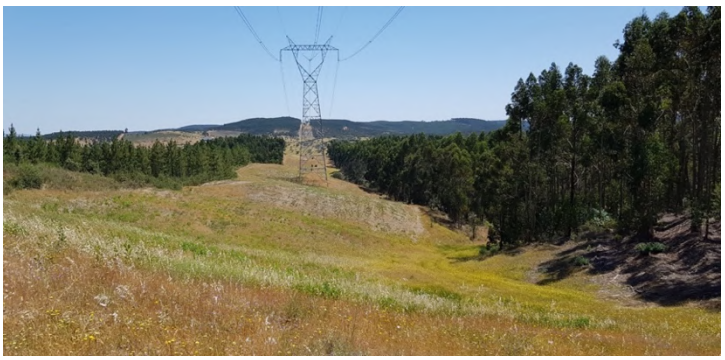
In 2011, they expanded their IVM practices through the EU LIFE Programme-funded project LIFE-Elia-RTE.[39] After the project concluded in 2017, RTE continued their IVM work through project calls from stakeholders and on an ad hoc project-by-project basis, largely in response to requests from local stakeholders. RTE aims to industrialise IVM implementation through a new internal measure that increases human and financial resources. This would better support their overall goal of expanding the IVM process implementation in their 27,000 ha of power

[38] TenneT (2023). Inspiration Guide: Nature-inclusive building
[39] This LIFE project ran from 2011-2017 between Elia, RTE and ecological consultants, Ecofirst. LIFE10 NAT/BE/000709.

lines in forested areas. RTE's next goal for IVM is to stop springtime flail mowing, which is the clear-cutting of all vegetation in the area.
Currently, a national coordinator allocates a dedicated budget, and regional coordinators implement these enhancements alongside their other field-related activities, as IVM is strongly linked to the involvement of employees in the field. In the future, RTE's goal is to have a dedicated IVM specialist for each region.

Redes Energéticas Nacionais (REN) – Portuguese TSO

Portuguese TSO, REN's commitment to IVM in their grid corridors is tied to their desire to sustainably transform their land management techniques and comply with strict legislation to protect infrastructure from rural forest fires. For this, REN undertakes an active approach to land use change, for example, through the conversion of fast-growing and invasive species into agricultural areas (olive groves, vineyards, pastures, orchards) and slow-growing grid-compatible native forest species, generating value for landowners and providing ecosystem services. Their approach also considers resilience to extreme weather events and sustainable project development with local communities.



Flowering meadow in grid corridor, 2023. Photo: ©Redes Energéticas Nacionas - REN

While REN has a dedicated Sustainable Networks department responsible for IVM, carrying out the IVM strategy is a holistic cross-departmental task. The collaboration ensures better decision-making and the ability to meet strategic objectives.

Red Eléctrica de España – Spanish TSO

Red Eléctrica de España (REE), part of the Redeia Group, is the TSO for Spain with over 44,000 kilometre of high voltage lines. Aware of the positive impact which IVM can generate on the environment surrounding their facilities, their IVM approach is enshrined within a group-wide 'Biodiversity Action Plan'. Furthermore, through partnerships with actors in rural areas such as shepherds, they note that IVM can be a tool for bringing sustainable employment opportunities and other local benefits for rural communities.

Several of REE's IVM projects and collaborations have received international attention in recent years, including via RGI's 'Good Practice of the Year Award'.[40] These include:

[40] Renewables Grid Initative (2024). About the 'RGI Grid Awards: Good Practice of the Year'

- Grid grazing *(Pastoreo en Red) – a* recognised Nature-based Solution by the IUCN (page 28-29).
- Bio Transport – a joint research project into the potential of vegetation management within pylons bases for ecosystem connectivity – winner of RGI's award (page 16).
- Marine Forest – a project for the recovery of *Posidonia oceanica* seagrass meadows in Majorca – winner of the public vote for RGI's '10th Anniversary All-Star' award.

Furthermore, REE provides internal and external training to employees, suppliers, and other stakeholders interested in specialised environmental trainings, including, for example, a citizens awareness campaign in Castilla and León on the prevention of forest fires and trainings for 500 employees on forest fire prevention in 2021.[41]

Fingrid Oyj – Finnish TSO

Finnish TSO, Fingrid has considered implementing selective-species removal and site-specific vegetation plans as its 'normal way' of managing vegetation for several years. This has created an over-arching vegetation management strategy that prioritises environmental considerations, thus protecting power lines and valuable natural habitats.

The environmental and vegetation management teams at Fingrid work closely together to plan the procedures, apply methods, and examine the results. Some strategies they implement include better conditions for rare butterfly habitats and leaving decayed wood on edge zones as nesting sites for birds, insects and wood-rotting organisms. Contractors and service suppliers outside of Fingrid also engage in responsible management in the corridors through contractual terms, auditing and environmental training.[42]

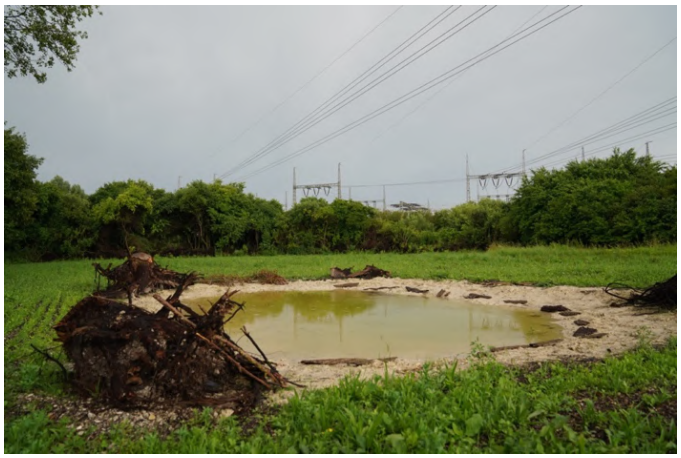
E.ON SE - European network of DSOs

E.ON is a network of 15 subsidiary DSOs in six European countries. Their aim is to make ecological corridor management[43] the standard approach for vegetation management in all their compatible high-voltage (110k V) overhead lines (13,000 kilometre) by 2029. E.ON's IVM strategy was developed in the mid-1990s, mainly by their German subsidiary, Westnetz GmbH. They realised intensive clear-cutting was not the most effective way to prevent vegetation interference with power lines, as vegetation only grew back with more vigour, which needed to be cut again within a few years. Hence, they began collaboratively developing an alternative mode, whereby the selective removal of fast-growing species of trees or bushes and fostering of slower-growing ones allowed them to preserve valuable biotopes, reduce long-term

[41] Redeia Group (2023). Environmental Statement EMAS 2022, pages: 72, 92
[42] Fingrid. (2024). Land use and environment.
[43] Ecological Corridor Management is synonymous with Integrated Vegetation Management (IVM).

maintenance and boost public acceptance for corridor maintenance. With extensive, low-conflict interventions, E.ON does not aim to "design" new biotopes but rather supports nature in restoring itself.

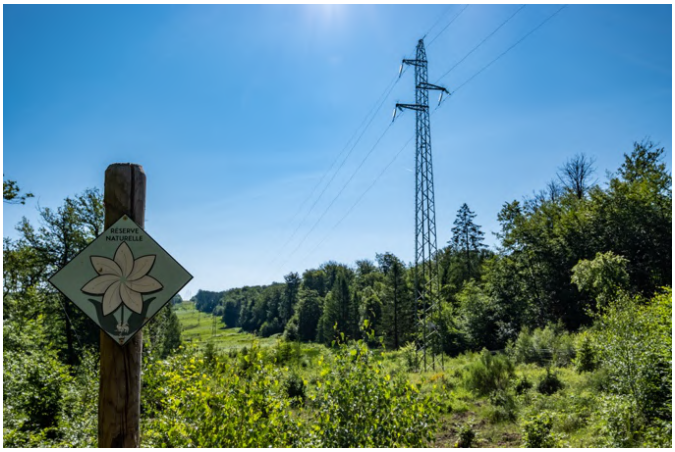
The central team at E.ON headquarters in Essen, Germany, is responsible for their IVM implementation. It coordinates all IVM rollouts in the DSOs, drives target setting, develops the necessary guidelines and standards, manages relevant stakeholders, and communicates around IVM. Additionally, each DSO in the E.ON network has its own team that is responsible for planning and implementing IVM on the local level. In 2021, the topic received a large boost with the launch of the United Nations' "Decade on Ecosystem Restoration program," which began the E.ON group-wide rollout.



Green Toad species conservation near Munich. Photo: Adriane Lochner, ©Bayernwerk Netz GmbH

Elia Transmission Belgium – Belgian TSO

Elia is the TSO in Belgium. In 2011 they took a leap forward in their IVM endeavours through the 6.5-year project 'LIFE-Elia-RTE – Creating Green Corridors under Overhead Lines'[44] (2011 to 2017), in collaboration with French TSO, RTE and a cooperative of ecological experts, Ecofirst. The project aimed to enhance biodiversity in grid corridors, reduce the need for recurrent cutting (through slower tree growth), develop long-term management plans via a 'win-win' multi-partner approach, and raise awareness among the public and across Europe. The project focused on wooded areas and targeted 28 sites in Belgium and seven in France. The interventions include general practices in addition to:



One of Elia's many 'green corridors in Belgium, 2023. Photo: ©Elia Transmission Belgium

- Conservation orchards of endangered wild local species.

[44] Ecofirst (2024). Life Elia-RTE project

- Restoration of endangered natural habitats, including peatland, heaths, and lean grasslands.
- Semi-natural ponds that quickly attract specific and vulnerable fauna with no management requirements.

After the project's completion in 2017, Elia decided to continue with IVM through a subsequent, self-funded 'Ecological corridors' project (2018 – 2030) and has incorporated IVM into their core sustainability programme 'ActNow', which aims to bring 90% of forest corridors under ecological management by 2030.

EirGrid Plc – Irish TSO

EirGrid is Ireland's onshore transmission system operator (TSO) and is the developer, operator, and owner of two interconnector projects: the East-West Interconnector to the UK and the Celtic Interconnector to France, which is currently under construction. EirGrid works to continually develop and operate the high-voltage grid in coordination with the state-owned electricity company Electricity Supply Board (ESB), which constructs and owns Ireland's onshore grid. Offshore, EirGrid is the designated operator and asset owner of all future grid connecting Offshore Renewable projects, once constructed.

EirGrid initiated its IVM strategy in 2019 when the Irish government became the second country globally to declare a biodiversity emergency.[45] As a conscientious developer, they followed the Irish biodiversity policy requiring public bodies to 'move towards no net loss of biodiversity. To do this, EirGrid launched a series of nature restoration projects, starting with its interconnector assets and then onshore grid projects through ESB partnership. EirGrid's 2022 publication entitled "Nature Inclusive Design Pilots"[46] introduced these nature restoration projects. Additionally, since 2022 EirGrid has also been developing a strategy for planting over underground cables (pages 48-49).

Moreover, EirGrid's vision statement declares a commitment to nature restoration. To further deliver on this vision, EirGrid's consultants are contractually required to implement nature-inclusive design (NID) proposals unless constrained by external factors such as land ownership. The pilot document also set out EirGrid's ambition to enable the planting of certain shrubs and trees over underground cables (UGCs).

E-REDES – Distribução de Eletricidade, S.A – Portuguese DSO

E-REDES is the Portuguese DSO, and it operates 68,000km overhead distribution network of high—and medium-voltage electricity, of which 28,000 kilometre are in forested areas. Due to

[45] Department of Housing, Local Government and Heritage (2022). Government announces National Biodiversity Conference to take place. June 8-9th
[46] EirGrid (2022). Nature Inclusive Design Pilots

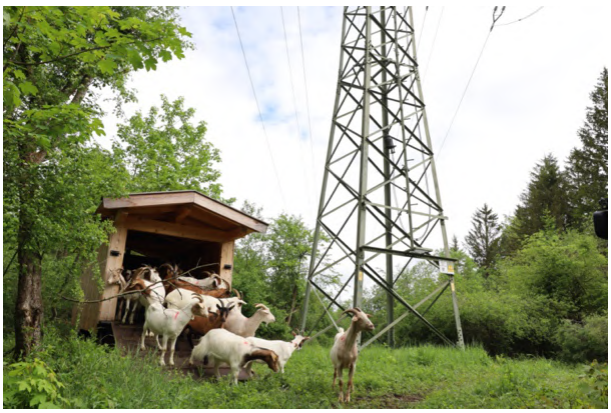
the location of infrastructure assets, fire prevention is a large part of what E-REDES does for their vegetation management. They do this as forest fires are one of the significant causes of biodiversity loss in Portugal, and as climate change increases, so does the frequency and severity of forest fires, which means there are high risks to the security of the electricity supply.

In 2020, E-REDES created a new department, the Vegetation Management Department, to directly manage vegetation and follow fuel management regulations. The 35 employees manage the vegetation in power line corridors to promote native species and further adapt to evolving conditions. The internal team also receive specific training on different activities such as drone operation and fire investigation and safety. Moreover, to support the internal team, E-REDES has formal agreements with forestry companies that carry out conventional vegetation management, and when needed, they also use the contracts to carry out IVM actions.

Bayernwerk Netz GmbH – German DSO

Bayernwerk Netz GmbH, a German DSO and a subsidiary of E.ON is committed to conducting IVM to enhance the ecological value of power line corridors, thus prioritising biodiversity while maintaining safety and security of supply. The company initiated their approach two decades ago, aiming to reduce the density of fast-growing trees and bushes within its corridors. The objective is primarily achieved through mowing, grazing, and selective tree removal near the power lines. Today, they continue to expand this practice by engaging external stakeholders, such as shepherds, farmers, and environmental NGOs.

To support IVM planning, Bayernwerk employs corridor managers assisted by external biologists. Implementation is therefore facilitated through written contracts with external partners and companies, ensuring efficient resource allocation to IVM locations and maintaining positive interactions with local stakeholders.

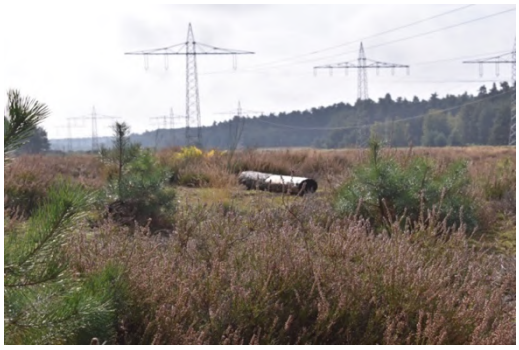


New grazing site in Pupplinger, 2024.
Photo: Christian Martens, ©Bayernwerk Netz GmbH AG

Amprion GmbH – German TSO

German TSO Amprion's advanced approach to IVM implementation applies to all suitable areas in their entire network. This equals close to 9,000 hectares to date (excluding agricultural or commercially used areas). Their ecologically driven strategy was initiated as early as 1994 when they began a technically and economically optimised form of ecological route maintenance. Early projects were executed in consultations with relevant local authorities, NGOs, forest administrations, landowners, and universities, as well as with the assessment of the nature and landscape around the power lines. Amprion's five principles on IVM are:

- Sustainable, stable biotope structures promote nature and species protection and connect valuable habitats.
- Continuous and extensive implementation instead of periodic and intensive route maintenance.
- Growth rate reduction of trees through the displacement of fast-growing species and the promotion of slow-growing species.
- Increased safety of power lines and minimal route maintenance costs by lowering them to an ecological and economic upper level.
- Avoidance of additional planting and the promotion the existing vegetation.

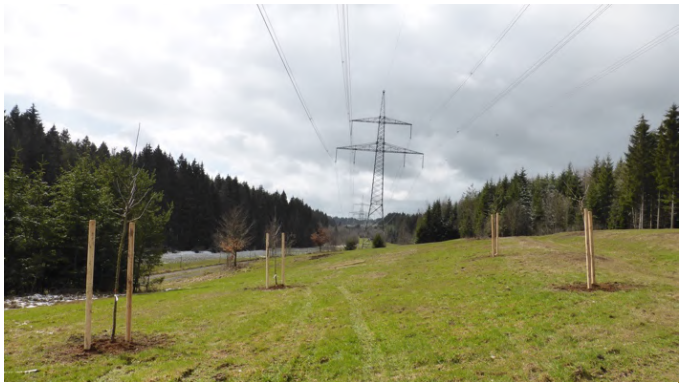


IVM Grid Corridor, 2021. Photo: ©Amprion GmbH

At the base of their holistic IVM strategy is strong collaboration between their internal departments and external service providers, further strengthened by regular training courses for employees. Amprion's environmental planning and nature conservation team updates IVM plans yearly, whereby specialists create digital management plans. Implementation is carried out by their operations department and external service providers, facilitating coordination with the authorities.

50Hertz Transmission GmbH – German TSO

50Hertz, one of four German TSOs, began implementing their IVM practice in 2015 and from 2020 onwards, consider IVM as a key performance indicator in their reporting processes. The programme works to implement IVM in at least 95% of all suitable line corridors by 2030, reducing the impact on biodiversity from power lines passing through forests. As part of the Elia Group, their "ActNow" programme also actively incorporates IVM to reach its sustainability targets.



Forest meadow under a HV power line, 2024. Photo: ©50Hertz Transmission GmbH.

50Hertz's IVM programme entails collaboration across multiple divisions and with external organisations to locate sites and support implementation. While experts at 50Hertz's headquarters in Berlin can provide information on IVM to regional divisions, technical colleagues in the regional centres are responsible for the management of lines. Specialists for nature conservation and technicians at the regional level receive training on topics related to German nature conservation law, and this background, along with daily interaction with sites, makes them highly qualified to identify prospective IVM sites. To further

increase their expertise, 50Hertz develops special training for their technicians. In some cases, 50Hertz delegates on-site management to area agencies. Following site identification, 50Hertz's nature conservation experts or regional technical colleagues contact landowners to decide if they will allow IVM implementation. This is important because, in most cases, 50Hertz is not the owner of the sites.

Works Cited

Aerial Photograph vs. Orthoimage (2024) U.S Geologocial Survey. Available at: https://www.usgs.gov/media/images/aerial-photograph-vs-orthoimage (Accessed: June 25, 2024).

Audoin, E. (2018) Valoriser l'additionnalité des services écosystémiques fournis par le mode de gestion des terres sous les lignes à très haute tension.

Decree Law No. 82/2021, Art. 3 (2021) Diáro da República No. 199/2021,. Portugal: Presidency of the Council of Ministers. Available at: https://diariodarepublica.pt/dr/en/detail/decree-law/82-2021-172745163 (Accessed: August 30, 2024).

Department of Housing, L.G. and H. (2022) Government announces National Biodiversity Conference to take place June 8–9, Government of Ireland. Available at: https://www.gov.ie/en/press-release/fb491-government-announces-national-biodiversity-conference-to-take-place-june-8-9/ (Accessed: June 26, 2024).

Ecofirst (2024) Life Elia-RTE project, Life Elia-RTE. Available at: http://www.life-elia.eu/en/ (Accessed: August 30, 2024).

EirGrid (2022) Nature Inclusive Design Pilots, EirGrid. Available at: https://cms.eirgrid.ie/sites/default/files/publications/211603-EirGrid-Nature-Inclusive-Design-Pilots_Published_Final.pdf.

Eldegard, K., Moe, S.R. and Vidar, S. (2012) Kraftgater som habitat : effekter av bredde, alder, skjøtsel og plassering på biologisk mangfold.

European Commission - CINEA (2023) Conservation of the eastern imperial eagle by decreasing human-caused mortality in the Pannonian Region, Life Public Database. Available at: https://webgate.ec.europa.eu/life/publicWebsite/project/LIFE15-NAT-HU-000902/conservation-of-the-eastern-imperial-eagle-by-decreasing-human-caused-mortality-in-the-pannonian-region (Accessed: September 2, 2024).

Ferrer, M. et al. (2020) "Transporting Biodiversity Using Transmission Power Lines as Stepping-Stones?," Diversity, 12(11). Available at: https://www.mdpi.com/1424-2818/12/11/439 (Accessed: August 30, 2024).

Garrano horses will help prevent fires on Cabreira Mountain (2022) REN. Available at: https://www.ren.pt/en-gb/media/news/garrano-horses-will-help-prevent-fires-on-cabreira-mountain (Accessed: June 27, 2024).

Grid manager and transmission agent (2024) Red Eléctrica. Available at: https://www.ree.es/en/activities/grid-manager-and-transmission-agent (Accessed: June 26, 2024).

Grupo Red Eléctrica (2021) Guía Práctica de Pastoreo en Red.

Lernpaket Ökosysteme (2024) Bildung mit Energie. Available at: https://www.3male.de/schule/lernpaket-oekosysteme (Accessed: June 27, 2024).

Life-Elia (2019a) "Transmission of Electricity Management of Vegetation in Forest Corridors: Local Partnerships," in. Ecofirst. Available at: http://www.life-elia.eu/_dbfiles/lacentrale_files/1300/1394/LIFE%20Elia-RTE_Local%20partnerships_EN_HD.pdf (Accessed: June 27, 2024).

Life-Elia (2019b) "Transmission of Electricity Management of Vegetation in Forest Corridors: Negotiations and Agreements," in Transmission of Electricity Management of Vegetation in Forest Corridors: Negotiations and Agreements. Ecofirst. Available at: http://www.life-elia.eu/_dbfiles/lacentrale_files/1300/1393/LIFE%20Elia-RTE_Negotiations%20and%20agreements_EN_HD.pdf (Accessed: June 27, 2024).

Life-Elia (2024a) Brochure n°2 - Cost_benefit analysis, Life Elia-RTE Project. Available at: http://www.life-elia.eu/_dbfiles/lacentrale_files/1100/1106/LIFE%20Elia-RTE_Cost_benefit%20analysis_EN.pdf (Accessed: August 30, 2024).

Life-Elia (2024b) Preparing and updating maps, Life Elia-RTE. Available at: http://www.life-elia.eu/en/Preparing-and-updating-maps (Accessed: August 30, 2024).

National Ocean Service (no date) What is lidar, National Ocean and Atmospheric Administration. Available at: https://oceanservice.noaa.gov/facts/lidar.html (Accessed: June 26, 2024).

Pedro Marques (2022) "Grids for Life: Innovative approaches to Vegetation Management from the Iberian Peninsula." Germany: Renewables Grid Intiative (RGI) . Available at: https://www.youtube.com/watch?v=QW2TsoDpAHQ&t=1812s (Accessed: June 27, 2024).

Penttilä, M. (2024) Land use and environment, Fingrid. Available at: https://www.fingrid.fi/kantaverkko/maankaytto-ja-ymparisto/ (Accessed: June 26, 2024).

Red Eléctrica (2021) The safety corridors of our lines, spaces for biodiversity and a refuge for fauna, Red Eléctrica de España . Available at: https://www.ree.es/en/press-office/news/featured-story/2021/03/safety-corridors-our-lines-spaces (Accessed: July 15, 2024).

Red Eléctrica (2023) Environmental Statement EMAS 2022. Available at: https://www.redeia.com/sites/default/files/publication/2023/06/downloadable/declaracionambiental_emas_2022_EN.pdf (Accessed: June 26, 2024).

Redeia (2024) Pastoreo en Red, Redia. Available at: https://www.redeia.com/en/sustainability/communities/social-innovation/pastoreo-en-red (Accessed: August 30, 2024).

REN supports the preservation and valorisation of Ermelo oranges with the planting of 1,350 orange trees (2024) REN. Available at: https://www.ren.pt/en-gb/media/news/ren-supports-the-preservation-and-valorisation-of-ermelo-oranges-with-the-planting-of-1-350-orange-trees (Accessed: June 27, 2024).

Renewables Grid Intiative (2020) SAGA, RGI. Available at: https://renewables-grid.eu/activities/best-practices/database.html?detail=210&cHash=683e4b9391cfb7997e2ab293adb8ab00 (Accessed: August 30, 2024).

Renewables Grid Intiative (2024) About the "RGI Grid Awards: Good Practice of the Year," RGI. Available at: https://renewables-grid.eu/activities/rgi-grid-awards.html?L=0 (Accessed: August 30, 2024).

RGI (2023) Implementing Integrated Vegetation Management across Europe. Berlin. Available at: https://renewables-grid.eu/publications/press-releases/detail/news/report-launch-and-working-group-implementing-integrated-vegetation-management-across-europe.html (Accessed: June 28, 2024).

RTE engagé en faveur de la préservation de la biodiversité terrestre et marine (2024) RTE. Available at: https://www.rte-france.com/rte-en-bref/nos-engagements/rte-engage-en-faveur-preservation-de-la-biodiversite-terrestre-et-marine (Accessed: June 27, 2024).

Sheep under power lines (2020) Landschaftspflegeverband Westsachsen e. V. Available at: https://schafe-unter-strom.de/ (Accessed: August 30, 2024).

Siemens (2024) About us, Siemens. Available at: https://www.siemens.com/ie/en/company/about.html (Accessed: June 25, 2024).

The European green bond standard – Supporting the transition (2023) European Commission. Available at: https://finance.ec.europa.eu/sustainable-finance/tools-and-standards/european-green-bond-standard-supporting-transition_en (Accessed: June 26, 2024).

Underground cables and the environment (2024) Amprion. Available at: https://www.amprion.net/Transmission-System/Technology/Underground-cable/Underground-cables-man-and-the-environment.html (Accessed: June 26, 2024).

Waldgesetz des Landes Brandenburg (LWaldG) (§37(2),8) (2004) Landes Brandenburg. Germany: Landes Brandenburg. Available at: https://bravors.brandenburg.de/gesetze/lwaldg (Accessed: August 30, 2024).

Imprint

Energy & Nature Best Practice Guide
Integrated Vegetation Management: Best practices from across Europe

Renewables Grid Initiative

Renewables Grid Initiative, e.V.
Manfred-von-Richthofen-Straße 4
12101 Berlin, Germany

Editor, Liam Innis
Senior Manager – Energy Ecosystems
liam@renewables-grid.eu

Editor, Jessica Higgins
Junior Manager – Onshore Energy and Nature
jessica@renewables-grid.eu

Layout, Eston McKeague
Manager – Communication
eston@renewables-grid.eu

Thanks

We gratefully acknowledge the grid operators who contributed to this guide.

Co-funded by the European Union

RGI gratefully acknowledges the EU LIFE funding support. Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the LIFE Programme. Neither the European Union nor the granting authority can be held responsible for them.