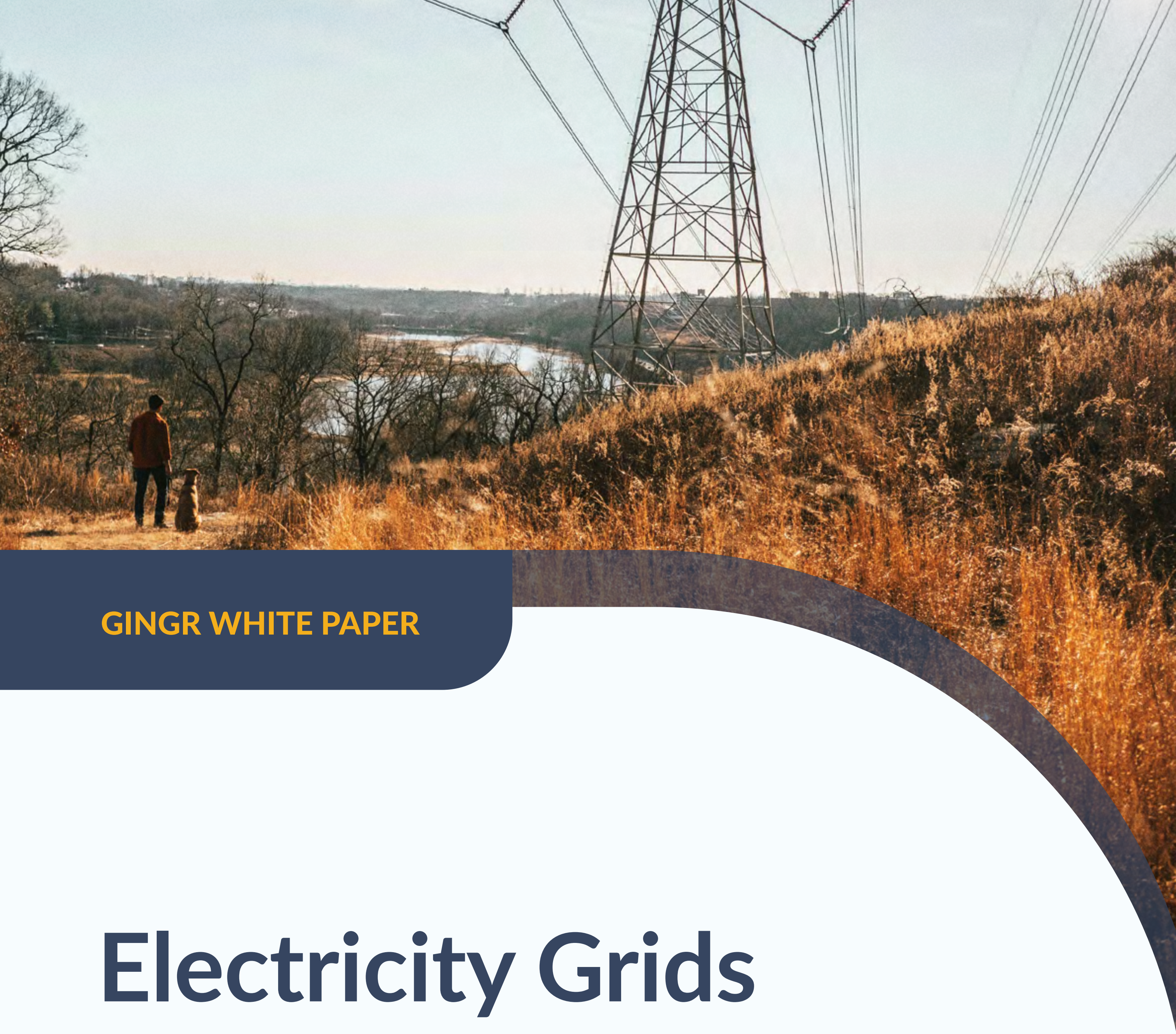

GINGR WHITE PAPER

Electricity Grids

Guiding Principles to Integrate Climate, Biodiversity and Social Goals

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April 2026

GINGR
Global Initiative for Nature, Grids and Renewables

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An Introduction to GINGR

The Global Initiative for Nature, Grids and Renewables (GINGR) is supporting the just and sustainable energy transition by providing assessment tools to quantify contributions to Nature- and People-Positive goals. These assessment tools will comprise monitoring and reporting systems that are globally aligned and standardised.

With the availability of a comprehensive framework, actors within the energy system will be able to report on progress towards biodiversity gains and co-created local community benefits in the deployment of wind, solar and electricity grids. The GINGR Framework will also support governments, the renewable energy industry, and the financial sector with the achievement of their energy, climate and biodiversity targets in a timely and socially responsible manner.

GINGR has approached this work through engagement with working groups that have broad and active participation from industry, NGOs and academia. The output will be robust, legitimate and practical guidance and tools that support the final objective of a global standard in monitoring and reporting. Recognising the significant challenges posed by implementation, GINGR will also develop a technical assistance hub to provide guidance and support, and a repository of best practices and lessons learnt.

The collaborative work on the GINGR Framework will be further complemented by a series of publications which aim to provide ready-made solutions for companies, governments, and the financial sector. These publications also have the potential to bring more stakeholders together to share experiences and data, as well as to improve and enhance biodiversity around renewables and grid infrastructure.

GINGR is a collaborative initiative of the International Union for Conservation of Nature (IUCN) and the Renewables Grid Initiative (RGI). Find out more at www.gingr.org

Executive Summary

The global transition to net-zero energy systems requires one of the most significant changes ever to our global infrastructure. Power grids act as the backbone for this transition, needing substantial expansion to both incorporate renewable sources like solar and wind, and address increased demand from electrification. This expansion may exacerbate ongoing biodiversity loss and social inequality, however, if managed properly, grid development could support ecosystems, enhance nature and reduce threats to species, public opposition as well as the potential for costly delays.

The **European Grid Declaration** on Electricity Network Development and Nature Conservation, created by the **Renewables Grid Initiative** provides a foundational framework for tackling challenges and supports both project developers and permitting authorities in their aim to deliver good projects. It provides clear advice for robust, resilient and procedurally sound approaches that can speed up deployment of electricity grid infrastructure while protecting nature, ecosystems and their services and respecting communities where development is taking place. It demonstrates that the expansion of grid infrastructure can coexist with biodiversity protection and procedural justice. While the principles highlighted in this paper originate from the European Grid Declaration developed in 2010, they are validated by recent experiences and good practices from several world regions. Indeed, each grid operator and each permitting authority around the world is confronted with similar challenges and so the principles presented are universally applicable.

This white paper consolidates current practices into a practical framework for electricity grid development. It details actionable steps and guiding principles — from strategic spatial planning in initial design stages to enhancing biodiversity through ecological connectivity, cumulative impact assessment, and inclusive governance — aimed at harmonising renewable energy integration with biodiversity preservation and social welfare, transforming grid infrastructure from a liability into a sustained catalyst for ecological and social renewal.


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Part I:

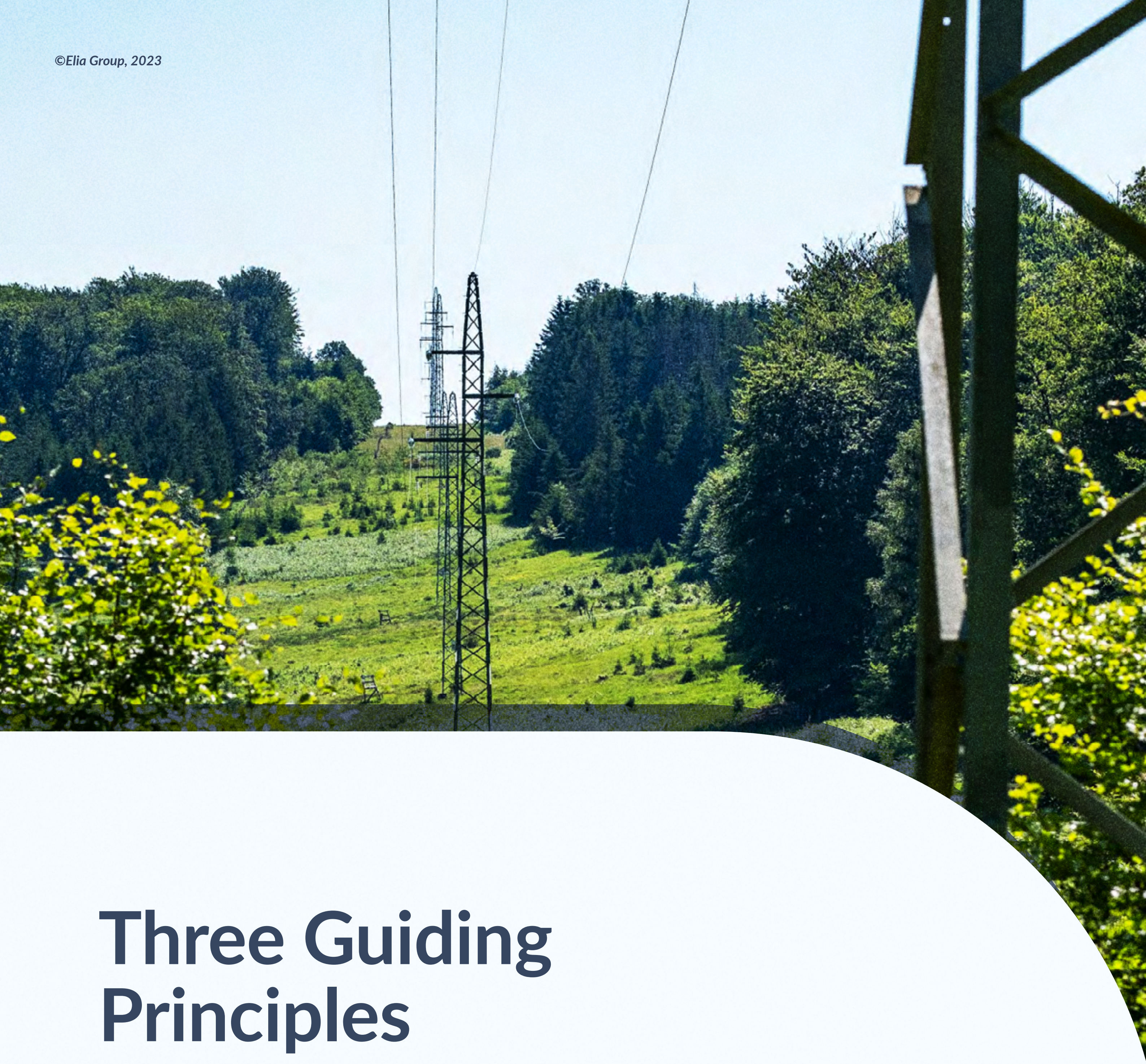
Grids as Energy & Social-Ecological Systems

Electricity is the most efficient fuel we have available today and in any foreseeable future. Electrifying economies is a global priority, including for reducing dependencies, inefficiencies and carbon emissions. Conservation of resources and energy saving should remain a top priority while we decarbonise. Europe has targeted 42.5% renewable energy by 2030[1]; the U.S. once wanted a carbon-free power sector by 2035; China aims for 80% non-fossil electricity by 2060[2]; and the African Union's Agenda 2063 calls for universal renewable access.[3]

A central challenge to electrification and renewable integration is the availability of sufficient grid infrastructure. Building grids is a lengthy process; finding ways to speed up necessary grid deployment is paramount. Renewable resources are often located far from demand centres. We see this with offshore wind in the North Sea, where connecting electricity to consumption areas requires crossing thousands of communities, or in Brazil and Chile, where solar and wind projects with long transmission corridors traverse many ecologically sensitive areas. Experience shows that when environmental and social safeguards are integrated early, opposition to projects is reduced, delays and disputes are avoided, and negative impacts minimised or removed.

It is therefore essential that a robust social–ecological perspective is integrated in the early stages of grid planning. Environmental screening processes, cultural identity, sense of place and relational values strongly influence how grid expansion is perceived and whether communities engage constructively. Incorporating these factors shifts planning beyond narrow impact assessment towards better risk management and the creation of more shared value.

The conclusion is clear: a resilient, decarbonised grid must be treated as a social-ecological system that is economically necessary, technically robust, environmentally responsible and socially accepted.[4] The question is not whether to build, but how to do so responsibly, using existing knowledge. This paper outlines practical approaches to grid planning and delivery grounded in environmental law and global experience, with the mitigation hierarchy and human rights principles as foundational guides. Supply-chain issues, while important, fall outside its scope and are not addressed.



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Three Guiding Principles

A first fundamental step is to bundle the:

- Needs for electricity
- Decarbonisation and biodiversity objectives
- Social goals into a unified planning and operational framework

The following three principles transform grid development into a flexible, inclusive, and ecosystem-centred approach. As a result, the grid evolves from a purely engineering project into a spatial instrument that meets electricity needs, while shaping land use, strengthening ecosystem resilience and influencing communities' interactions.

Principle 1

Integrating Ecology & Ecosystem Services Into Grid Planning

Protecting the natural environment is a key objective. The mitigation hierarchy is a well-established tool, and it should guide both analysis and decision-making processes. Specifically, grid expansion should avoid harm by making use of ecological data, such as species migration and habitat maps from the very start of the planning phase. Ecological data are essential to proactively identify sensitive areas, understand the economic value of ecosystem services and therefore inform grid planning and corridor identification. This approach can also support the early identification of possible conflict areas, the design of solutions needed to address those, and help reduce the number of challenges that may need to be dealt with during or after construction.

Investing in spatial analysis and "***designing out***" biodiversity conflicts create a clear and defensible project path, lowering the chances of legal issues, last-minute changes and permit denials, thereby speeding up the timeline from conception to commissioning.[5] While avoidance of sensitive areas is key in the mitigation hierarchy, it is often overshadowed by least-cost routing, engineering simplicity and political pressures, with ecological factors frequently ignored in cost-benefit analyses that miss long-term risks such as litigation, delays, reputational damage and operational challenges in high-risk areas.

Financial and regulatory models seldom account for long-term ecological and social costs and risks. Energy regulators, unless explicitly required by their mandate, tend to favour investment options that appear less costly because they do not incorporate environmental and societal measures. We therefore recommend planning and permitting frameworks that quantify both ecological and financial risks, include precautionary spatial mapping that respects cultural and social diversity and reflects the long-term benefits of more inclusive approaches.[6] Valuing ecological benefits such as water filtration, pollination and soil stability — alongside the ways in which people relate to and identify with their environments — can fundamentally reshape the Cost Benefit Analysis (CBA) of grid projects.

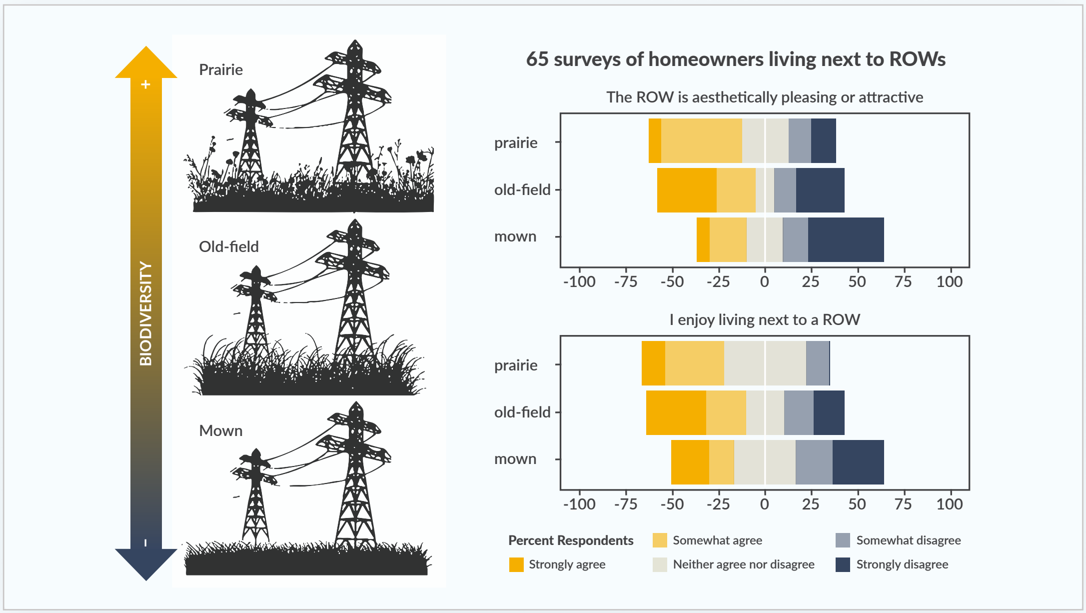
Embedding the value of ecosystem services at the early stages of grid planning can transform transmission infrastructure into integrated landscape assets, thereby increasing both their societal acceptability and functional role. This approach redefines the environment from a constraint to a source of value that enhances local priorities. For example, managing rights-of-way for pollinators or establishing green corridors can turn grids into contributors to environmental quality rather than sources of degradation. In doing so, it shifts the narrative from imposition to partnership and local value creation.

Data from resident surveys, shown in ***Figure 1***, support this argument. The survey displays views on mown, old-field, and prairie-managed corridors, revealing that residents closer to biodiverse Rights of Way (ROW) report higher perceived biodiversity, better aesthetic appreciation and more favourable attitudes towards the corridor.[7] This underscores the need to incorporate social perception and cultural ecosystem services into planning, alongside biophysical evaluations.

The inclusion of ecosystem service values can additionally augment local acceptance of the project.[8] This transition fosters social and political support, minimising the risk of disputes or delays that can hinder projects for years.

Figure 1 ➔

RESIDENT PREFERENCES AND PERCEPTIONS OF BIODIVERSITY
IN THE RIGHT-OF-WAY OF POWERLINES



Source ➔ *Garfinkel, M., Minor, E. S., Bello, A., & Shochat, E. (2023). Resident preferences and perceptions of biodiversity in electric powerline rights-of-way. Journal of Environmental Management, 330, 117175. https://doi.org/10.1016/j.jenvman.2022.117175*

Principle 2

Early Engagement, Transparency & Legitimacy

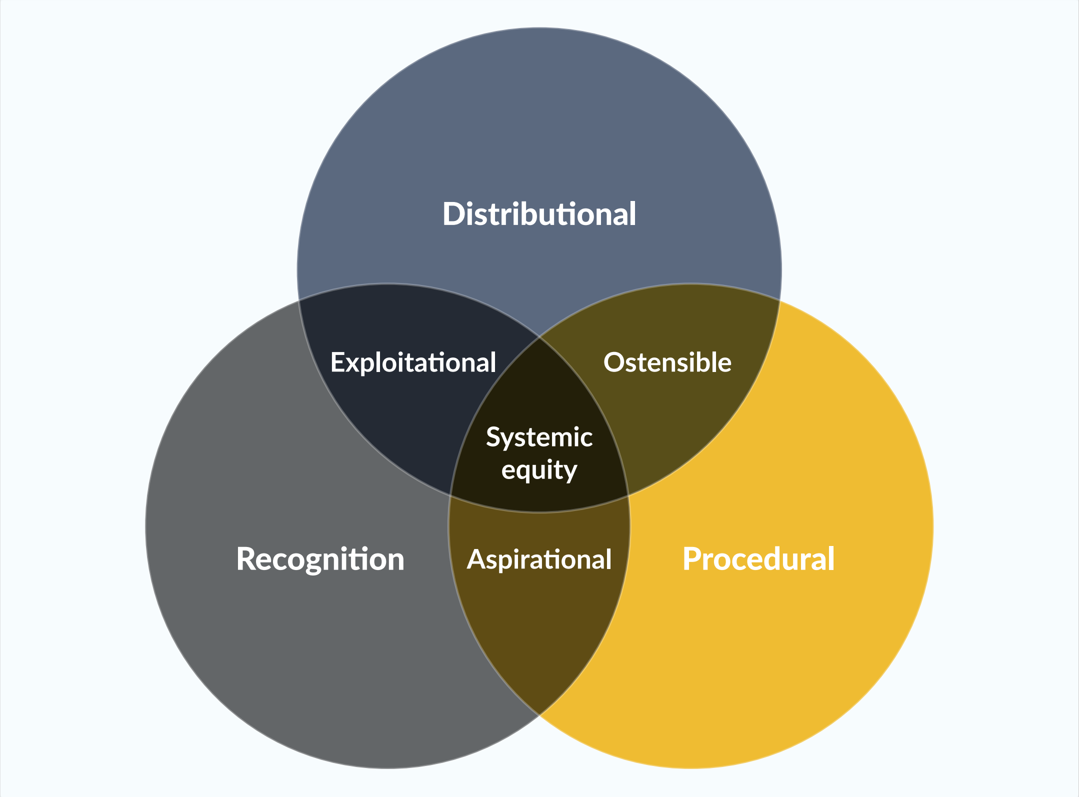
Trust in new transmission lines is established early, through open discussions about electric needs, accessible data, and genuine participation. The European Grid Declaration[9] stresses that early involvement, before a preferred corridor is determined, fosters shared governance instead of reactive consultation. Where European TSOs have implemented early dialogues on needs, joint option evaluations and clear trade-off explanations the planning process has become quicker, more predictable and significantly more socially acceptable.[10] Practices collected by RGI consistently show that early, co-design-focused engagement enhances social license and optimises routes by incorporating local knowledge into design decisions.[11] [12] Early and participatory impact assessment allow communities, indigenous groups and civil society groups to share local insights and concerns before critical decisions are made.[13]

This early engagement process uncovers social, cultural and environmental issues making them easier and more cost-effective to address. The result is a more credible and socially resilient design that encounters less resistance during formal permitting, thereby decreasing the chances of appeals and legal challenges, which are major causes of delay in significant infrastructure projects. There are a myriad of practices that have been developed, deployed and assessed across countries and over the past two decades. A curated selection of effective and innovative approaches can be found in the RGI "**Good Practices Database**". When properly designed, engagement practices produce very positive results and help build trust between local communities and project developers.

To make engagement truly effective, it's important to clarify the timeline and explain how and when people can take part in decision-making. Every decision should be fair, inclusive and balance benefits and burdens across different social groups. Real equity only happens when we consider three types of justice together: how resources are shared (***distributional***); how decisions are made (***procedural***); and how people are respected and recognised (***recognition***). Ignoring any of these aspects leads to outcomes that are incomplete and unstable.

Research on ecosystem-service governance highlights the importance of distinguishing between beneficiaries, providers and intermediaries, because their different levels of power, profiles, capacities and influence shape decisions. By valuing diverse identities, values, and knowledge systems we strengthen recognition. By ensuring meaningful participation in decision-making[14], we promote procedural equity. By fairly distributing project benefits and burdens, we support distributional equity.

Figure 2 ➔ SYSTEMIC EQUITY FRAMEWORK FOR JUSTICE OUTCOMES



Source ➔ *Baker, E., Carley, S., Castellanos, S., Nock, D., Bozeman, J. F., Konisky, D., Monyei, C. G., Shah, M., & Sovacool, B. K. (2023). Metrics for decision-making in energy justice. Annual Review of Environment and Resources, 48, 737-760. https://doi.org/10.1146/annurev-environ-112621-063400*

Figure 2 shows how this integrated methodology[i] goes beyond mere consultation to truly empower affected groups, including vulnerable local and indigenous communities. Procedural justice demands that these groups have a genuine voice and influence decision-making, not just token inclusion.

Simultaneously, distributive justice ensures that real project benefits, such as jobs, community investments, shared ownership or long-term service improvements are distributed locally and fairly to those impacted by the project. More equitable project governance of ecosystem services should aim to integrate more diverse stakeholders into decision making. Projects perceived as fair and beneficial, particularly where impacts are mitigated and benefits are enhanced for impacted communities, are more likely to gain societal acceptance. The experiences and case studies presented in RGI's **Community & Local Benefits** work provide clear evidence of this.[15] As Vanclay et al. (2015) state, this is necessary for the project to earn its 'social licence to operate'.[16] This social license offers the solid base required for a project, during the construction and operation stages, and minimises political, legal and reputational risks that cause delays, suspensions or cancellations and can bring cascading impacts to future projects both in the vicinity or in different locations.

Principle 3

Adaptive Governance Based on Local Knowledge

Adaptive management acknowledges ecosystems' dynamic nature and uncertainty, requiring governance to be flexible, iterative and learning-oriented (***Figure 3***). It views project implementation as a continuous cycle of planning, action, monitoring, evaluation and adjustment, enhanced by evidence from diverse knowledge systems — including citizen monitoring, scientists, NGOs, universities, indigenous knowledge holders, and local communities — within a cohesive monitoring framework.

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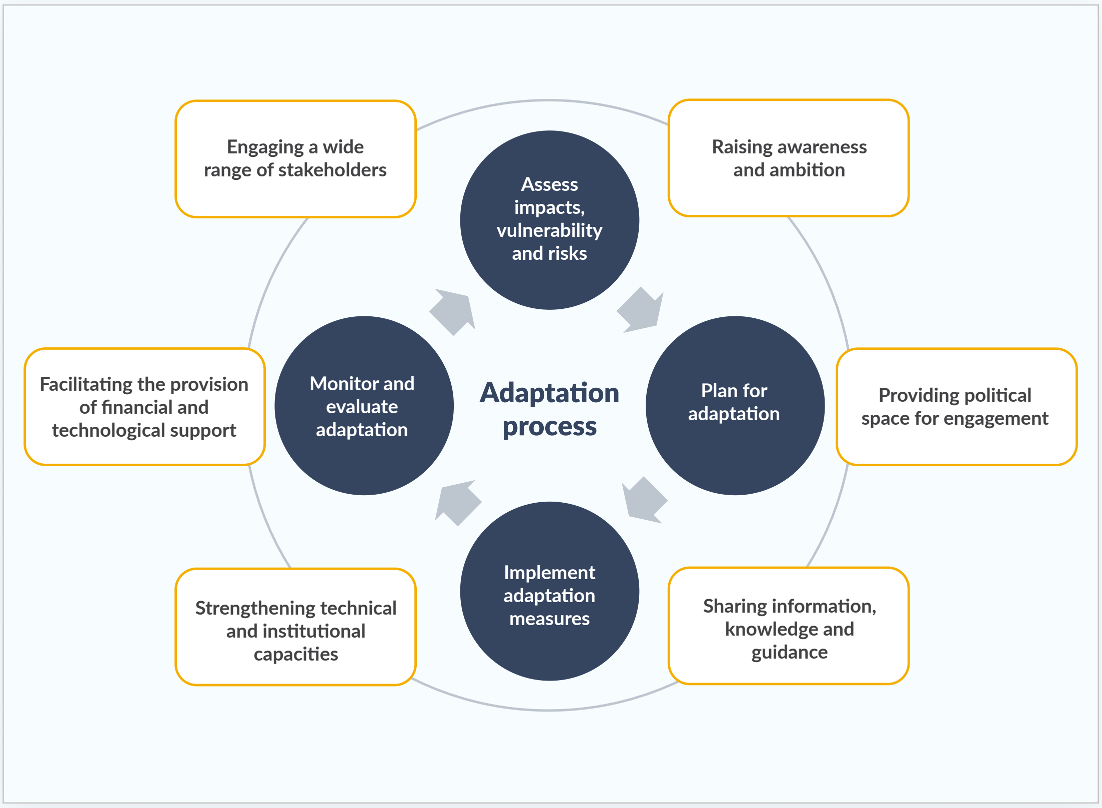
i. *Figure 2. Systemic Equity Framework for Energy Justice. This figure shows how distributional, procedural, and recognition equity must intersect to achieve systemic equity in energy justice. It also identifies partial/incomplete outcomes (ostensible, aspirational, exploitational) that emerge when one of these core justice dimensions is not fully addressed. Source. adapted from Baker et al., 2023*

Figure 3 ➔ UNFCCC ADAPTATION CYCLE AND ENABLING CONDITIONS



Source ➔ *https://unfccc.int/topics/adaptation-and-resilience/the-big-picture/introduction#adaptation*

Adaptive management means establishing clear environmental goals, taking management actions, monitoring outcomes and adjusting strategies accordingly.[17] This flexibility can be enhanced by allowing permitting authorities to approve projects despite uncertainties, provided there is a strong monitoring commitment and predefined response plan. It fosters regulatory confidence in identifying unforeseen impacts, prevents paralysis-by-analysis and facilitates quicker project advancement.

Enhancing adaptive management needs legally binding monitoring, clear reporting, defined thresholds for mandatory corrective action when limits are exceeded, and related necessary budgets.

Merging scientific data with local knowledge yields solutions that are more context-specific and robust. Scientific models and satellite data offer a broad perspective but often overlook crucial social and ecological details. Tengö et al. (2017) argue that sustainability governance benefits from "***a multiple evidence base approach***" that enables Indigenous, local and scientific knowledge systems to contribute in parallel to international science–policy processes such as IPBES and the CBD.[18]

This integration can uncover culturally important sites, seasonal movements, customary land-use practices and subtle ecological connections that might otherwise go unnoticed. Incorporating these insights early on, supports suitable and adaptive Nature-Based Solutions, enhances feedback loops and management responses over time, fosters greater trust, and results in more resilient project designs, ensuring ecological functions, cultural meanings and adaptive management are all considered in route selection, mitigation, and monitoring.

Part II:

Practical Steps & Ecological Tools for Robust Grid Planning

Energy System & Grid Planning

Before initiating strategic spatial and environmental planning for the grid, a crucial first step is to create transparent and credible long-term energy system scenarios. This process converts goals related to energy security, system adequacy, climate ambition and affordability, among others, into a clear, quantitative pathway providing the need and justification for grid expansion. Biodiversity protection and social considerations should be integrated into these scenarios from the start — but are generally not — alongside decarbonisation objectives.

Energy system modeling and scenario analysis are essential for building the business case for grid planning. **In the past years, grid planners have made substantial efforts to integrate new considerations into their planning approaches in order to balance various objectives:**

- Meeting demand
- Achieving net-zero pathways
- Ensuring system reliability amid climate change
- Extreme weather and demand fluctuations
- Integrating renewable capacity
- Enhancing energy security by decreasing dependence on fuel imports

Given growing resource scarcity, it should also address materials and resource limitations and propose solutions to meet system objectives within specified timeframes. By employing open-source or transparent modeling methods, project advocates can objectively show that an expanded, optimised, and modernised grid is essential for a secure, affordable and clean energy future.

Grid development starts with decisions made at a broad geographic level, where planners evaluate regional electricity demands and policy goals. At this point, the objective is to pinpoint where additional transmission capacity is required, rather than to determine specific routes. These strategic choices lay the groundwork for long-term security, reliability and decarbonisation.

Once needs are identified and approved by energy regulators, investment decisions lead to pinpointing specific corridors for new infrastructure. Environmental spatial planning is crucial at this stage to reduce conflicts and risks as it collects data on ecosystems, land use, cultural heritage and human activities. When well done, spatial planning helps avoid sensitive areas, eases communities' pressures and informs decision-making. This integrated planning method shifts the discussion with potential opponents from "***is new grid infrastructure necessary***" to "***how can it be responsibly implemented***", anticipating potential opposition.

Aligning Ecological Planning Tools Across Scales

Successful grid deployment relies on the timely use of a coherent series of strategic planning tools that incorporate environmental and social factors before project designs are initiated. When these tools are effectively used, they address questions and solve conflicts at the right level thus creating a seamless decision-making process — from overarching vision to specific site design that proactively identifies and mitigates conflicts, rather than addressing them later. Their consistent and coherent application determines the minimum benchmark for grid planning and deployment.

Strategic Spatial Planning (SSP)

SSP establishes a long-term framework for how land and space should be used in the future. It is generally carried out by public planning authorities, and it aims to guide developments and investments in a coordinated way.

Generally, SSP does not include information about grid infrastructure. However, recent efforts to designate renewable areas, mainly for the exploitation of wind and solar, have become part of the SSP (***Figure 4***). This is important to note because designated renewable areas will require connections to the grid, thus building the case for new infrastructure to be built or reinforced towards those locations. The main challenge in applying the SSP is coordination across administrative lines, sectoral responsibilities and disjointed data systems. Where this coordination is successful, SSP transforms into a clear allocation of space for diverse uses, technologies and nature protected areas.

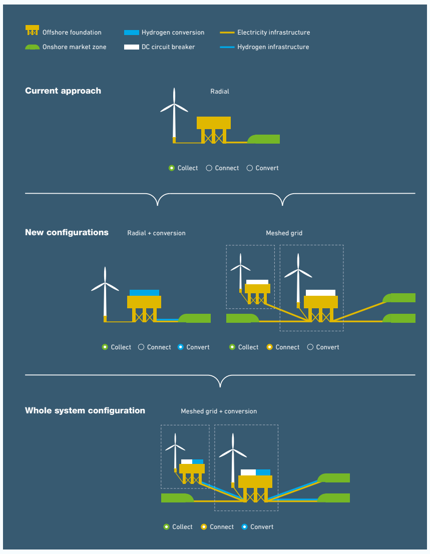
Figure 4 ➔ CASE STUDY NORTH SEA WIND POWER HUB

Case Study: North Sea Wind Power Hub (2024 Vision Paper)

The North Sea Wind Power Hub (NSWPH) demonstrates how early transboundary strategic planning can structure large-scale offshore grid expansion. Instead of relying solely on radial grid connections, the hub-and-spokes model integrates offshore energy hubs, hybrid interconnectors, and hydrogen conversion infrastructure. **The system fulfils three spatial functions:**

- **Collect** (offshore wind aggregation)
- **Connect** (cross-border transmission)
- **Convert** (hydrogen production)

By shifting from a single central hub to a distributed modular configuration, the concept reduces marine spatial conflicts, avoids duplicated infrastructure, and enables anticipatory grid investment. This case illustrates how system-level spatial design can de-risk decarbonisation pathways before project permitting begins.



Source ➔ *https://northseawindpowerhub.eu/files/media/document/North%20Sea%20Wind%20Power%20Hub_Vision%20Paper%202024.pdf*

Strategic Environmental Assessment (SEA)

SEA is a process for evaluating the environmental effects of a proposed plan or program before it is adopted. It does not decide what the plan should be, but instead investigates what the proposed plan or program does to air, soil, soil biodiversity and climate. It explores possible alternatives, suggests mitigation measures and informs decision-making. SEA is however not only about environmental impacts as it also includes socio-economic considerations in the assessment process.

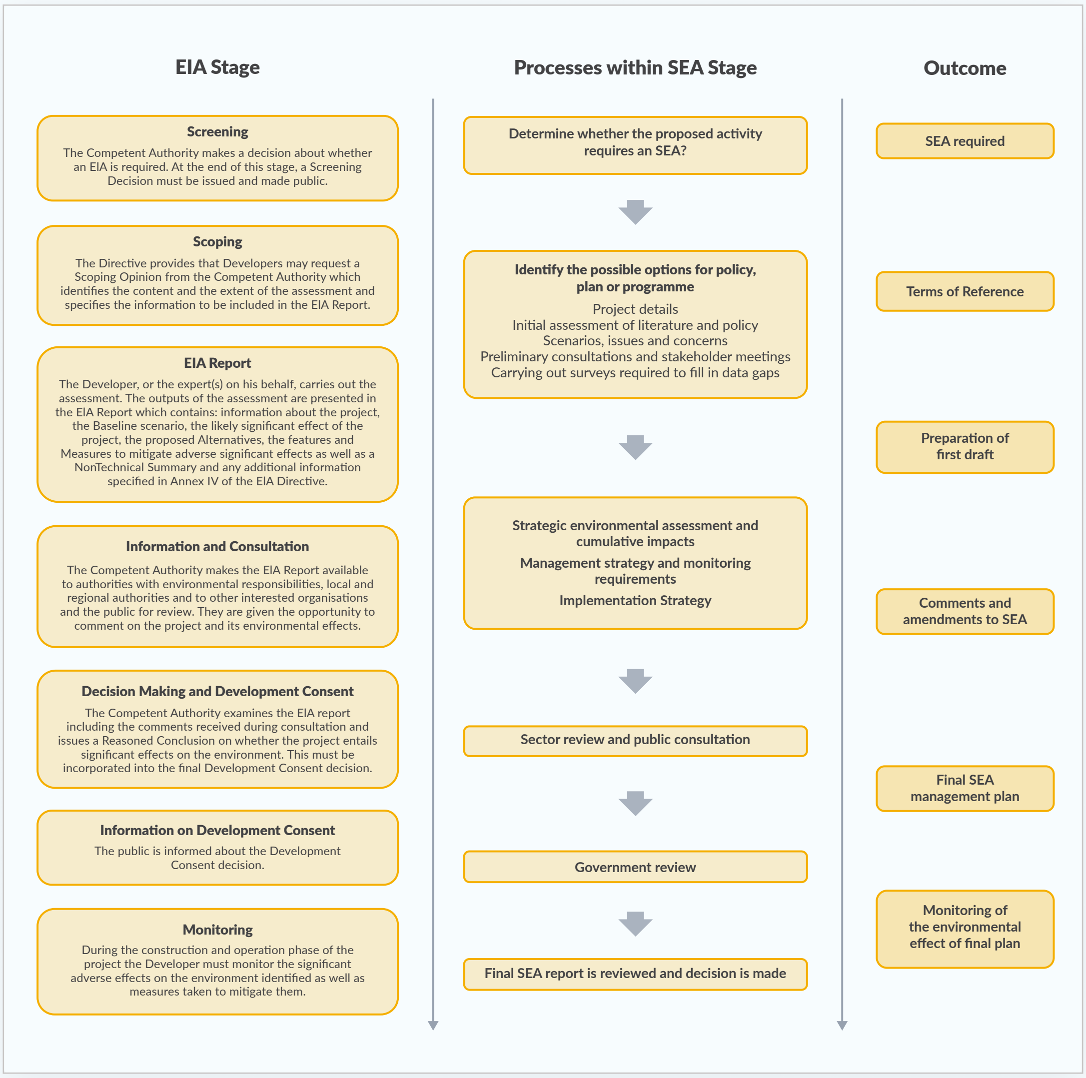
This is important for grid infrastructure as well as for any other large infrastructure projects. Indeed, the SEA provides data and insight about the relation and functionalities between the living environment and socio-economic aspects. **These include information about impacts on:**

- Human health through pollution, noise, water quality etc.
- The living conditions and quality of life of affected communities along or in the vicinity of a corridor
- Access to green space and related services
- Effects on vulnerable groups, cultural heritage and landscape
- Displacement or changes in settlement patterns

Similarly, the SEA covers several economic aspects thus exposing potential conflict of interests. For grid infrastructure, particularly relevant are effects on agriculture and forestry, impacts on tourism and landscape value, and property values. When conducted thoroughly and early, SEA offers a solid and credible basis that can expedite project delivery.

As depicted in the adapted ***Figure 5***, SEA and cumulative impact analysis, along with the establishment of management and monitoring requirements, facilitates the resolution of high-level trade-offs, the creation of mitigation hierarchies and the identification of exclusion zones in advance, reducing the need for project-level EIAs to revisit fundamental issues, thus speeding up consent processes while enhancing the quality and strength of decisions.[19]

Figure 5 ➔ STAGES OF STRATEGIC ENVIRONMENTAL ASSESSMENT (SEA)



EIA Stage

Screening
The Competent Authority makes a decision about whether an EIA is required. At the end of this stage, a Screening Decision must be issued and made public.

Scoping
The Directive provides that Developers may request a Scoping Opinion from the Competent Authority which identifies the content and the extent of the assessment and specifies the information to be included in the EIA Report.

EIA Report
The Developer, or the expert(s) on his behalf, carries out the assessment. The outputs of the assessment are presented in the EIA Report which contains: information about the project, the Baseline scenario, the likely significant effect of the project, the proposed Alternatives, the features and Measures to mitigate adverse significant effects as well as a NonTechnical Summary and any additional information specified in Annex IV of the EIA Directive.

Information and Consultation
The Competent Authority makes the EIA Report available to authorities with environmental responsibilities, local and regional authorities and to other interested organisations and the public for review. They are given the opportunity to comment on the project and its environmental effects.

Decision Making and Development Consent
The Competent Authority examines the EIA report including the comments received during consultation and issues a Reasoned Conclusion on whether the project entails significant effects on the environment. This must be incorporated into the final Development Consent decision.

Information on Development Consent
The public is informed about the Development Consent decision.

Monitoring
During the construction and operation phase of the project the Developer must monitor the significant adverse effects on the environment identified as well as measures taken to mitigate them.

Processes within SEA Stage

Determine whether the proposed activity requires an SEA?

Identify the possible options for policy, plan or programme
Project details
Initial assessment of literature and policy
Scenarios, issues and concerns
Preliminary consultations and stakeholder meetings
Carrying out surveys required to fill in data gaps

Strategic environmental assessment and cumulative impacts
Management strategy and monitoring requirements
Implementation Strategy

Sector review and public consultation

Government review

Final SEA report is reviewed and decision is made

Outcome

SEA required

Terms of Reference

Preparation of first draft

Comments and amendments to SEA

Final SEA management plan

Monitoring of the environmental effect of final plan

Source ➔ *Adaptation of the Underwood paper. Underwood, E., Taylor, K., & Tucker, G. (2018). The use of biodiversity data in spatial planning and impact assessment in Europe. Research Ideas and Outcomes, 4, e28045. https://doi.org/10.3897/rio.4.e28045*

However, in numerous jurisdictions SEAs are frequently performed too late to significantly affect outcomes, after crucial political decisions have already been made. This diminishes their effectiveness and transfers unresolved conflicts to the project level, leading to higher costs, delays, redesigns and heightened legal and other risks. When governments, through designated agencies, take the lead in carrying out SEAs, results are generally very positive and help to de-risk investments, build trust and contribute to a faster permitting process.

A relevant example (***Figure 6***) is Vietnam's Power Development Plan VIII[20], where SEA informed national offshore wind targets and zoning decisions before project licensing, integrating biodiversity and social constraints at plan level and reducing downstream permitting risk.

Figure 6 ➔ VIETNAM POWER DEVELOPMENT PLAN VIII

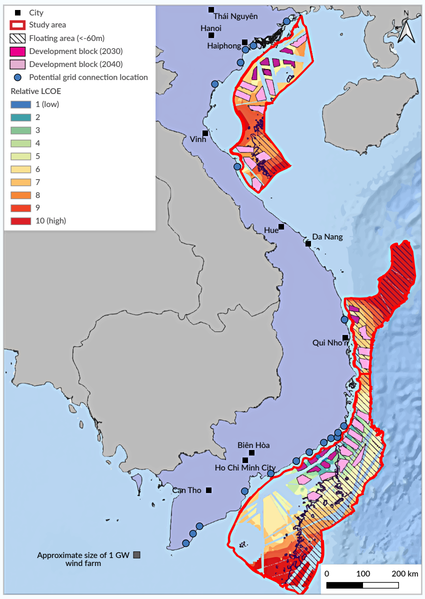
Case Study: Vietnam Power Development Plan VIII (PDP8)

Vietnam's offshore wind sectoral planning under PDP8 shows how SEA can shape national energy strategy upstream. Targeting 6 GW by 2030 and up to 15 GW by 2050, the planning process applied layered spatial modeling integrating technical constraints, biodiversity sensitivity, social values and leveled cost analysis.

The approach progressively refines Technical Potential Areas into Development Zones and Development Blocks before project licensing.

By embedding biodiversity and social sensitivity mapping into national zoning decisions, the SEA reduces cumulative environmental risk and improves regulatory certainty.

This case demonstrates how strategic modeling can align energy expansion with ecological resilience and conflict avoidance.



Source ➔ *https://openknowledge.worldbank.org/bitstreams/68051070-2d11-48c3-ada6-1a78b1871495/download*

A major step forward would be for authorities to make SEA's compulsory, to allocate clear responsibilities and timelines for their delivery and ensuring that the outcomes effectively guide any required political and investment decisions. An opportunity also exists in enhancing policy alignment across ministries (energy, environment and agriculture) which can lower project costs and risks and ultimately boost investor confidence.

Environmental Impact Assessment (EIA)

EIA serves as the project-level tool that translates strategic commitments from spatial planning, SSP and SEA into specific site safeguards. As shown in the left side of ***Figure 5***, the process begins with screening, to determine whether an EIA is required, followed by scoping, which defines the assessment's content and level of detail. At its core, the EIA applies the mitigation hierarchy (***avoid, minimise, restore and compensate***) at project level. The EIA report establishes baseline conditions, assesses cumulative effects, examines reasonable alternatives and defines mitigation and monitoring measures. The EIA report establishes a legally binding framework for informed decision-making. Public consultation enables authorities, stakeholders and communities to review and influence the assessment before consent is granted, forming a legally robust basis for decision-making.

When initiated early and aligned with strategic planning, EIAs reduce risk and accelerate delivery by minimising late-stage redesign, legal challenges and delays. Standardised and digitised EIAs further improve efficiency and predictability for regulators and investors, while ongoing monitoring during construction and operation verifies outcomes and strengthens the social and environmental licence to build. Properly designed EIAs (***Figure 7***) are not a bureaucratic obstacle but can be a delivery enabler.[21]

A clear planning priority hierarchy further improves resource efficiency and supports cost-effective net-zero pathways:

- Reduce demand and improve efficiency
- Upgrade and co-locate within existing corridors
- Avoid and minimise residual impacts
- Transparently address unavoidable effects

Applied consistently, this sequence prioritises low-impact solutions, avoids unnecessary infrastructure and provides a credible rationale for investment and approval, while recognising that substantial new infrastructure remains essential.

Figure 7 ➔ BIRD SENSITIVE INFRASTRUCTURE PLANNING

Case Study: Germany – Bird-Sensitive Infrastructure Planning

German infrastructure EIAs incorporate species-level ecological knowledge into transmission and construction planning. Avian ecology, breeding behaviour, habitat requirements and disturbance sensitivity are translated into mitigation measures such as seasonal construction restrictions, nesting buffers, adaptive vegetation management and collision risk reduction. Distinctions between nestlings and precocial species, territory size and foraging requirements inform project design.

This approach ensures that project-level implementation reflects ecological function rather than abstract compliance. This case illustrates how EIAs operationalise biodiversity protection through concrete design and timing adaptations.

Source ➔ *https://www.researchgate.net/publication/360300614_Beschwingtes_Bauen_-_fur_Vogel_planen_pp_378-420_in_Handbuch_Naturschutzfachkraft_Praktischer_Naturschutz_fur_Baustellen_Betriebsgelande_und_Infrastrukturen*

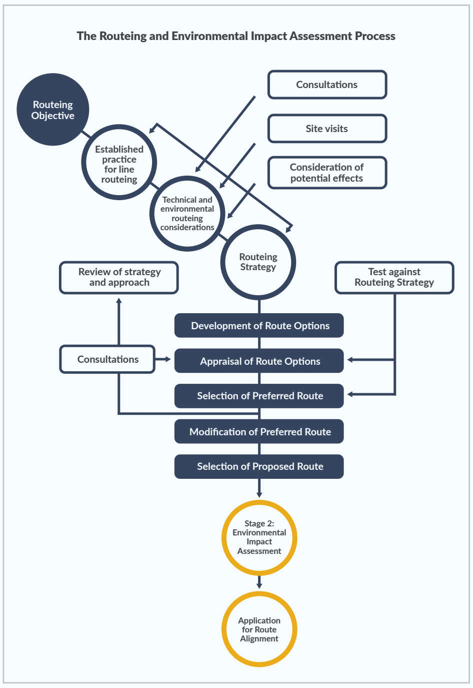
In short, EIA cannot be replaced by the SEA, as it provides a more granular understanding of the environment where the project is going to be built. However, in the presence of a strong SEA, the EIA can be expedited thus contributing at reducing permitting timelines. As illustrated in ***Figure 8***, during the environmental evaluation, stakeholders' engagement activities should be carried out in parallel to harvest local knowledge and contribute to defining the best strategies for the project implementation.

Figure 8 ➔ ROUTE AND SITING OPTIONS EVALUATED FOR THE PROPOSED NEW SUBSTATION IN SCOTLAND

Case Study: Braxton Substation Environmental Impact Assessment

The Braxton Substation EIA process shows why project-level assessment remains essential alongside strategic planning. It uses detailed baseline surveys, regulatory requirements and local consultation to refine the substation design, predict significant effects and secure targeted mitigation and monitoring at a resolution SEA cannot provide.

Within this, the Holford rules operationalise ‘avoid and minimise’ for electricity infrastructure: avoid close proximity to settlements, protect valued landscapes and skylines, follow existing linear features where possible and use landform and vegetation to reduce visual impact. In the Braxton case these rules structure route and siting options, but it is the EIA that tests them against local receptors, compares alternatives and refines context-specific measures (e.g. layout tweaks, screening, micro-siting) needed to achieve an acceptable, consentable design.



Source ➔ *https://www.spenergynetworks.co.uk/userfiles/file/EIAR_Vol_II_Chapter_3_The_Routeing_Process_and_Design_Strategy.pdf*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Part III:

Data, Monitoring & Reporting

Environmental tools and methods are only good if they can make use of sufficient data. Data collection is a fundamental strategic decision that will shape future infrastructure build-up. Traditionally treated as a competitive advantage and proprietary asset, data collection needs to become a shared objective. In view of the large amount of electricity grid investments and other energy infrastructure in general, a centralised system for data collection covering pre-construction, construction operation and decommissioning would reduce duplication, improve baselines and enable cumulative impact assessments.

While linear-infrastructure-related biodiversity data-sharing initiatives exist in Europe and Asia (often railways), these remain fragmented. By contrast, **EMODnet**[22] demonstrates that an integrated, open and operational data platform can successfully underpin planning, SEA and EIAs.

Although Europe and Asia host several initiatives linking biodiversity and linear infrastructure (e.g. roads, railways), these remain relatively fragmented compared to EMODnet's level of integration and operational maturity. By contrast, EMODnet is a long-term, fully operational marine data infrastructure, providing open, standardised pan-European layers (bathymetry, habitats, biology, human activities, etc.) through a single portal that directly underpins monitoring, marine spatial planning, SEA and EIAs.

Power grid planning requires a comparable terrestrial system: a platform capable of categorising impacts across spatial and temporal phases, linking them to clearly defined indicators (e.g. ecosystem integrity, ecological connectivity, species mortality risk), and applying harmonised metrics that capture both quantitative and qualitative dimensions, building upon established standards rather than duplicating existing frameworks. Field data generated through EIAs should be shared in standardised, interoperable formats to strengthen baseline conditions and enable adaptive management measures (such as Integrated Vegetation Management[23] or the deployment of Bird Diverters[24]) whose effectiveness can be systematically monitored and evaluated over time.

Standardising survey methodologies, equipment (from quadrats and acoustic sensors to camera traps and eDNA), and geospatial protocols is essential to ensure comparability. Integrating community perceptions and local knowledge, as highlighted in the **Community & Local Benefits** work, further strengthens legitimacy and supports Nature-Based Solutions. In a nutshell, a shared environmental data platform for linear infrastructure would not simply be "***best practice***", but it would become enabling infrastructure for a Nature- and People-Positive energy transition.


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Part IV:

How Do We Do More Than Just a Good Baseline

Verifying Net-Positive Outcomes

The previous sections have created a strong foundation for responsible grid expansion aligning climate, security, biodiversity and social goals through coordinated planning and structured mitigation. This reflects what is currently understood as "***good practice***". However, when we look ahead and see the scale of infrastructure required that needs to be built, it means that future development needs to go further than just minimising harm. It must deliver measurable net benefits for nature and society, shifting from impact reduction to positive outcomes.

Moving from "***do no harm***" to "***do good***" requires a fundamental shift from qualitative commitments to quantified, verifiable results. The absence of shared, standardised metrics for ecological and social outcomes has led to fragmented approaches, inconsistent results and, in many cases, either exaggerated claims or silence in reporting. This has fuelled both greenwashing and greenhushing. Robust, common metrics are therefore essential to demonstrate genuine Nature- and People-Positive performance.

In their absence, claims of being "***Nature-Positive***" or "***People-Positive***" remain vague and unverifiable, measures aimed at contributing to positive outcomes are hard to finance without a quantification of their intrinsic value.[25] Restoration or compensation claims that are not preceded by robust avoidance and minimisation, or that rely on poorly defined and weakly verified outcomes, can mask ongoing ecological loss. As highlighted by the Cross-Sector Biodiversity Initiative (CSBI)[26], without clear rules, transparent data and accountability, the hierarchy can be distorted to legitimise harm. Genuine regeneration therefore depends on standardised measurement, transparent monitoring and a redefinition of infrastructure's role within living landscapes.

Part V:

Conclusion

The electricity grid is not just an engineering feat; it significantly influences societal interactions with nature. The time of viewing environmental and social issues as mere constraints is over. By adopting a Nature-Positive approach — focused on strategic planning, ecological restoration and inclusive governance — grid infrastructure can shift from a conflict source to a renewal catalyst while fulfilling its original purpose.

Linear infrastructure, often spanning over hundreds of kilometres and traversing various environmental, social and economic landscapes, demands tailored and integrated strategies. Strategic Environmental Assessment (SEA) provides a vital opportunity to pinpoint and implement targeted actions that yield maximum benefits, for biodiversity, local communities, economic growth or a mix of these.

The **European Grid Declaration** has outlined the vision. This compilation of existing principles and practices establishes a clear path to achieve it. The result is an energy transition that not only fuels economies but also enhances the ecological and social frameworks they depend on. A genuinely Nature-Positive does more than transmit electricity — it revitalizes ecosystems, upliftws communities and represents the potential for a resilient, sustainable and fair future.

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About GINGR

GINGR — the Global Initiative for Nature, Grids and Renewables aims to support the just and sustainable energy transition by providing assessment tools to quantify contributions to Nature- and People-Positive goals. To facilitate this, GINGR will develop monitoring and reporting systems that are globally aligned and standardised. GINGR is a joint effort by the Renewables Grid Initiative (RGI) and the International Union for Conservation of Nature (IUCN).

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