TERRITORIAL STUDY //

Making space for the renewable energy transition

MAK-RES

Final Report // December 2025

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Key takeaways: Making space for the renewable energy transition

The expansion of renewable energy across Europe is no longer primarily constrained by technology or ambition, but by the way energy targets are translated into territorial decisions. **This report examines how spatial planning, governance arrangements and social acceptance shape the pace and quality of renewable-energy deployment.** Drawing on comparative case studies, it highlights where current approaches work, where they fall short, and which policy and planning choices can help accelerate deployment while managing land-use conflicts and societal concerns.

- **Renewable-energy targets become more effective when anchored in space**
  National and EU energy objectives often lack a clear territorial counterpart. Where planning systems do not specify how much renewable capacity different regions are expected to accommodate, deployment tends to rely on ad-hoc, project-by-project decisions, leading to uncertainty and conflict. Planning frameworks that translate energy goals into spatial responsibilities provide greater predictability and coordination → see chapter 3: The role of spatial planning
- **RED III pushes Member States to confront the spatial implications of their energy goals**
  Recent EU legislation places stronger emphasis on faster permitting and the identification of suitable areas for renewable energy. In particular, the requirement to designate acceleration areas encourages a shift towards more proactive spatial planning. How effective this will be depends on how well these new elements are integrated into existing national planning systems. → see chapter 2: The European dimension; chapter 3.3: Implementation of RED III Acceleration areas
- **Land-use conflicts are structural, but they can be managed**
  Competition between renewable energy, agriculture, biodiversity protection and other land uses is a defining feature of the transition. The case studies show that multifunctional approaches—such as agrivoltaics, hybrid parks or biodiversity-enhancing designs—can reduce conflicts and expand the range of viable sites when supported by appropriate planning and mitigation frameworks. → see chapter 4: Integrating renewable energy into competing land uses: Synergies and mitigation pathways
- **Social acceptance depends on tangible benefits, not on attitudes towards renewables**
  Opposition rarely stems from a general rejection of renewable energy. Instead, acceptance is shaped by procedural quality, early and continuous engagement, credible mitigation of impacts and the distribution of local benefits. Where communities experience tangible advantages and transparent decision-making, resistance tends to decrease over time. → see chapter 5: Social acceptance and local benefits
- **Experience matters: acceptance often increases once projects are operational**
  Across several case studies, residents living near existing installations report fewer concerns than those without direct experience. This "demonstration effect" suggests that visible, functioning projects and communicated local benefits play an important role in reducing perceived risks. → see chapter 5.5: Conclusions
- **Accelerating deployment requires action at both EU and Member State level**
  The EU can support the transition through targets, legal frameworks and funding for data collection, capacity-building and knowledge exchange. However, implementation ulti-

mately depends on Member States' planning systems, permitting procedures and governance arrangements. → see chapter 6.4: Future policy development

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Abbreviations

BauGB	German Building Code
CS	Case Study
EEG	Renewable Energy Sources Act (Germany)
EIA	Environmental Impact Assessment
ELP 2050	Spain's Long-Term Decarbonisation Strategy
EMZ	Yield Index – Land Productivity Score
ESPON	European Observation Network for Territorial Development and Cohesion
EU	European Union
GW	Gigawatt
INECP	Integrated National Energy and Climate Plan
LEP IV	State Development Programme IV
LOTUS	Extremadura Law 11/2018 on Sustainable Territorial and Urban Planning
MDLPA	Ministry of Development, Public Works and Administration
MITECO	Spanish Ministry for Ecological Transition and Demographic Challenge
MW	Megawatt
NECP	National Energy and Climate Plan
NGO	Non-Governmental Organisation
PACES	Sustainable Energy and Climate Action Plans
PATJ	County Territorial Plan
PATN	National Territorial Plan
PATZ	Zonal Territorial Plan
PUG	General Urban Plan
PUZ	Zonal Urban Plan
PV	Photovoltaic
RAA	Renewable Acceleration Area
RE	Renewable Energy
RED	Renewable Energy Directive
RED III	Recast Renewable Energy Directive
RES	Renewable Energy Sources
RLP	Rhineland-Palatinate
ROG	Spatial Planning Law (Germany)
ROP	Regional Spatial Plan
SEA	Strategic Environmental Assessment
SGD	Structural and Approval Directorates (Germany)
TWh/GWh	Terawatt-hour/Gigawatt-hour
UNEF	Spanish Photovoltaic Union

1 The need of transforming energy production

1.1 Background and context

Europe's transition towards climate neutrality is reshaping territorial development across all Member States. Rising pressures from climate change, the urgency of reducing greenhouse-gas emissions, and the need to strengthen energy security and resilience, particularly in light of recent geopolitical disruptions, have placed renewable energy at the centre of European energy strategy. Achieving these objectives requires a rapid and substantial expansion of wind, solar and supporting infrastructure, with direct implications for how land and sea are used, protected and governed. Renewable energy is therefore no longer only a technical or economic challenge, but increasingly a spatial one that intersects with biodiversity conservation, agricultural production, cultural landscapes and local well-being.

This expansion confronts Member States with a set of structural territorial questions: where large-scale renewable installations can be located; how to balance energy generation with competing land uses; and how to manage cumulative environmental effects while maintaining the quality and character of landscapes. Spatial planning systems – national, regional and local – play a decisive role in answering these questions. They determine how suitable areas are identified, how conflicts are managed, how environmental safeguards are applied, and how responsibilities are distributed across levels of government. At the same time, public acceptance has emerged as a critical factor influencing the pace and feasibility of deployment. Communities often face the local impacts of projects while benefits may occur elsewhere, underscoring the importance of transparent procedures, early engagement, and fair distribution of costs and advantages.

While recent EU legislation, including the revised Renewable Energy Directive (RED III), has strengthened the political and regulatory momentum for renewable energy deployment, the practical challenges remain deeply territorial. Planning traditions differ widely, data availability and mapping methods are uneven, and governance coordination is often incomplete. This creates uncertainty for authorities, developers and communities alike. The ESPON MAK-RES project responds to these challenges by examining how spatial planning frameworks, land-use policies and governance arrangements shape the expansion of renewable energy, and how they can better support a socially accepted, environmentally responsible and territorially balanced transition.

1.2 Project objectives

Building on the challenges outlined above, the MAK-RES project seeks to better understand how European planning systems can support a rapid yet socially and environmentally responsible expansion of renewable energy. As renewable energy deployment increasingly intersects with land-use pressures, biodiversity concerns, local opposition and fragmented governance arrangements, there is a growing need for evidence on how planning frameworks, regulatory instruments and participatory processes can be adapted to manage these tensions effectively. The project therefore adopts a spatial perspective on the energy transition, focusing on how land is allocated, how competing priorities are balanced, and how planning systems can create the conditions for predictable, equitable and territorially coherent development.

To guide this analysis, the Terms of Reference define four central research questions:

(1) *What are the primary barriers to the spatial deployment of renewable energy and what planning policies can be used to overcome these barriers, including the creation of synergies between renewable energy generation and other land-use priorities?*

(2) *What policy instruments can be used to facilitate land-use changes to make space for renewable-energy production (e.g. land ownership, permitting, redistribution reforms)?*

(3) *What are best practices to promote stakeholder engagement, public awareness and social acceptance of renewable-energy deployment, including the creation of win-win local effects?*

(4) *What has been the experience in using digital data and mapping techniques for assessing spatial needs and identifying suitable locations for renewable-energy generation?*

Together, they address the core dimensions of spatial governance, land-use change, social acceptance and the role of data and digital tools. Hence the project's main objective is to generate insights for strengthening spatial planning, improving policy coherence and supporting a socially just and territorially balanced renewable energy transition across Europe.

1.3 Methodological approach

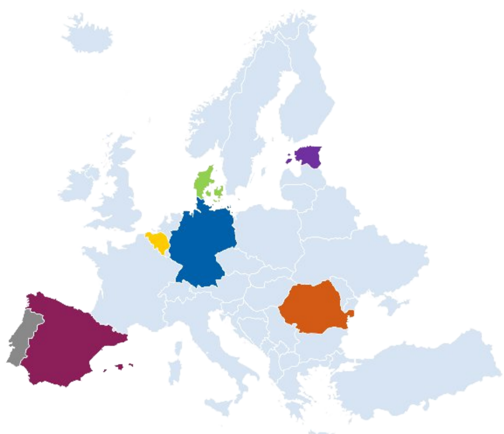
The MAK-RES project applies a mixed-method grounded in three complementary pillars: a literature and policy review, national and regional case studies and a comparative synthesis supported by stakeholder engagement across Europe.

The core of the research is a set of **seven case studies,** each implemented through targeted **desk research, workshops and semi-structured interviews** with national, regional and local actors involved in planning, permitting and renewable-energy development.

The seven case studies and their focus area are:

- Belgium: Solar park "Ostende airport", Flanders (2024)
- Denmark: Wind park "Vibberstoft Thy til Vind", Thisted (2024)
- Estonia: Hybrid park "Sopi-Tootsi" (2024/2025)
- Germany: Hybrid park "Energy Park Wörrstadt", RLP (ca. 1998)
- Portugal: Wind park Barão de São João, Algarve (2009)
- Romania: Wind park Casimcea (2012)
- Spain: Solar Park "Talayuela II", Extremadura (2003)

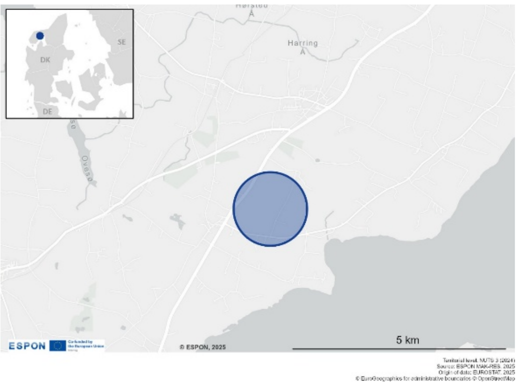
Examined focus areas

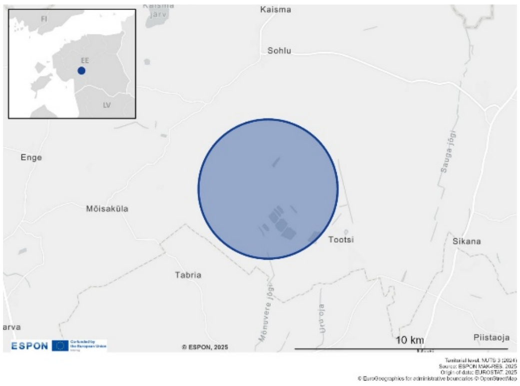


West Flanders

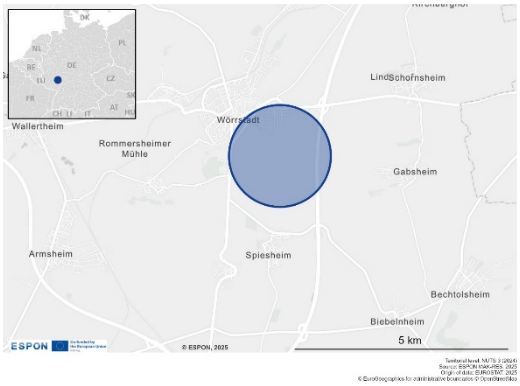
Vibberstoft Thy til Vind

Sopi-Tootsi

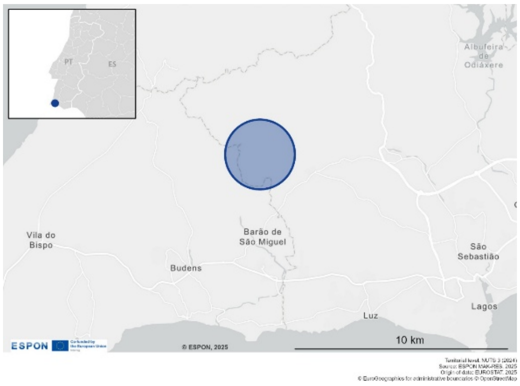




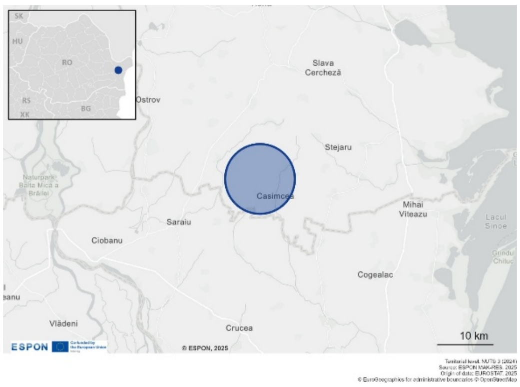
Energy Park Wörrstadt



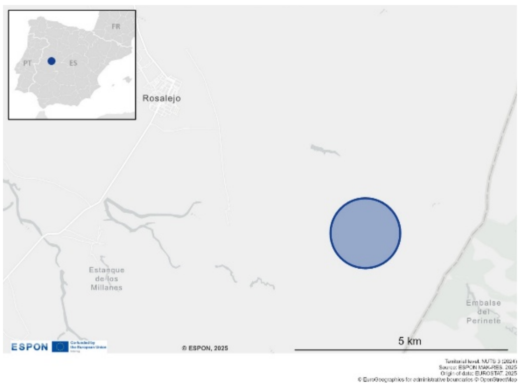
Barão de São João wind park, Lagos, Al-garve



Casimcea



Talayuela II photovoltaic plant



Workshops and/or interviews with planners, sectoral authorities, developers, environmental organisations and community representatives were organised to explore conflicts, trade-offs and practical solutions when developing wind or ground-mounted solar parks.

This field work was complemented by a review of EU-level policy documents, studies and outputs from relevant projects. It included a review of EU-level funding and financing instruments, with a view to identify and present the types of funding and support mechanisms aiming to foster renewable energy roll-out. While not exhaustive, this EU-level desk research and document analysis helped situate the case studies within the broader policy landscape and informed the development of the common analytical template, ensuring that each case study addressed comparable governance issues, land-use challenges, social acceptance questions and data needs.

Cross-case learning was supported by several collective activities. A dedicated **cross-case study workshop** enabled the core team and all case study authors to compare findings, identify recurring barriers, and consolidate emerging patterns across different planning systems. The focus was on clarifying any aspects of the case study that were unclear, closing information gaps, and discussing working hypotheses for the final phase of the project. At the final stage of the project, each case study included a **restitution activity** in which the cross-case findings and draft conclusions were presented to regional stakeholders for validation.

Additional input was gathered from the project's **Steering Committee,** whose members provided regular feedback on analytical direction and interpretation of preliminary findings.

Two larger stakeholder engagements enriched the analysis with perspectives from practitioners and policymakers across Europe. Four World Café sessions at the meeting of the **Network of Territorial Cohesion Contact Points (NTCCP)** in Køge in September 2025 brought together representatives from national administrations and planning bodies to discuss land-use conflicts, governance coordination and experiences with emerging EU requirements. During the **ESPON seminar in Aalborg** in November 2025, the project team hosted interactive fishbowl discussions and attended a series of presentations directly related to the theme of this study, which also framed the overall seminar programme. The event provided an opportunity to exchange insights with a broad range of national and regional experts, practitioners and scholars. These discussions offered valuable real-world reflections and practical perspectives that further informed the comparative synthesis.

The final phase of the project brought together insights from the case studies, stakeholder engagements and targeted document review into a structured cross-country comparison. This enabled the team to identify common challenges, highlight promising practices and formulate recommendations for strengthening the spatial governance of renewable-energy deployment across Europe.

1.4 Report structure and content

The report is structured to provide a coherent analytical pathway from the drivers of the energy transition at EU level to the concrete territorial mechanisms that shape its implementation. Building on the conceptual framing and methodological outline presented in this **introductory chapter,** the subsequent chapters are as follows:

Chapter 2 outlines the **European dimension,** situating the territorial challenges of renewable-energy deployment within the broader EU climate and energy policy framework. It reviews key legislative instruments – including the Renewable Energy Directive (RED III) – and European funding and financing mechanisms that shape national planning environments.

Chapter 3 examines **the role of spatial planning** in making space for renewable energy. Drawing on insights from seven case studies, this chapter analyses how planning systems link national energy goals to land-use decisions, how different zoning and permitting instruments function in practice, how municipalities navigate limited capacity, and how Member States are approaching the designation of Renewable Energy Acceleration Areas under RED III.

Chapter 4 investigates **synergies and mitigation pathways** for integrating renewable energy into territories characterised by competing land uses. It identifies opportunities such as agrivoltaics, biodiversity-enhancing solar parks, hybrid wind-solar configurations, and brownfield redevelopment, while also detailing the mitigation measures used to address ecological, spatial and visual impacts.

Chapter 5 examines the societal dimension of deployment: **social acceptance and local benefits.** The chapter analyses participation practices, communication strategies and benefit-sharing models that shape public trust and local consent. It shows that acceptance depends not only on procedural compliance but on credible engagement and the visible distribution of local benefits.

Chapter 6 presents **recommendations** for improving spatial-planning governance, strengthening permitting processes, enhancing the use of digital mapping tools, fostering social acceptance, and addressing research gaps. These recommendations are aimed at policymakers at European, national, regional and local levels.

The **seven case study reports** are presented in a separate document.

2 The European dimension

2.1 The European climate and energy policy

The European Union has continuously developed its climate and energy policy since 2009 to address the challenges of climate change and energy security. A key milestone was the **2009 Climate and Energy Package,** which established the "20-20-20" targets: a 20% reduction in greenhouse gas emissions, a 20% share of renewable energy in final energy consumption, and a 20% increase in energy efficiency by 2020 (EC, 2009). In 2019, the EU presented the **European Green Deal,** aiming to achieve climate neutrality by 2050 (EC, 2019). This ambitious undertaking was legally anchored in 2021 through the **European Climate Law** (EC, 2021/1119), which mandates a net reduction in greenhouse gas emissions of at least 55% by 2030 compared to 1990 levels.

To implement these objectives, the EU launched the **"Fit for 55"** package (EC, 2021), which includes a comprehensive revision of existing legislation, such as the **Renewable Energy Directive** (RED III, EC, 2023b: (EU) 2023/2413) and the **Energy Efficiency Directive** (EC, 2023a: (EU) 2023/1791). These revisions aim to increase the share of renewable energy in final energy consumption to 42.5% by 2030 and significantly improve energy efficiency. In response to Russia's aggression against Ukraine and the consequent need to reassess European energy strategy, the **RePowerEU Plan** (EC, 2022) was introduced. Its objective is to end dependence on Russian fossil fuels. Consequently, it raised the targets set under the Fit-for-55 package: the EU now strives for a 45% share of renewable energy in the energy mix by 2030. Member States of the EU (2024/2025) must prepare a **National Energy and Climate plan** (NECP) outlining how it will contribute to the EU's climate and energy targets.

2.2 RED III for accelerated planning processes

As part of the climate and energy policy for 2030, the EU pursues three main goals: reducing greenhouse gas emissions, increasing energy efficiency, and raising the share of renewable energy. Against this background, the **RED III Directive sets the target of increasing the share of renewable energy in the EU's final energy consumption** to at least 42.5% (+2.5% voluntary) by 2030. As an important component for achieving this goal, the directive obliges Member States to significantly shorten the often lengthy permitting procedures for renewable energy installations.

To do so, Member States must first **identify the areas required to meet their national contributions** (according to their NECP) toward the EU-wide renewable energy target for 2030. Article 15b states that the availability of energy resources, projected energy demand, and the availability of energy infrastructure must be taken into account when identifying these areas. It is explicitly stipulated that Member States should promote multiple land use within the identified areas, and that renewable energy projects should be compatible with existing uses of the land. At this stage, the RED III Directive does not explicitly require Member States to consider environmental aspects. This mapping had to be done until May 21st, 2025.

From these identified areas, the so-called **Renewables Acceleration Areas (RAA)** for one or more types of renewable energy sources are to be designated by February 21st 2026. According to Article 15c(1)(a), *"competent authorities shall designate sufficiently homogeneous land, inland water, and sea areas where the deployment of a specific type or specific types of renewable energy sources is not expected to have a significant environmental impact."* For these areas, accelerated permitting procedures are foreseen (cf. Article 16a) to speed up the expansion of renewable energy.

The selection of RAA should be based on suitable and proportionate instruments and data (e.g., wildlife sensitivity maps) to identify and minimize potential environmental impacts at an early stage. Furthermore, when these areas are designated in the framework of plans, a Strategic Environmental Assessment (SEA) must be carried out, in which measures to mitigate potential negative impacts are defined.

2.3 European programmes supporting renewable energy development

Beside of setting targets and rules for speeding up the development of renewable energy, the European Union provides a mix of funding and financing opportunities, which may be combined, and are directly or indirectly supporting renewable energy projects and/or renewable energy deployment. This section provides an overview of the most relevant funding and financing sources, programmes and support mechanisms that support either directly or indirectly the development of onshore wind parks or ground-mounted solar parks.

The **EU renewable energy financing mechanism** was established by Regulation (EU) 2020/1294, under the broader framework of the Governance Regulation (EU) 2018/1999 and became operational in 2021. Its main goal is to help EU Member States cooperate to expand renewable energy deployment, facilitating achievement of both EU-wide and national renewable energy targets, in alignment with the European Green Deal.

The mechanism works by linking "contributing" countries – which provide voluntary financial contributions – with "hosting" countries that allow new renewable energy projects on their territory. Contributing countries benefit by effectively financing renewables in places where production is more cost-effective (e.g. offshore wind for land-locked countries), while host countries receive investment in renewables with no burden on their national budget, along with gains such as local jobs, reduced emissions, improved air quality, modernised energy systems and reduced import dependency. Both kinds of countries share the statistical benefits of the renewable energy produced toward their national renewable-energy targets.

Projects are selected through competitive tenders and can receive either investment support (for building the renewable-energy facilities) or operating support (for the produced energy). The mechanism supports all technologies covered by the Renewable Energy Directive (EU), across electricity, heating & cooling, and transport sectors. The tenders are run by the European Climate, Infrastructure and Environment Executive Agency (CINEA) (EC, 2025a).

Horizon Europe Cluster 5 is the main EU research & innovation funding instrument for 2021-2027, with a total grant envelope of about EUR 93.5 billion. It supports R&D including energy topics: energy supply and systems, grids, storage, and climate-related innovation (EC, 2025b).

LIFE – Clean Energy Transition sub-programme aims to support the shift to a renewable-energy-based, climate-neutral economy at regional and local level, by funding coordination and support actions such as planning, capacity building, enabling regulatory frameworks, and mobilisation of private investment. While it does not directly fund large infrastructure, it can support smaller-scale and enabling offshore renewable investments, especially in regions or territories not connected to main grids (EC, 2025c).

Cohesion policy funds (particularly the European Regional Development Fund (ERDF), Cohesion Fund (CF) and the Just Transition Fund (JTF)) aim to support economic, social and territorial cohesion across the EU by reducing regional disparities and supporting green and digital transitions. Although there is no earmarked renewable energy budget, Member States and regions can choose to allocate part of their cohesion funding to project supporting renewable energy (generation, infrastructure, grid, etc.), depending on their priorities.

Connecting Europe Facility – Energy (CEF Energy) supports sustainable energy infrastructure and cross-border energy projects. With a grant envelope of EUR 5.83 billion for 2021-2027, CEF Energy aims to help implement projects of common interest (PCIs) or cross-border renewables projects, including offshore wind and ocean energy, especially where markets alone would not deliver them. Eligible projects include those contributing to grid integration, interconnection, and infrastructure to enable renewable energy uptake (EC, 2025d).

Modernisation Fund (MF) supports energy transition and modernisation in lower-income EU member states (currently 10 countries) financed via the EU Emissions Trading System revenues. Over 2021-2030, the Fund amounts to ca. EUR 48 billion (variable depending on carbon prices). Eligible investments include electricity generation from renewables, energy efficiency, storage and grid modernisation (EC, 2025e).

InvestEU Fund provides EU-backed guarantees to mobilise private and public investments across policy areas. With a EUR 26.2 billion guarantee envelope for 2021-2027, InvestEU can support equity or loan financing for capital-intensive and high-risk renewable projects such as floating wind, offshore grid cabling, port conversions, wave or tidal energy installations. Other types of renewable energies can be supported as well, e.g. photovoltaic power plants. This can help crowd in private investors by reducing risk and enabling larger-scale deployment of offshore energy infrastructure (InvestEU, 2025).

2.4 Conclusions

The European Union shapes the strategic environment for renewable-energy deployment by setting **binding energy and climate targets** and by establishing the legal architecture within which Member States must accelerate implementation. Recent legislation, particularly **RED III,** is designed to help close the gap between EU-level ambitions and on-the-ground delivery by requiring Member States to consider how renewable energy goals can be translated into their territorial systems. The directive requires governments to identify areas suitable for deployment and to designate a limited number of renewable-energy acceleration areas where pre-assessed conditions allow for simplified and faster procedures. Together, these measures aim to shorten permitting times, increase predictability for developers and administrations alike, and ultimately accelerate the roll-out of renewable-energy installations.

In addition to its regulatory role, the EU supports renewable-energy deployment through a broad set of **funding and financing instruments and programmes.** These range from the EU Renewable Energy Financing Mechanism, which enables cross-border investment in cost-effective projects, to Horizon Europe and LIFE programmes that fund research, innovation and enabling measures for the energy transition. Cohesion Policy funds and the Modernisation Fund can co-finance renewable energy infrastructure, grid upgrades and territorial development linked to the green transition, while the Connecting Europe Facility supports energy networks of cross-border relevance. Through InvestEU, the EU also helps mobilise private capital for capital-intensive or higher-risk projects. Together, these instruments provide Member States and project holders with financial tools to reduce investment barriers, modernise infrastructure and strengthen the conditions for accelerated deployment.

However, the concrete act of turning European ambitions into functioning renewable energy installations remains with the remit of Member States. National and subnational authorities must translate EU-level targets into territorial strategies, deploy spatial-planning instruments that identify suitable locations and minimise land-use conflicts, and operate permission procedures that are both efficient and credible. Ultimately, it is at this level that decisions about land availability, local participation, and environmental compatibility determine whether renewable-energy projects can be brought into operation at the scale and speed required. The European framework can set direction and provide support, but **delivery depends on the capacity and commitment of national planning systems and the local actors** who implement them.

3 The role of spatial planning

The rapid expansion of renewable energy fundamentally depends on how spatial planning allocates, regulates, and safeguards land for wind and grounded-mounted solar development. While energy and climate targets are set nationally through the National Energy and Climate Plans, their **territorial implications are rarely quantified or systematically translated into land-use requirements.** As a result**, spatial planning becomes the key mechanism** through which these energy targets are translated into concrete renewable energy power stations producing electricity by identifying suitable areas and balancing competing land uses.

The EC-DG Energy study (2023:52 et seqq.) identifies bureaucratic burdens, non-transparent processes, the lack of adequate spatial planning and legal coherence as well as incomplete and vague frameworks and guidelines as key "process related barriers" obstacles in the roll-out of renewable energy. Furthermore, conflicts between different public goods exist, e.g. conflicting environmental regulations, land use conflicts and military/air defence issues. The processes in place to balance these public goods were rated as another main obstacle and show room for improvement.

This chapter focuses on how spatial planning links national energy ambitions to concrete spatial decisions, which instruments are used to regulate renewable-energy siting, and if and how emerging EU requirements under RED III reshape these practices. The main sources of information feeding into this chapter are the case study reports.

3.1 Linking energy goals to spatial planning

Across all case studies, energy (and climate) targets are defined in the National Energy and Climate Plans (NECPs), which are mandatory for all EU Member States under Regulation (EU) 2018/1999. Yet, the degree to which these national targets are embedded in spatial-planning hierarchies varies considerably. In some countries, the NECP objectives are formally translated into land-use designations, zoning criteria and permitting frameworks, while in others, the link between energy policy and spatial planning remains informal or project-based.

In **Germany** renewable-energy targets are set at the **national level** and then **translated through a hierarchical planning system** that define the responsibilities of regional and local authorities. The national and EU energy objectives are transposed into federal law through the *Federal Climate Protection Act* and the *Renewable Energy Sources Act (EEG)* and the *Wind-on-Land-Act.* These laws require the states *(Länder)* to contribute proportionally to national capacity goals, which are then embedded in state development plans *(Landesentwicklungspläne)* and further detailed in regional plans *(Regionaler Raumordnungsplan)* and municipal land-use plans *(Flächennutzungspläne).* Thus, energy targets are not only national but territorially distributed through the federal planning hierarchy.

In **Denmark,** the *Climate Act (Klimaloven)* sets national greenhouse gas and renewable energy targets. Under the Danish *Planning Act (Planloven)* municipalities are required to include in their municipal plans *(kommuneplaner)* general guidelines for identifying areas that may be suitable for wind turbines and solar installations. While these guidelines provide a technical basis for zoning, they do not require municipalities to designate such areas, nor do they translate national renewable energy ambitions into specific regional or local targets. Municipalities can opt to designate zones where wind and solar development is either encouraged or restricted, and many also formulate their own local objectives for renewable energy. However, these objectives remain disconnected from national targets. Recent policy reforms have reinforced the state's role in ensuring that municipalities allocate more land for renewable energy development. From 2022 to 2025, a series of political agreements focusing on increasing green energy from solar and onshore wind created better conditions for expanding solar and wind energy production.

The case studies show that in other countries, the link between energy objectives and spatial planning remains **more fragmented or dependent on regional interpretation.** In Belgium and Spain, national targets are defined within the NECPs, but the competence for energy and spatial planning lies primarily[1] with the **regions and autonomous communities,** which enjoy substantial discretion in implementation. Regional energy policies are setting the frame for (especially) wind energy deployment. In **Belgium,** each region – Flanders, Wallonia and Brussels – sets its own renewable-energy objectives (which updated the NECP with regional specific RE targets) and integrates them into distinct planning frameworks, leading to divergent approaches across the country. **Spain** follows a similar logic: While the Spanish *long-term decarbonisation strategy (ELP 2050), National Integrated Climate and Energy Plan (NCEP)* and other policy documents define overall energy goals, their territorial translation occurs through regional energy strategies and spatial plans. The case studies in Spain and Belgium do not indicate that these targets are formally transposed into binding obligations for municipal or local level.

In the case of **Portugal,** the *National Energy and Climate Plan (PNEC 2030)* and the *National Programme for Spatial Planning Policy (PNPOT)* provide the strategic framework within which regional and municipal plans *(PROT* and *PMOT)* align their renewable-energy zoning and land-use decisions. Targets, however, are defined exclusively at the national level, with no provision for binding targets by regional or local authorities. Similar situations show the case studies of **Romania** and **Estonia,** where energy targets are established nationally but remain weakly embedded in spatial planning instruments. Both rely mainly on **sectoral energy strategies** and **project-based zoning or permitting,** such as Romania's *Zonal Urban Plans (PUZ)* or Estonia's municipal spatial plans, rather than on a coordinated hierarchy of plans linking energy policy and territorial development.

In two case studies there are spatial goals attached to the targets: In Germany municipalities are required to **designate a minimum share of land** for wind-energy deployment. In Portugal the intention is different: the legal framework **establishes a maximum threshold** for onshore RE development. The legal framework *"empowers municipalities to withhold permits when the cumulative area of renewable projects – across all technologies – equals or exceeds 2% of municipal territory".* The emphasis is on balanced distribution rather than quantitative territorial obligations. In contrast, off-shore wind park planning in Portugal has been spatially detailed in the Offshore Renewable Energy Allocation Plan *(Plano de Afetação para as Energias Renováveis Offshore,* PAER), which is to be integrated into the *Maritime Spatial Plan.*

3.2 Spatial planning instruments

Countries deploy a wide range of spatial-planning instruments to **regulate the siting of renewable-energy projects,** yet these instruments differ considerably in their binding

[1] In Spain the competence of authorising PV projects depends on the installed power: Spanish State administration if ≥50 GW; regional government if <50 GW

force, territorial precision and governance logic. The case studies show that **municipalities remain the pivotal actors** responsible for designating land uses through local plans, even where national or regional levels provide strategic guidance. Some countries employ structured zoning approaches that clearly delineate priority or exclusion areas, while others rely on indicative criteria derived from sectoral legislation, allowing **developers to take the lead in site identification.** Where higher-level frameworks are absent or only loosely defined, municipalities must interpret national energy goals themselves, assess environmental and spatial feasibility case by case, and respond to strong developer pressure – often with limited resources and expertise.

This section explores how governance structures, zoning categories, developer-driven practices and local-level responsibilities interact, and how these spatial-planning instruments collectively shape the feasibility, distribution and quality of renewable-energy deployment.

3.2.1 Planning competences in RE deployment

Across the case studies, the authority to define areas for renewable-energy development reflects each country's constitutional structure and planning tradition. In **federal or regionalised systems** such as Germany, Spain, and Belgium, the power lies primarily at the **regional level** (states, autonomous communities, regions), which determines suitability through regional spatial or territorial plans within national legal frameworks. In **unitary systems** like Denmark, Portugal, Romania, and Estonia, the **municipal level** plays the central operational role, though with very different degrees of national coordination. **Germany and Denmark** combine strong local implementation with clear national guidance and legal instruments that define planning categories and criteria. By contrast, the case studies of **Portugal, Romania, and Estonia** identify a lack of binding frameworks at higher levels, leaving area identification to case-by-case municipal planning or developer initiative. In the **Belgium and Spain** case studies, the highly decentralised models are characterised by regional discretion, diverse approaches and fragmented spatial outcomes. Overall, the responsibility for defining areas is widely dispersed, and only a few systems – most notably Germany and Denmark – achieve coherent vertical coordination between national objectives and local spatial designation.

In **Germany,** the delineation of areas suitable for renewable-energy development is undertaken by the **federal states** (Länder) and their regional planning associations. Federal law provides the legal categories – *priority (Vorranggebiete)* for wind energy and *reservation (Vorbehaltsgebiete)* areas – whereas the Länder determine the criteria in their state development plans *(Landesentwicklungsprogramme)* and the regional spatial plans *(Regionale Raumordnungspläne).* They further detail the criteria and delineate the exact boundaries of these areas on maps. These designations are binding for municipalities when preparing local land-use and zoning plans. Municipalities may designate additional areas for renewable-energy development – for example, for ground-mounted solar parks or smaller wind projects. However, these additional areas need to remain consistent with the overarching regional framework

In the **Danish** case study, the main responsibility for identifying suitable areas for renewable energy development rests with the **municipalities,** which exercise this zoning authority within a nationally coordinated planning framework. Under the *Planning Act (Planloven),* municipalities may choose to designate zones where wind and solar energy development is either promoted or restricted, and many also establish their own local ambitions for renewable energy expansion. In practice, however, the identification of concrete sites is strongly shaped by both local communities and industry actors. Developers, in particular, frequently take the lead by proposing areas that meet technical requirements and align with market conditions. At the statutory level, the municipal plan outlines the broader areas considered appropriate for renewable energy facilities, while the subsequent local plan translates these designations into binding regulations governing the implementation of individual projects. The state plays a more visible role in relation to energy parks, although its authority does not extend to determining either their precise location or overall scale. Rather, the purpose of state-designated energy parks is to ease certain planning requirements within designated energy park zones, thus allowing projects to be established in areas that would otherwise fall outside normal planning provisions. Energy parks cannot be designated through a top-down mandate. A prerequisite for state designation is explicit support from the municipal council, the absence of overriding national interests that would argue decisively against the proposal, and compliance with statutory requirements such as minimum size. Designation occurs through application rounds in which municipalities, renewable energy developers, or both may propose specific areas for consideration. Despite the state's facilitative role, energy park development must therefore be locally initiated, and no area can be designated without municipal consent.

In the **Spanish** case, the **Autonomous Communities** act as the main planning authorities for renewable-energy deployment. A national environmental-sensitivity model provides a common reference for identifying areas of higher or lower ecological conflict, but its application remains indicative rather than binding. Most autonomous communities have established **territorial plans for wind energy** while no equivalent framework exists for photovoltaic energy. *"Autonomous Communities, which are responsible for territorial and urban planning policies and instruments (to which renewable energy installation projects must comply), have not developed territorial plans for the installation of photovoltaic plants with binding zoning. They either resort to non-binding guidance documents that establish indicative zoning (as in Andalusia and Castilla-La Mancha), or they leave their drafting in the hands of departments other than territorial planning (usually those of industry and energy) (as in the case of the Basque Country)."* In regions such as **Extremadura,** proposed maps of preferential **PV** areas were never approved, leaving project siting to be decided **case by case** within regional planning and environmental procedure. After approval from the regional level which checks if it is aligned with the territorial and urban planning instruments, the municipality includes the decision on their subregional land use plan.

The **Belgium** case study shows that the responsibility is entirely **regionalised.** Flanders, Wallonia, and Brussels each hold full competence for spatial planning and renewable-energy implementation. In **Flanders,** spatial management is done via statutory land-use plans *(Gewestplan, Ruimtelijk Uitvoeringsplannen* at regional, provincial, or municipal level). These instruments form the legal basis for assessing whether wind and solar projects are compatible with existing land-use designations but they **do not contain specific categories for renewable-energy** infrastructure. A new approach currently under development, the principle of *bestemmingsneutraliteit,* aims to treat renewable-energy installations as a neutral land use compatible with most existing functions, thereby removing categorical barriers where spatial integration is possible. Flanders promotes renewable deployment through policy guidance, notably the *Wind Circular (2025),* which sets a three-step assessment hierarchy favouring siting in already developed areas, near large infrastructures, or in clustered wind farms. At the same time, municipalities can designate specific locations for wind turbines or set additional siting criteria in their community plans and municipal land-use plans. However, since the introduction of the single *Omgevingsvergunning* (integrated environmental and planning permit), the **final decision on major projects rests with the regional authorities** applying the supra-local framework. Project permitting is however decided case by case taking environmental and security restrictions and spatial considerations into account.

In **Portugal,** the case study highlights that energy-policy are primarily sectoral and lack spatially explicit mechanisms for allocating land to onshore renewable-energy development. Portuguese legislation **does not establish a regional zoning framework** dedicated to the siting of renewable-energy projects, and consequently no formal zoning plan exists for this purpose. At the regional level, the Regional Spatial Planning Programmes *(PROTs)* provide strategic guidance by identifying regional potentials, land-use conflicts and environmental sensitivities. Most PROTs are now under revision, and the energy dimension is expected to gain importance in light of the accelerating energy transition. At municipal level, the Municipal Master Plans *(Planos Diretores Municipais,* PDM) remain the main instruments regulating land use. These plans define the land-use categories, determining where renewable-energy projects may be permitted or restricted. Municipalities may designate areas for renewable-energy deployment provided they remain aligned with regional guidelines. In the **case-study area,** the *Lagos Municipal Master Plan* treats renewable-**energy projects as compatible with most land-use** classifications. A later revision prioritised upland areas (Serra Algarvia) for new electricity-generation infrastructure. However, no formal municipal zoning framework exists that explicitly identifies suitable areas for renewable-energy development.

In the **Romanian** case study, there are **no formally designated suitability or exclusion zones** for renewable-energy development. The identification of suitable areas currently depends on local urban plans and permitting processes. County or Zonal Territorial Plans *(PATJ/PATZ)* may include indicative references to renewable energy, but detailed zoning decisions occur at the **local level** through *General Urban Plans (PUG)* and *Zonal Urban Plans (PUZ).* The latter is typically initiated by **private developers,** who prepare feasibility studies and propose land-use changes for approval by local authorities.

In **Estonia,** spatial-planning competences for **renewable energy lie predominantly with municipalities,** which possess broad planning autonomy and make the majority of land-use and construction decisions. The municipal level defines the spatial feasibility of renewable projects. The national government issues general siting guidance, but **no binding national or regional zoning system** exists for renewable energy. The national spatial plan (Estonia 2030+) offers **no siting framework** for onshore wind. County-level plans are outdated and selectively address wind development, having been drafted before major technological advances and are insufficient for current renewable-energy needs. In **Estonia,** as a result, higher-level plans *"tend to hinder rather than support wind-farm"* development. Due to this gap, municipalities increasingly rely on Special Spatial Plans to enable wind-farm siting, although these plans are themselves under revision and may be removed from the Planning Act. Local comprehensive plans tend to contain vague provisions, creating uncertainty for developers and frequent administrative disputes. For ground-mounted **solar parks, no zoning plan is typically required:** municipalities set the design conditions and issue building permits based on the project. Overall, the case study concludes renewable-energy development has been "inconsistent and largely incidental".

This general situation of the spatial planning system and instruments in the different countries as outlined above has to be taken into account, when looking at the spatial planning mechanisms for the site selection process for wind and solar parks.

3.2.2 Exclusion criteria, priority areas and exclusion areas

Planning systems across the case studies differ in how they determine whether land is suitable for renewable-energy development. Some countries rely on formal zoning with clearly designated priority or exclusion areas, while others use criteria-based assessments and environmental screening practices. The EC-DG Energy (2023:123) condenses the current spatial situation like this: "So-called go-to areas tend to be more important for mature RES markets, while no-go areas are more frequently identified in countries where RES penetration is so far lower". The following approaches were identified in the case studies:

Definition of exclusion criteria

Most planning systems establish **exclusion criteria** that determine where the development of renewable-energy installations is a no-go, or only under strict conditions possible. These mechanisms aim to balance land-uses and to protect environmentally sensitive, densely populated, or otherwise sensitive landscapes. While the legal form, binding strength and thresholds vary, the criteria used is quite similar and can be summarised as follows:

- **Nature protection and ecological assets:** Natura 2000 areas, national parks and reserves, water-protection zones, biotopes and habitats, ecological corridors and valuable landscapes
- **Agricultural resource protection:** avoidance of high-quality soils
- **Cultural heritage and landscapes:** UNESCO/heritage areas and landscape character constraints
- **Settlement buffers and human health:** minimum distances to dwellings and noise-based setbacks (e.g. 55 dB day/45 dB night leading to ~400-800 m for wind in Portugal, or 1000 m buffer in Estonia, depending on height 800-1000 m in Germany)
- **Risk and safety:** flood-prone land, aviation corridors
- **National defence,** e.g. in Estonia *"for national security reasons, the construction of wind farms in counties adjacent to the Russian border is strictly restricted."*

These criteria are sometimes used to define explicit exclusion areas (partly in parallel to the suitability areas).

Priority areas and/or exclusion areas/no-go areas

Based on a set of environmental and/or social criteria **priority areas** designate territories where renewable energy is encouraged and enjoys planning precedence.

Exclusion areas mark those areas that are not available for RE use due to other existing sensitive and/or competing land uses as identified by the defined exclusion criteria. Sectoral legislation provides the starting point for defining exclusion areas, as regulations on nature protection, water management, agriculture, and disaster prevention remain legally binding across all planning levels. These frameworks establish the baseline spatial constraints within which renewable-energy planning operates.

Evidence from the case studies

In **Germany,** *Vorranggebiete* **(priority areas)** give renewable energy binding priority over other land uses. Within them, competing activities must demonstrate compatibility. In Rhineland Palatine they are *"identified based on wind-speed thresholds (~≥ 5.6 m/s at 140 m) and minimal conflicting uses".* In the case study region *Vorbehaltsgebiete* **(reservation areas)** are used granting PV special consideration without absolute exclusivity. They make up *"~26 potential sites designated as reservation zones for ground-mounted PV on low-yield soils (<35 EMZ), including within 500 m corridors of highways or rail lines".* The criteria determining the (un-)suitability for RE deployment is **explicitly integrated in statutory plans.** *"Tools such as GIS-based overlays were used to account for exclusion criteria (e.g., settlement buffers, aviation corridors, and nature protection zones) and technical constraints (e.g., wind potential, grid accessibility)."*

In **Denmark,** spatial planning instruments are used both to delineate zones where renewable energy development may take place and the areas where it is restricted. Municipal zoning identifies suitability zones that allow wind and solar installations under specified conditions, while a series of other planning themes (e.g., nature protection areas, cultural heritage, low-lying land reserved for ecological restoration, environmental conservation zones, and so forth) operate as exclusion zones that block renewable-energy development altogether. It is worth to highlight that these designations are not fixed. Municipal zoning for renewable energy can be revised relatively quickly, allowing adjustments as local priorities change. The initial zoning process typically draws on "*GIS-based overlay mapping that evaluates broad spatial constraints such as grid and transport access, nature protection zones, cultural heritage buffers, low-lying land for restoration, and settlement boundaries".*

In the Thisted case study, the municipality introduced **neutral zones** in which wind or solar projects may be proposed, and where developers were encouraged (albeit not required) to seek indicative local support (under Danish planning law, municipalities cannot approve or reject projects on the basis of public support). Instead, within neutral areas, project proposals are assessed through five local criteria – local ownership, neighbour compensation, nature enhancement, landscape integration, and community support – which allow planners to incorporate local sentiment as one of several qualitative considerations in determining suitability. A recent addition to the Danish planning system is the establishment of **state-designated energy parks** *(statsligt udpegede energiparker).* Each designated area must offer a minimum annual production potential of 100 GWh, and is reserved for either wind, solar, and Power-to-X development or a combination of renewable energy development. Altogether, these planning instruments are explicitly designed to support municipal ambitions, while helping municipalities advance projects that might otherwise face stricter spatial constraints. Energy parks must be understood, fundamentally, as initiatives that are inherently locally driven and remain subject to municipal approval. Proposals may originate from municipalities, community groups, or renewable-energy developers, but state designation cannot proceed without explicit consent of the municipal council. Thus, the state's role is facilitative rather than directive since it provides enabling conditions, but the ultimate authority over whether, where, and how energy parks are developed remains with the municipalities.

In **Spain** MITECO developed an *"environmental sensitivity zoning model for renewable energy, both wind and photovoltaic, for environmental assessment purposes"* which included zoning especially for wind park development in regional territorial plans. *"However, not all Autonomous Communities have implemented this same zoning for photovoltaic energy"* and the binding nature varies throughout the countries autonomous regions. In addition, the case study concludes that in order to establish suitability zoning for solar development, it is necessary to *"develop appropriate zoning criteria".* A similar conclusion is stated in the study of the Öko-Institut (2025:30) *"Although mapping tools (e.g., by MITECO) and updated sensitivity maps (e.g., by SEO/Birdlife) exist, no coordinated spatial mapping is being reported".*

In other cases, e.g. **Estonia** the exclusion is **based on a screening practice** that has been refined over many years and is used as a non-binding proxy for no-go areas. *"Estonia does not have an official national standardised methodology, but by default, developers and authorities refer to a set of commonly agreed suitability criteria and the terrestrial bird population analysis. These same criteria were also applied in the designation of national renewable energy priority development areas".*

In **Belgium,** exclusion criteria are not codified in a national framework but emerge from **regional guidance** and environmental assessment procedures. In **Flanders,** the *Wind Circular* sets a spatial hierarchy that limits development in open or sensitive landscapes unless clustered and well-integrated. To add on that, some *"municipalities or provinces have drawn up indicative wind/solar potential maps or "leidraad" (guidelines) to guide developers"* – but these are non-binding and not rolled out.

In Romania and Portugal **exclusion derives from the sectoral law** with only minimal input from guidelines. In **Romania** flood-prone areas, natural protected areas or high-quality agricultural soils do not allow developing certain activities, including RE projects; *"These restrictive areas are generally imposed by national legislation and cannot be overridden through the approval of updated urban plans".* The same is true for **Portugal.** However, in the course of identifying RED III acceleration areas, Portugal has developed a *"a GIS-based assessment integrating environmental and cultural heritage constraint mapping and the development of an exclusion algorithm for the removal of areas subject to siting restrictions"* which will be in place in the future.

The case studies show examples of a ranking within these categories. While some are "hard" exclusion criteria leading to a disqualification of the area, others are "soft" criteria, that recommend the exclusion or further investigation. e.g. in **Estonia** *"During the preparation of the thematic plan, a list of criteria was established to identify areas unsuitable for wind farm development, including, for example, nature conservation areas, densely populated zones, cultural heritage sites, and infrastructure corridors. Additionally, conditional or recommended criteria were defined, such as ecological corridors (green networks) and valuable landscapes, which require further consideration".*

Another way of dealing with "hard" exclusion criteria is the latest update of the state development plan in the focus area of the **German** case study, allows development in the formally excluded cores of protected areas, if the core protection goal remains intact. *"It redefines the treatment of protected zones by formally excluding core zones of nature parks, the Pfälzerwald biosphere core areas, and UNESCO World Heritage sites – such as the Upper Middle Rhine Valley – from wind energy development, albeit with the introduction of a rule-not-exception principle that may, in exceptional cases, allow development if core protection goals remain intact."*

3.2.3 The role of private developer in renewable-energy siting

In the majority of the case studies (Portugal, Romania, Estonia, Belgium, Spain), the identification and planning of renewable-energy sites emerges more from private initiative. The private sector fills the gap left by limited spatial guidance – identifying potential sites, often bearing the costs of assessments and plan modifications.

The role of wind park and solar park developers

In **Romania,** *"most often, large-scale RE projects are* ***developed by private investors,*** *with the role of local public authorities limited to urban plan approvals and building permitting".* Large-scale projects are initiated by investors who identify suitable areas based on technical and environmental feasibility – typically considering wind speed, grid capacity, and proximity to connection points, while avoiding protected or high-fertility agricultural areas. *"Private investors have usually developed their own studies when deciding to implement RE projects."* Since territorial and urban plans rarely reserve land for renewable-energy development, developers draft their own **Zonal Urban Plans (PUZ)** to secure necessary approvals. Public authorities mainly perform regulatory functions – issuing urbanism certificates and building permits – while municipalities lack the capacity or mandate to proactively plan renewable sites. Recent legal reforms allowing smaller projects to bypass PUZ procedures have simplified the process but have not shifted initiative away from private actors.

In **Estonia,** developers also play a central role in shaping renewable-energy siting. They commonly **initiate the planning process,** finance the required Strategic Environmental

Assessment (SEA), and submit applications to adapt spatial plans to local councils. Site identification relies on **informal zoning techniques** derived from long-standing screening practices and national environmental criteria. In practice, developers pre-assess feasibility using shared criteria – wind potential, defence constraints, and ecological sensitivity – before requesting the initiation of **special spatial plans,** which then formalise the location. *"As a rule, developers have already determined whether an area is suitable for wind park development based on known criteria when applying for the initiation of a special [spatial] plan."* Local governments approve or reject these initiatives but seldom initiate them by themselves.

In **Belgium,** project development is mainly **developer-driven,** too, even though regional authorities hold strong planning competences. In Flanders, developers use GIS-based analyses to identify potential sites compatible with existing land-use plans and environmental standards. In the **Ostend Solar Park,** for example, the developer Energy Vision selected the site independently, and the municipality's role (due to size, location and energy type it was not a regional responsibility) was limited to granting the combined environmental and planning permit. *"Energy Vision identified the site as potentially interesting for the creation of a solar park. They have their own method of identifying potential sites based on GIS analysis".* Similarly, in **Wallonia,** private operators typically propose sites that regional authorities then assess against environmental and spatial criteria.

In **Portugal,** in the absence of a spatially explicit planning framework, **developers likewise lead** the site-selection process. Private developers identify feasible locations, often supported by experts from the **National Laboratory of Energy and Geology (LNEG).** Developers prepare their own constraint maps, balancing grid access, land ownership, and environmental compliance. Municipalities are responsible for permitting and ensuring land-use compatibility under the *Plano Director Municipal (PDM).* They have a reviewing role rather than actively steering site identification. As a result, the Environmental Impact Assessment (EIA) process often serves as the main instrument for legal compliance of proposed projects.

In **Spain,** where territorial competence lies with the Autonomous Communities, usually solar park developers take the initiative to identify and design projects within the general guidance provided by regional and environmental regulations. The case of **Talayuela Solar (Extremadura, Spain)** illustrates a model of **collaborative developer-led planning,** where the private company designed its project through iterative consultation with municipal and regional authorities. This process integrated multi-criteria analyses (landscape, heritage, ecological, and urban compatibility) and extensive stakeholder dialogue, resulting in high local acceptance and minimal political conflict. The case highlights how strong corporate responsibility and early engagement can substitute for formal planning in securing socially robust outcomes.

In **contrast, Denmark** and **Germany** present a more **institutionalised and plan-led approach,** where the public sector retains a stronger steering role. In **Denmark,** a decentralised planning system grants municipalities the authority to designate suitable areas for renewable energy in their municipal plans and local plans while also enabling them to respond to initiatives put forward by private developers. This arrangement ensures that renewable energy development follows a systematic, plan-led approach rather than relying on ad hoc project approvals. Developers operate within this predefined spatial framework but remain important partners in project design and public consultation. In **Germany,** site identification is embedded in a multilevel planning hierarchy: the *Länder* and regional planning associations define the *Vorranggebiete* and *Vorbehaltsgebiete,* while municipalities implement these designations locally. Developers work within these boundaries, though they contribute to refining sites through detailed environmental and technical studies during the permitting phase.

The role of transmission-system and grid operators

Across all case studies, **grid capacity emerges as both a bottleneck** for the spatial feasibility of new projects and a **key criterion** guiding private developers' site selection. Additionally, the study by the European Commission (EC – DG Energy, 2023) identified issues related to grid connections and operation procedures as one of the main obstacles in of RE roll-out.

Beyond the role of the wind and solar park developers and the formal spatial planning administration, **transmission-system and grid operators** are important spatial actors influencing where renewable energy can be deployed. As the Spanish case points out, the operator Red Eléctrica exerts significant influence by defining grid-connection points and available capacity, which in turn determine the spatial feasibility of new installations. *"The existence of Red Eléctrica de España is fundamental to the deployment of renewables because it has a clear influence on the location of new power plants near it or within its area of influence, as well as determining the final viable capacity in GW of each new power plant".*

In Denmark, the grid operator Energinet is *"systematically involved throughout the planning process, contributing technical oversight and regulatory input".* Starting from the statutory consultations of the municipal plan, the municipal screening and zoning (operationalised in Thisted via the Thy model) to the SEA, EIA and permitting. Hence making sure that projects are only initiated where grid capacity allows for it.

3.2.4 The challenges for the municipalities

In many case studies municipalities or comparable local authorities have a decisive position in determining whether land can be used for renewable-energy development. Their role is shaped by the framework conditions under which they must interpret land-use compatibility. As Maya Perera (2025) from the European Environmental Bureau pointed out: *"Every project has its place in the local community. The local authority is the one who has to balance the difference interests."*

Where no suitability zoning exists, the decision for the land-use has to happen on a case-to-case basis. Municipalities must assess whether a project is spatially appropriate and socially viable – often under significant time pressure. This means they are expected to help meet national energy targets but without comprehensive strategic guidance and lacking territorial overview needed to judge site suitability beyond the local scale.

Local authorities face the challenge of evaluating land-use suitability, interpreting complex regulatory frameworks, managing public opposition, and managing increasing volumes of applications. Evidence from several case studies illustrates **that municipalities are overstrained with these responsibilities.** The EC study on "technical support for RES policy development and implementation" (EC – DG Energy, 2023) notes that a shortage of experienced staff in municipalities is a key obstacle in the process. The issue lies in either a lack of sufficient public clerks to handle applications, or in the staff not having the required experience or technical expertise to perform these tasks effectively.

This pressure at the local administrations is most acute in countries where municipalities carry the main decision burden without robust higher-level frameworks.

The case studies in **Romania and Estonia** explored, that the local governments face major capacity gaps in data, expertise, and procedural tools. They rely on fragmented environmental and spatial information, and the absence of shared databases or digital participation systems slows decision-making.

The Romanian case study states that *"institutions lack the expertise and coordination needed to support renewable planning. Environmental and land-use data are fragmented across agencies, with no effective sharing mechanisms".*

The Estonian case study identified that *"the massive public hearing required by law during planning means a very high workload for local governments, while digital solutions [...] are lacking".* The case study also notes *"at local tier, a single local authority is too small, isolated and politically sensitive a unit to implement a consistent and coherent long-term energy transition in the national interest". "Local governments are largely left alone in fulfilling renewable transition goals, struggling through confronting interest and contested public relations. ... Facilitators and specialised staff lack both moral support from leadership and councils and financial support."*

Portugal and Spain face similar pressures: shortages of qualified staff and a proliferation of speculative project proposals have generated administrative bottlenecks, with some planning departments struggling to manage applications within legal deadlines. In Portugal *"the main constraint lies in the shortage of trained human capital to manage the numerous and complex licensing processes".*

In Spain, this challenge roots in **speculative project submissions,** which has produced an authorisation surplus significantly exceeding actual investment needs and the NECP 2030 capacity forecasts. In the absence of binding territorial plans for photovoltaic development, developers frequently submit applications not to build immediately **but to secure potential locations** ahead of short funding windows linked to national and EU incentives. *"In many cases, it is not so much a matter of initiating real projects, already decided upon and prepared and requiring land, but rather of obtaining authorizations for potential locations for potential developers."* This structural pattern, rooted in Spain's longstanding path dependency of land and authorisation speculation, saturates the system with "paper projects" and **generates unnecessary territorial pressure.** As a result, territorial and urban-planning administrations become overwhelmed: *"land use planning (department) is usually understaffed and urban-planning (departments) are overwhelmed by the flood of requests arriving from developers... this often leads to delays, if not complete blockages, in the functioning of some departments".*

In response to these dynamics, a milestone-based system introduced by Royal Decree-Law 23/2020 has sought to curb speculative accumulation of grid access rights by requiring projects to demonstrate concrete progress within fixed deadlines. So far however, there is no data indicating that this situation has been resolved.

These capacity limitations at the local level, combined with inconsistent or absent spatial guidance, can lead to highly uneven decision-making across municipalities, some adopting pragmatic facilitation, others delaying or blocking projects due to uncertainty or overload.

In contrast, countries with strong municipal, regional or national frameworks, such as **Denmark and Germany,** illustrate how **national guidance, clear zoning criteria and multi-level coordination can ease some aspects of local planning.** When suitability zones are predefined and exclusion rules clearly established, municipalities operate with a clearer mandate and more predictable decision-making environment. This improves territorial coherence and reduces conflict.

Importantly, even where no formal zoning exists, municipal decisions are not taken in a vacuum. Sectoral legislation – nature protection rules, settlement buffers, soil protection, safety zones – still constrains project siting. But in countries with weak coordination, these layers remain fragmented, forcing municipalities to interpret complex and sometimes contradictory requirements. This places municipalities in the difficult position of having to advance national energy objectives without the strategic guidance and territorial overview necessary to identify the most appropriate locations. **Where higher-level frameworks are weak, local spatial decisions become the primary mechanism steering RE deployment;** without the corresponding institutional support, resources or strategic alignment needed to fulfil this role effectively.

3.3 Implementation of RED III Acceleration areas

Renewable Energy Acceleration Areas (RAAs) are a spatially explicit policy mechanism introduced through the EU Renewable Energy Directive (RED III, adopted in 2023). They require Member States to identify, by 2026, pre-screened areas with low environmental risk in which renewable energy projects can be approved through simplified and faster procedures (see chapter 2.2). Although RAAs do not replace existing planning instruments, they must be integrated into national and regional planning systems, shaping where renewable energy can expand with priority.

The status quo of the implementation of RED III in the case study regions

The implementation of RAAs is **still ongoing** across all case studies. Importantly, several case study teams noted that responsible authorities were unable to share full information because procedures were not yet finalised, politically sensitive, or still under internal negotiation. As a result, the **evidence available varies significantly in depth,** and some processes may already be outdated at the time of publication. The following synthesis therefore draws exclusively on official statements and explicit evidence provided by the case studies as of mid–2025 and uses the study "From policy to action – Follow up – Overview of Renewable Energy Spatial Planning and Designatoin of Accerleration Areas in Selected EU Member states" (Öko-Institut, 2025) as secondary source.

Romania is at a very early stage, with RED III not yet transposed into national legislation. A draft law is under interministerial review (as of July 2025), and *"it is expected that a methodology for defining both RAAs and no-go areas be included in the legislative proposal… followed by an integration of such areas in both spatial planning law and instruments."* At present, site identification remains developer-led, and RAAs are expected to provide the **first structured, national-level siting methodology** once legally adopted.

Portugal is among the most **advanced in developing a methodological foundation** for RAAs, though formal designation is pending completion of a Strategic Environmental Assessment (SEA). The case study reports that *"Portugal has been a pioneer in identifying Renewable Energy Acceleration Areas (RAAs)",* and that the National Energy and Geology Laboratory (LNEG) developed *"a GIS-based assessment integrating environmental and cultural heritage constraint mapping and the development of an exclusion algorithm. … The reduction of subjectivity in the definition of exclusion criteria was achieved through the involvement of multiple public entities from diverse sectors … and environmental NGOs".* Five alternative scenarios were produced but *"the implementation of RAAs awaits completion of a Strategic Environmental Assessment (SEA) to validate these scenarios."* Once approved, RAAs will be included in a binding spatial plan.

Denmark is the only country among the case studies that had **fully transposed RED III** by the May 2025 deadline. Rather than establishing a stand-alone RAA, Denmark **integrates the acceleration logic into its existing planning system.** Here, the purpose of state-designated energy parks is to enable municipalities to plan for renewable energy development in areas that would otherwise be difficult to justify under standard planning rules.

In **Germany** RED III fits into an already mature system of wind-priority and reservation areas. Regional planning authorities in Rhineland-Palatinate **have long operated with mapped**

zones and are now preparing to translate these into formal RAAs. However, the case study notes, *"Regional planning authorities in Rhineland-Palatinate are responsible for designating priority areas for wind energy and prospective acceleration areas in accordance with RED III. At this point, no information can be provided due to the recently adopted federal regulations."* Thus, while operational details are pending, the overall planning structure is well aligned with RED III requirements, and RAAs will build on existing spatial categories under the Wind-on-Land Act.

In **Spain** there was not enough information available to the case study authors to capture the state of RED III acceleration areas properly. A similar experience was described by the study of the Öko-Institut (2025:30) *"Little to no information is shared about the implementation and mapping process"*

Estonia has not yet designated RAAs, and RED III implementation is expected only after forthcoming legislative steps. According to the Öko-Institut study (2025) Estonia has undertaken a technically advanced coordinated mapping exercise. The Estonian Environment Agency applied a structured two-phase GIS-based process to identify suitable areas for onshore wind: a nationwide exclusion mapping using more than 100 datasets, followed by a refinement phase focused primarily on state-owned land, supported by extensive biodiversity surveys and wind-yield modelling. However, the analysis also notes that mapped areas remain insufficient to meet 2030 targets, that multiple-use options were not integrated, and that a small share of private land will still be needed.

In **Belgium Wallonia** exists an established legal basis: *"A Decree of 29 April 2024 empowers the Walloon government to adopt plans establishing acceleration zones [...] with streamlined procedures."* These zones will be linked to regional energy objectives and accompanied by simplified permitting codes. **Flanders** is advancing technical analysis but has not yet finalised designation: *"Flanders [...[is examining potential 'versnellingszones' (acceleration zones) for RE,"* with mapping showing that *"only a small fraction [...] had no major spatial constraints."* A draft decree to comply with RED III's permitting provisions was approved in November 2025 in which RAAs are integrated within binding territorial planning instruments. No region has of yet designated specific RAAs.

Findings from the relation between RED III acceleration areas and spatial planning

RED III provides an opportunity to bring more structure and predictability into renewable-energy deployment, especially in countries where siting has relied heavily on dispersed criteria, case-by-case assessments or developer-led localisation. The experience from Romania, Portugal and Estonia suggests that identifying acceleration areas can help authorities and developers converge on more suitable zones and gradually build a clearer territorial framework where such orientation has so far been limited. The Öko-Institut study (2025) reinforces this conclusion, highlighting the following as a key takeaway: "The RED III provides a sound framework for long-term planning of RE expansion. It creates planning security and a clear perspective, even when national political structures fluctuate or project stall." (Wingenbach, 2025). The study also confirms, that RED III has been a major catalyst for countries that previously lacked structured suitability mapping. In several cases – including Estonia and Portugal (which were among the 10 countries assessed) – the directive prompted the establishment of coordinated national processes for collecting and integrating spatial data and for developing transparent, map-based suitability assessments. While the quality and completeness of these datasets continue to evolve, RED III has clearly accelerated the creation of systematic mapping frameworks and initiated a more coordinated debate on land-use management for renewable-energy deployment (2025:31).

By contrast, in countries with mature RE zoning traditions, established suitability and exclusion criteria, and functioning multi-level coordination, RAAs may deliver only limited added value. In such systems, key elements of RED III – spatial screening, streamlined procedures, and territorial prioritisation – are already embedded in existing planning instruments. Introducing additional acceleration designations can therefore **risk adding procedural complexity without substantially improving** spatial outcomes, particularly where RAAs must be aligned with already comprehensive territorial plans. The Öko-Institut study (2025:31) confirms this conclusion and recommends "putting priority on a streamlined transposition into the national legal framework".

3.4 Land ownership and redistribution reforms

Land ownership structures may strongly influence how easily land can be converted to renewable-energy use. Yet, no country in the sample applies formal land-pooling or redistribution reforms to reallocate tenure or ownership for renewable deployment. Instead, land-use change is mainly facilitated through zoning obligations, permitting flexibility and negotiated leasing arrangements, supported by compensation or benefit-sharing mechanisms.

The closest case is Germany where federal states and municipalities are obliged to **designate a minimum share of land for renewables –** *"Rhineland-Palatinate is obliged to designate at least 1.8% of the state's area as wind energy areas by 31 December 2026 and at least 2.2% by 31 December 2032".* This functions as an indirect land-allocation requirement, but not as redistribution, it mandates zoning, not property transfer.

3.5 Digital data and mapping techniques used

GIS and sensitivity mapping approaches

Digital spatial data and GIS-based methods play a central role across the case studies in **identifying suitable locations** for renewable-energy deployment and in assessing environmental and land-use constraints. Public authorities and/or developers apply multi-criteria GIS techniques to integrate diverse datasets – land use, biodiversity, grid infrastructure, wind/solar potential, settlement patterns, and protected areas – into screening tools that help identify productive and low-conflict areas at early planning stages.

The **German** case study provides a clear example of how regional planners use GIS overlays to integrate environmental, technical and settlement data: *"Tools such as GIS-based overlays were used to account for exclusion criteria (e.g., settlement buffers, aviation corridors, nature protection zones) and technical constraints (wind potential, grid accessibility)".* The GIS workflow starts with exclusion masking, goes on with suitability filtering, is subsequently enriched with conflict analysis which leads to the identification of high-potential and low-conflict areas.

Similar, **Denmark's** Thisted Municipality's Thy Model explicitly relies on GIS screening before any political or community dialogue. *"The initial zoning is informed by GIS-based overlay mapping that evaluates broad spatial constraints such as grid and transport access, nature protection zones, cultural heritage buffers, low-lying land, and settlement boundaries."*

Likewise, the **Estonian** western counties' thematic plan has used multi-criteria GIS zoning since 2010. *"Suitability analyses – or zoning based on GIS methodology – have been employed".* The criteria integrated into the GIS screening include nature conservation areas, densely populated areas, cultural heritage sites, infrastructural and ecological corridors and valuable landscapes. The spatial data availability is strong: *"All map layers necessary for GIS spatial* *analysis, including nature protection areas, restrictions, and others, are easily accessible and downloadable".* This supports robust sensitivity mapping and shortens early screening phases.

Spain has developed a regional environmental sensitivity zoning model, but no objectified PV zoning criteria are identified yet. Stakeholders emphasise the need for coherent, harmonised datasets across levels of government: *"Improve geographical information systems for zoning and maps in a coordinated way between all political-administrative levels: better if only one or clearly harmonized"*

In Flanders, **Belgium,** some municipalities use GIS-based potential maps ("leidraad") incorporating multiple criteria and the region commissioned a mapping study that *"shows how zoning constraints and buffer rules limit wind development".* In **Romania** and **Portugal** multilayer GIS analysis was used in the identification of the RED III Renewable Acceleration Areas.

Environmental data gaps and implications

Despite progress in digital tools and the broad availability of geospatial data, biodiversity-related data gaps remain a major constraint across most case studies. The study by Öko-Institut (2025) noted that incomplete, outdated or inaccessible data sources pose a major issue for the mapping exercise.

These gaps arise for structural reasons: **field-based ecological surveys require significant time and resources,** and **biodiversity data becomes outdated quickly** as species move or respond to local changes. The case studies highlight concrete examples.

In **Romania,** planning is slowed by missing data: *"The lack of official geodatabases with relevant information such as soil class quality or ecological corridors also delays decision-making processes, as additional studies or permits are requested".*

In **Estonia,** the increasing detail required in environmental assessments has created delays, partly due to incomplete or dispersed ecological data: *"Today no detailed wind farm plan or solution SEA can be carried out without prior bird, vegetation, and bat studies." "[...] there is a lack of overview of existing studies despite advanced digital environmental registry and other depositories in Estonia."*

In **Germany,** similar issues arise, particularly in Rhineland-Palatinate: *"Wind energy planning is hindered by insufficient biodiversity and species protection data (...). This limits the ability to make reliable and legally secure site designation."* Interviewees note that some regions, such as Baden-Württemberg, operate with more intensive investigations, while others lack equivalent state-level datasets.

Public authorities in **Portugal** report that environmental information remains inconsistent and ageing: *"The quality of available geographic information sometimes hampers the analysis of project locations during preliminary stages." "The scarcity and outdated nature of data and databases relating to nature conservation and species further complicate the assessment of cumulative environmental impacts."* An assessment of the RAA implementation in ten EU member states (among them Estonia, Germany, Portugal and Spain) identified Portugal as the clearest example of data gaps, as *"limited availability and accessibility of relevant data, especially on environmental issues"* and *"no nature and species sensitivity mapping exists [...] for the Portugal mainland"* (Öko-Institut, 2025:26).

The existing data constraints systematically affect the reliability of sensitivity mapping and the legal robustness of spatial decisions, underscoring the need for up-to-date biodiversity datasets to support screening tools.

Digital tools for participation and communication

Digital mapping tools also play an increasingly important role in public participation and stakeholder engagement. In **Denmark,** interactive digital maps are used extensively to support informed dialogue: *"Digital data, mapping tools, and visualisations further enhance participation and social acceptance by providing transparent, accessible, and location-specific information. Interactive digital maps can visualise potential impacts, land-use changes, zoning categories, and environmental considerations, translating complex data into tangible insights."* Søren Møller Christensen from the Baltic Energy Island Bornholm pointed to the difficulty in active strategic planning. If the planning is supposed to attract investment and be socially accepted it is necessary to provide visualisations, including architecture and landscape design, to know what exactly is going to be developed on a certain site.[2]

Maps and visualisations help stakeholders understand proposed developments in a spatially explicit manner and can reduce misunderstandings that often fuel opposition. They also make processes more transparent by showing cumulative effects and alternatives.

3.6 Conclusions

The case studies show that the **weak connection between national renewable-energy targets and the allocation of land needed to realise them is a fundamental challenge for spatial planning.** Nearly all countries define energy and climate ambitions through their National Energy and Climate Plans, but these ambitions are rarely translated into **binding territorial commitments.**

Because national targets are seldom spatialised, **responsibility for identifying suitable and unsuitable areas shifts downward to regional and, most often, municipal authorities.** This places lower levels of government in the position of deciding where renewable-energy installations might fit within their jurisdiction – yet without knowing how much they are expected to accommodate, or whether their territory is even the most appropriate location in the wider national or regional context. In these circumstances, municipalities can only determine which parts of their land appear more or less suitable, not whether their contribution aligns with broader energy-system needs or territorial logics.

Spatial-planning instruments attempt to structure this task, but they vary widely. **Suitability or priority zones and exclusion areas,** exist in some countries. Most countries or regions developed **indicative zoning guidelines.** In many cases, public authorities rely on a combination of sectoral laws, planning guidance, environmental screening practices and locally interpreted criteria to assess feasibility. Sectoral exclusion criteria – based on environmental protection, settlement buffers, defence zones, flood risk or agricultural value – are present in all case-study countries, though they differ in level of detail and in the stage of planning or permitting at which they apply. Where higher-level guidance is limited or fragmented, local authorities must assemble these criteria themselves and determine spatial feasibility on a case-by-case basis. This reinforces the tendency for siting decisions to become **individual administrative judgements,** rather than components of a coordinated territorial strategy.

In this context, **digital data and mapping techniques play a central role.** The availability and quality of geospatial data – especially on environmental sensitivities, land use, and grid

[2] Møller Christensen, S. was presenting at the ESPON Seminar in Aalborg, on 19th November 2025

infrastructure – largely determine whether suitability assessments can be performed consistently and transparently. The case studies and literature show considerable variation: some countries already operate advanced digital mapping systems, whereas others are only now – in the context of identifying RAAs according to RED III – establishing nationwide datasets and mapping practices. In several cases, gaps in biodiversity or species-protection data constrain the ability to perform reliable spatial screening and create uncertainty in later phases of planning and permitting. Conversely, where accessible and harmonised data exists, planning authorities can more systematically identify sensitive areas, compare siting alternatives, and communicate decisions more transparently.

The absence of clear spatial frameworks also shapes the relationship between public authorities and the private sector. **Developers often step in to identify potential sites,** finance feasibility studies, and initiate land-use changes. This can accelerate investment and RE deployment, but it also shifts much of the analytical burden to local authorities, which must assess land-use compatibility without strategic guidance. This dynamic can produce uneven spatial patterns, depending on developer priorities, grid capacity, and local acceptance rather than planned territorial objectives.

RED III can lead to a changed approach, but its **effects vary across planning systems.** In countries where suitability mapping, environmental sensitivity analyses, or structured zoning had not been developed, the directive has provided a clear impetus to create such frameworks. By contrast, where planning processes and zoning instruments are already well established, integrating RED III requirements into existing legal and procedural frameworks is more complex. Without careful alignment, RAA risk adding administrative layers rather than accelerating deployment.

Summing up, renewable-energy siting is shaped less by individual planning tools than by the **overall configuration of governance responsibilities, the clarity of spatial frameworks.** The availability of consistent spatial data also plays a role. In most countries, planning authorities at local or regional levels must take crucial siting decisions without explicit territorial targets, without clarity on their expected contribution, and without certainty that their jurisdiction is the most appropriate location in the broader energy system. This leads to incremental, case-by-case approaches that can be efficient in individual decisions but struggle to deliver coordinated territorial outcomes. The gradual strengthening of mapping techniques, digital data infrastructures and suitability screening, accelerated by RED III, allow a shift toward more transparent and evidence-based spatial planning.

4 Integrating renewable energy into competing land uses: Synergies and mitigation pathways

The rapid expansion of wind and solar energy requires not only the designation of suitable land but also a careful negotiation of how these infrastructures coexist with existing territorial functions. Across the MAK-RES case studies, competition for land – between agriculture, biodiversity protection, housing, cultural landscapes, economic uses, and technical infrastructure – acts as a structural constraint on renewable energy deployment.

Chapter 4 examines land-use synergies found in the case study areas and analyses mitigation pathways, detailing how environmental, visual and operational adjustments and social benefits are used to make renewable-energy deployment compatible within sensitive contexts.

4.1 Land use synergies

The expansion of renewable energy places increasing pressure on already contested land resources. Land requirements differ considerably between technologies: while wind turbines occupy relatively little ground area, ground-mounted solar installations require substantial surfaces for the same energy output. Yet, the case studies demonstrate that with careful planning and design, renewable energy projects can coexist with – and even enhance – agricultural production, biodiversity and nature protection, recreation and other territorial functions.

4.1.1 Agrivoltaics (Agri-PV)

Balancing the expansion of ground-mounted solar installations with agricultural production has become one of the most visible land-use challenges. Yet, the case studies show that multifunctional approaches, combining energy generation with agricultural and ecological functions with agrivoltaics-systems, can transform potential conflicts into synergies. These approaches however remain an exception.

In several regions, pilot projects and regulatory frameworks aim to enable the simultaneous use of land for **crop cultivation** and electricity generation.

In **Rhineland-Palatinate,** one of **Germany's** most fertile agricultural regions, concerns about land-use competition are particularly pronounced. According to the *Regional Development Plan (LEP IV),* the use of arable land for PV should therefore be limited to 2% and restricted to low-yield areas. Within designated priority areas for agriculture, such installations are compatible with regional planning only, if farming can continue with minimal restrictions. The *Guidelines for Planning and Evaluating Photovoltaics (RLP, 2024)* recommend that these dual-use options be reflected in regional plans, and several draft *Regional Plans (ROP)* already permit Agri-PV systems in agricultural priority zones under defined conditions. Planning guidelines encourage the use of Agri-PV to *"reconcile solar energy with agricultural interests."* While stakeholders note that *"the lack of scientific evidence regarding which crops are best suited for combined use remains a barrier."* Early trials focus on specialty crops such as fruit and vineyards.

Similar approaches are being tested in **Denmark,** *"Municipal plans generally designate land for single uses, and multifunctional solutions are confined to research projects or small-scale demonstrations". "Currently, pilot projects are testing how solar panels can be combined with crops and grazing, with early results pointing to potential benefits for both energy production and farming".* These dual-use practices are not yet part of formal spatial planning. But in the case study area Thisted, municipal planning reflects a growing awareness of the need to balance renewable-energy deployment with broader land-use priorities. The municipality has embedded its zoning system within strategies for nature restoration and biodiversity protection, while piloting *"dual-use strategies such as agrivoltaics and biodiversity-friendly solar parks."*

In **Romania,** *Law No. 254/2022* temporarily permits renewable-energy projects on agricultural land outside urban growth boundaries, provided that the plots are smaller than 50 hectares and on less fertile farmland. It introduces the possibility of dual-use strategies on farmland and permanent grasslands. In contrast, Belgium's small territory and high land pressure make implementation more contentious: while research identifies *"28% of agricultural land potentially suitable for agrivoltaics",* farmers in Wallonia caution that Agri-PV *"drives up land prices"* and prefer installations on *"already developed or constructed areas."*

Grazing and agropastoral integration appear as the most pragmatic form of dual use. In the Talayuela II project in **Spain,** *"several agrivoltaics initiatives have also been launched, such as the introduction of sheep to control unwanted vegetation instead of using pesticides, or a beekeeping project on the plant grounds itself".*

In **Portugal,** multifunctional land use is recognised in national legislation but remains largely voluntary in practice. *Decree-Law No. 30-A/2022* encourages developers to *"maintain traditional land-based activities such as sheep grazing, poultry farming, and beekeeping"* within renewable-energy sites. The application of these measures to is left to project-level discretion.

Whereas agrivoltaics is still under development, **wind energy and agriculture** have long demonstrated practical coexistence, especially in countries with high land scarcity. In Belgium, *"wind farms typically use only a small fraction of land for turbine bases and access roads, so farming can continue around them".* In Denmark, wind turbines are a familiar feature of rural landscapes and *"already coexist with agriculture and forestry".* In Estonia, *"in general, agricultural or forestry land use continues within the area of a wind farm".* Across these examples, wind energy development is largely compatible with existing agricultural and forestry uses.

4.1.2 Biodiversity and ecosystem services

While renewable-energy installations inevitably alter local ecosystems, several case studies demonstrate that well-designed projects can enhance biodiversity and ecological resilience. Measures such as pollinator-friendly vegetation, wildlife corridors, and habitat restoration can integrate decarbonisation with conservation objectives.

Biodiversity-oriented ground-mounted solar installations

Biodiversity-oriented renewable projects demonstrate how ecological enhancement can be integrated into energy production. In Denmark *"initiatives are experimenting with biodiversity-friendly solar park"* and in Thisted (Denmark), biodiversity enhancement is one of the locally defined criteria guiding renewable-energy zoning.

In Extremadura **(Spain),** the Talayuela II solar park developed an Environmental Integration Plan to minimise environmental impacts and promote biodiversity protection. Measures include "planting a screen of native species along the fence, constructing a 5,000 m² pond to facilitate the breeding of native birds such as the bee-eater and the sand martin, introducing

European pond turtles as a breeding centre, and installing nest boxes and shelters for owls, kestrels, reptiles, and arthropods." These actions, complemented by agrivoltaics initiatives earned the site the "Seal of Excellence in Sustainability" from the Spanish Photovoltaic Union (UNEF).

Renewable energy and wildfire prevention

Both -the case studies of Portugal and Spain highlight potential synergies between energy production and fire-risk reduction. In Portugal, the stakeholders recognise *"potential synergies with wildfire prevention through the creation of firebreaks, access roads, and vegetation management,"* particularly where wind and solar projects intersect with forested areas. Similarly, in the Spanish case, renewable-energy development was identified as possible way to strengthen natural fire barriers: *"One solution is to integrate solar plants as firebreak infrastructure, located in already degraded zones or forest edges, combined with vegetation management through grazing or mechanical mowing."* These measures could help to reduce fire hazards, control erosion, and enhance the ecological resilience of rural territories.

4.1.3 Hybrid parks (combining wind and solar)

The dual land-use of wind and solar installations represents a promising approach to improving land efficiency and grid utilisation while reducing spatial conflicts. By sharing infrastructure like access roads and batteries, hybrid parks limit additional land take and visual impact.

Two of the seven case studies represent such hybrid parks: The *Sopi–Tootsi hybrid park* in Estonia and the *Energiepark Wörrstadt* in Rhineland-Palatinate (Germany). In Germany the regional plan explicitly foresees *"dual use of wind and PV in priority areas for wind energy"* but there is a clear priority to the use of wind power which is not to be impaired by PV development.

Although there are indications that hybrid or clustered renewable projects are encouraged, the case studies provide no clear evidence that stakeholders actively pursue or identify specific synergies between wind and solar development.

Interesting in this regard is the recent development in Denmark. Since 2024 it is possible to create state-designated energy parks *(statligt udpegede energiparker). "Each park must offer a minimum annual potential of 100 GWh and is earmarked for combined wind, solar, and Power-to-X development. These parks benefit from streamlined procedures and greater legal flexibility".*

4.1.4 Using brownfields and built-environment

All case studies encourage the reuse of degraded, underutilised, or already sealed land – such as brownfields, industrial estates, airports, and other components of the built environment (including façades and rooftops) – as a strategic means to accommodate renewable-energy expansion while mitigating land-use conflicts.

For instance, the German case mentions *"Solar PV expansion is primarily focused on rooftops and previously used land"* and privileged permitting of PV systems *"provided that they are built along motorways or multi-track railway".* Policies in Belgium encourage *"siting of wind farm projects near motorways, in ports or industrial zones"* and the *"implementation of solar panels on roofs rather than on land".* The Romanian report highlights the aim *"for large-scale solar energy production capacities on former tailings dumps".* In Spain, Extremadura's territorial planning law allows *"increased building volume when justified by renewable integration. This makes solarisation of the building stock (rooftops, façades, carports in public spaces) an obvious* *synergy",* Stakeholders in the Romanian case study see *"potential use of degraded areas for infrastructure installation (e.g. abandoned quarries)".*

However, the development of solar panels on brownfields and building land is not an easy task, as other spatial considerations such as buffer zones to settlements, safety distances, and the protection of local architectural heritage must be taken into account. Moreover, a more dispersed pattern of renewable-energy production can create additional challenges: to achieve equivalent generation capacity, a much larger number of smaller installations is required, which increases both spatial management complexity and development costs compared with a few large-scale projects.

Among the examined cases, there are two concrete examples of large-scale renewable-energy deployment on a pre-used site. One is the Belgian *Ostende–Bruges Airport solar park* which represents an integrated approach to renewable-energy siting within an existing industrial landscape. The 60,000-panel installation, covering approximately 60 hectares, was developed on airport land that *"can hardly be valorised because of airport activities,"* thereby avoiding conflict with residential, commercial, or agricultural functions. The project's acceptance further benefited from the absence of nearby residents. The case study explicitly notes that similar installations could be replicated at other airports across Europe, where extensive sealed surfaces offer significant potential for renewable-energy generation without additional land take.

A second example is the *Sopi–Tootsi hybrid park* in Estonia, developed on a former peat-field, representing a case of brownfield reuse. Yet, its deployment remains constrained due to strict environmental buffers protecting bird habitats, and parts of the plan have not been approved. Other brownfields in northeastern Estonia, such as former open-cast mines, cannot be used because of national defence restrictions.

4.2 Definition of mitigation measures

While land-use synergies create opportunities for integrating renewable energy installations into existing territorial functions, many locations remain contested or environmentally sensitive. Across the case studies, mitigation measures emerge as a critical instrument that allows renewable energy development to proceed in such contexts by reducing, compensating or managing spatial conflicts. Mitigation thus acts as a bridge between renewable-energy deployment and the protection of ecological, social and cultural values and can thus help foster social acceptance.

4.2.1 Anchor points of mitigation measures

The case studies show that mitigation measures are introduced at different stages.

Mitigation measures as part of the environmental assessment procedures (SEA – strategic environmental assessments and EIA – environmental impact assessments)

Strategic environmental assessments and environmental impact assessments require by law mitigation measures for counterbalancing potential negative effects on the environment. The requirement to conduct and SEA or EIA is laid down in the respective EU Directives (Directive 2001/42/EC; Directive 2014/52/EU). However, its implementation lies in the responsibility of the national legislation. The thresholds for conducting an EIA vary.

In Germany, EIAs are mandatory *"for wind farms with three or more turbines or PV systems exceeding 50 MW".* In Portugal, recent reforms introduced land-take thresholds, with photovoltaic parks below 100 ha and wind projects with fewer than 20 turbines (or 10 in certain sensitive areas) potentially exempt from EIA after screening. The Danish, Estonian, Belgian and Romanian case studies describe EIA requirements in more qualitative terms, without fixed MW or area thresholds, while the Spanish Talayuela II case specifies a 50 MW capacity threshold for whether the regional or national government conducts the strategic environmental assessment.

Mitigation measures developed in social participation and negotiation processes to address community concerns and secure acceptance

Participation and negotiation processes usually result in developing mitigation measures to address community concerns and to secure acceptance. These measures can include layout modifications, expanded settlement buffers, visual screening, community benefit schemes or local co-ownership models.

In Denmark, this dimension is particularly pronounced: local approval in "neutral areas" depends on *"whether projects contribute to local ownership, neighbour compensation, biodiversity enhancement, and landscape integration",* reflecting how mitigation is negotiated at community level. In Spain, the Talayuela Solar project demonstrates a similarly participatory approach based on *"close, direct and permanent contact... to continuously solve possible conflicts and demands."* In Portugal at the Barão de São João Wind Park, part of the mitigation package also reflects local negotiation, including municipal compensation: *"The park also contributes 2.5% of its revenue to the Lagos municipality as compensation for local impacts."*

Mitigation measures developed in local plans and permits becoming legally binding

The development of local plans and the grant of building and operating permits usually call for mitigation obligations that become legally binding. These obligations may include noise thresholds, curtailment obligations, lighting and aviation-safety rules, ecological offsets or detailed monitoring requirements.

In Portugal, the RASOD bird-protection protocol for the BSJ wind park was formalised through the operating permit, contributing to the project's feasibility within Natura 2000. In Germany, operational permits routinely include strict noise, species-protection and offset requirements that allow development to proceed in otherwise highly regulated landscapes.

The mitigation measures can be grouped into a set of **typical bundles** that recur across national contexts and technologies.

4.2.2 Types of mitigation measures

Ecological Mitigation and Biodiversity Protection

Ecological mitigation forms the backbone of most SEA and EIA-driven conditions, typically targeting collision risks, disturbance effects, biodiversity offsets, habitat loss and ecosystem fragmentation – depending on the energy source in question.

A distinctive example is Portugal's Barão de São João wind park in a Natura 2000 area that uses Radar-Assisted Shutdown on Demand (RASOD) to prevent bird collisions and *"bird deflectors on high-voltage lines with continuous avifauna monitoring."*

The wind park faced major permitting barriers due to its position on a key migratory flyway for soaring birds. To reconcile high wind potential with biodiversity protection, the project implemented a *Radar-Assisted Shutdown on Demand (RASOD)* protocol – an automated radar system integrated with field observation that temporarily halts turbine operation when birds of conservation concern approach the rotor zone. The system operates with eight observation points staffed by trained biologists who verify radar signals and trigger shutdowns when risk thresholds are met.

Hence the RASOD system serves as an important and targeted mitigation measure, aiming to minimise the negative impact of wind turbines on avifauna. Empirical monitoring shows that RASOD reduced avian mortality to zero for critically endangered species, while turbine downtime accounted for just over 1% of annual operating hours, demonstrating a highly effective mitigation with minimal energy loss. The model offers a scalable solution to minimise cumulative migration impacts. Expanding RASOD protocols across European flyways could turn previously unsuitable areas into viable renewable-energy sites, aligning biodiversity conservation and clean-energy objectives

Similar biodiversity-focused mitigation is found in Estonia, where SEAs increasingly incorporate detailed biodiversity studies. They often include *"turbine shutdown during intensive migration periods"* to protect bird and bat populations, and where *"no detailed wind farm plan or SEA can be carried out without prior bird, vegetation, and bat studies".*

In Romania, EIAs routinely include *"a detailed measured plan for mitigating negative impacts on biodiversity, as well as a monitoring programme".* Likewise, the Danish case study points to *"requirements for biodiversity offsets"* that act as mitigation measure.

Technical and operational mitigation

Technical and operational mitigation measures are mainly important in wind park developments. They aim at reducing impacts from turbine operation, as e.g. noise and lighting. These are typically codified in EIAs and later enforced through operating permits.

The German EIA process "involves detailed assessments (e.g., ecology, landscape, noise, and shadow)". Denmark provides a detailed example: *"Binding mitigation measures are also introduced, such as micro-siting, noise abatement, visual screening, biodiversity offsets, and compensation schemes."* These measures become binding before any permit is issued: *"The EIA is integral to the adoption of the local plan and must be completed before permits can be issued."* Similarly, Portugal's EIA decisions "establish conditions to be observed throughout project development," including documentation obligations and monitoring.

Spatial and landscape-integration mitigation

Landscape mitigation operates through siting adjustments, view-shed optimisation, density rules and spatial buffers. The Portuguese case study states that mitigation measures *"often include landscape interventions (e.g., 1.25 new trees are planted for every 1 tree removed), the installation of visual barriers, and other actions designed to minimise visual impact and enhance landscape integration".* Landscape measures appear in Spain's Talayuela II project through ecological integration, including: *"planting a screen of native species along the fence..."* Danish local plans also require binding landscape-integration measures and minimum settlement buffers are used as an explicit exclusion and mitigation mechanism. Similar in Germany where settlement buffers are used as exclusion criteria. In Belgium (Flandern) landscape integration rules are defined via SEA at zoning level in case these plans (GRUPS) refer to renewable energies *"installation conditions (height, density, distances, integration into the landscape), and any environmental mitigation measures)."*

Spatial mitigation remains essential for reducing visual intrusion and aligning projects with local landscape character.

Social-economic benefits

Beyond environmental, technical, or spatial adjustments, social benefits constitute an additional form of mitigation. While measures such as landscape integration, buffer zones or biodiversity safeguards reduce the physical footprint of projects, compensation schemes, local participation models, financial involvement of residents, and community-development funds or the development of municipal infrastructure mitigate the social footprint by ensuring that host communities perceive a direct and tangible gain from accepting new infrastructure. The following chapter examines these social-benefit mechanisms in detail, analysing how stakeholder engagement, participatory processes, and benefit-sharing arrangements shape social acceptance and political backing for renewable-energy deployment.

4.3 Conclusions

The integration of renewable-energy production into existing land uses requires balancing competing territorial priorities. Land-use synergies – such as agrivoltaics, hybrid parks, biodiversity measures or the use of brownfield and already developed areas – demonstrate that renewable-energy infrastructure does not inevitably displace existing functions. When well designed, these **dual land use** approaches support parallel land uses, reduce conflicts and, in some instances, generate added ecological or socio-economic value, for example through habitat restoration, improved agricultural productivity, or the revitalisation of underused industrial areas.

Where such synergies are insufficient or not possible, **mitigation measures** become decisive. Environmental, technical, design interventions and social benefits introduced through planning, permitting, or negotiated processes help to minimise adverse impacts and make projects acceptable within sensitive landscapes. The case studies indicate that these measures often determine whether development remains territorially feasible. While the form and emphasis of mitigation differ between countries, the comparative evidence shows that mitigation is not merely a compensatory tool but a key enabling mechanism that brings renewable-energy deployment into territories where competing land uses, environmental sensitivities or community concerns would otherwise preclude development.

In sum, while renewable-energy expansion inevitably requires trade-offs, the case studies demonstrate that **well-designed synergies and robust mitigation pathways can reduce conflict intensity and improve the spatial fit of energy infrastructure,** making deployment more compatible with broader territorial objectives. Their systematic integration into planning and permitting therefore represents a critical lever for achieving both energy and land-use goals.

5 Social acceptance and local benefits

Large renewable-energy projects often face resistance at the local level. Concerns about visual impacts, noise and landscape change can intensify when projects appear to be imposed from above, especially in rural areas already hosting much of the renewable infrastructure.

This chapter explores how social acceptance can be strengthened through inclusive governance, credible communication and equitable benefit-sharing, highlighting best practices identified across the case studies.

5.1 Stakeholder engagement

The case studies demonstrate that early, transparent and iterative participation appears as a strong enabler of public trust. Social acceptance is further increased when public authorities or developers communicate tangible community benefits from the outset. Conversely, where participation is procedural or confined to legal minimums, conflicts over the "hosting-burdens" tend to intensify.

All case studies operate within the common EU framework established by the Strategic Environmental Assessment (SEA) Directive (2001/42/EC) and Environmental Impact Assessment (EIA) Directive (2011/92/EU), which guarantees a minimum level of public participation whenever a SEA and/or EIA is required (depending on energy source, project size, thresholds, etc.). Differences arise in how this obligation is interpreted and extended in practice. Some integrate stakeholder dialogue early in spatial planning and maintain it throughout implementation, while others limit consultation to the formal hearing required under the assessment procedure. The following overview focuses on participation *beyond* these minimum requirements, highlighting how engagement unfolded in each specific case-study area.

The **Danish** planning system treats stakeholder engagement as an integral component of renewable energy deployment. The *Planning Act and the Environmental Assessment Act* define mandatory consultation and participation phases. The processes typically include an initial idea phase, a public debate stage, and a formal consultation period linked to municipal and local plans. How municipalities implement and supplement the legally required participation measures varies significantly. Thisted Municipality stands out for its inclusive model.

In Thisted, the Vibberstoft Thy til Vind project exemplifies how formal participation can merge with community ownership to create genuine local consent. The municipality established a participatory model (Thy model) that links informal citizen involvement with formal planning procedures, allowing residents to influence project selection and zoning decisions through early consultations, surveys, and local votes well before statutory planning begins *"allowing citizens' voices to be actively heard even before the planning process begins".*

The municipality divides its territory into three planning zones (negative areas, neutral areas, and energy zones) guiding where renewable energy development is prohibited, conditionally possible, or prioritised. The process begins with an open call for project proposals from developers, landowners, and local energy groups. Proposals are evaluated using five locally defined criteria, i.e. local ownership, neighbour compensation, nature enhancement, landscape integration, and community support based on a public survey of over 4,000 residents. Projects meeting these standards are then submitted to digital local referenda in the affected communities. Although these votes are not legally binding, they carry decisive political weight: only projects with majority local backing proceed to formal planning.

This participatory phase precedes statutory procedures, effectively embedding social considerations into the earliest stages of spatial decision-making. The zoning and evaluation framework is formally integrated in the municipal plan and publicly available online, ensuring transparency and predictability.

The Thy model with its additional requirements tends to extend project timelines in early stages. Experience suggests that *"the process has required considerable coordination and learning as municipalities, developers, and residents adapt to a more participatory and negotiated approach. Nevertheless, by addressing potential conflicts, filtering out unsuitable projects, and fostering early consensus, the approach may ultimately reduce later delays, appeals, and cancellations."*

All in all, this approach appears to be effective not only in advancing renewable energy deployment but also in sustaining high levels of local acceptance. *"When citizens both vote and see their choices reflected in political decisions, it boosts legitimacy. This direct link between citizen voices and political outcomes makes the process feel meaningful rather than merely symbolic."*

In **Germany,** the legal architecture of public participation is highly structured but allows for flexibility in practice. In **Rhineland-Palatinate,** stakeholder engagement extends beyond the legally required participation under the *Regional Planning Law* and *Baugesetzbuch.* In Wörrstadt, early and transparent dialogue has become a hallmark of local planning practice. The municipality has long pursued a proactive energy policy and maintains regular communication with residents through local meetings and planning discussions. During the regional planning phase, *"hundreds of individual comments, many from Wörrstadt and neighbouring municipalities, resulted in revisions of the draft plan,* (including) *the removal of one disputed site".* Beyond these statutory steps, informal early dialogue formats, e.g. information events and roundtables organised jointly by municipalities, developers, and the *Energy Agency of Rhineland-Palatinate,* play a key role in addressing concerns and building trust. This early coordination has contributed to a cooperative planning culture in which local energy cooperatives and municipalities work jointly, thereby reinforcing public confidence and the long-term social acceptance of renewable energy projects.

Estonia represents a case of legally mandated but evolving participation practice. The *Planning Act* enriches the formal requirements of EIA stakeholder involvement. It distinguishes between cooperation with competent state authorities and public participation through hearings. The Estonian Environmental NGOs Council is systematically involved in these processes. In practice stakeholder-engagement during the Sopi–Tootsi planning process remained limited. The municipality organised the mandatory public display and hearing, but few comments were received. Personalised notification of all landowners within a 2-3 km radius, now common due to recent court rulings, was not yet applied. Beyond the legal minimum, *a Memorandum of Understanding* between the municipality and the developer establishing a framework for cooperation. The case study notes, that *"over ten years, public awareness of participation in planning processes has increased",* that it is now *"common to receive hundreds of appeals".* The process remained procedural rather than interactive, showing that formal adherence to participation rules does not necessarily ensure meaningful local involvement.

In **Belgium,** the airport location in Ostend-Bruges and the energy source PV meant that no additional legal consultation was required, yet the developer chose to initiate voluntary dialogue, like targeted communication campaigns and local information sessions and offered financial benefits to the citizen. *"No neighbours were located in the surroundings of the project and therefore, no specific procedures were compulsory. Energy Vision is used to participation processes because on most of their projects, it is needed to help the acceptance of the project. The project holder [...] thus communicated on participatory processes to help social accept-*

ance locally". These efforts substituted for the lack of formal consultation and effectively pre-empted opposition. The case shows that developer-driven participation can deliver legitimacy when transparent and combined with tangible local benefits.

The **Spanish case** mirrors the Belgian experience in relying on proactive company outreach rather than additional formal mechanisms. The developer worked closely with the municipality to identify local priorities. *"Once the new Talayuela II project was launched [...] an initial informational phase began with an open house in the town. The company team informed residents about the new project and invited them to establish a dialogue and a communication channel. They were also invited to submit statements of interest to participate in a training and personnel selection process tailored to the needs of the plant and the company.* [In Addition] *businesses and activities present in the area were also invited."* As a result, the developer provided professional retraining. These initiatives visibly linked the project to local welfare and helped to build public endorsement. Here, social engagement was framed less as consultation and more as partnership in local development.

In **Portugal** stakeholder participation is legally required only within the EIA framework, which was required for the Barão de São João site. There were no participatory elements beyond the mandatory measures. Despite its mandatory nature, public participation is often limited in effectiveness. *"It is conducted exclusively via an online platform after the project design is finalised, with no assurance of substantive project modifications. [...] Participation occurs solely online, within limited timeframes, and involves complex technical documents that may impede public comprehension of project impacts [...] Although some developers engage local communities early and occasionally consult environmental NGOs, such practices are neither widespread nor mandated. No cases of co-design involvement were reported."* In summary, public consultation in Portugal remains confined to procedural compliance; while it meets formal obligations, it rarely alters project parameters or strengthens local ownership.

Recent legislative amendments influenced by the REPowerEU initiative and RED III Directive have introduced procedural flexibility and exemptions from EIA requirements depending on their size[3]. This diminished the scope of legally mandated public participation. According to stakeholders *"This reduction correlates with decreased community engagement and weakened local influence over decision-making, potentially undermining overall acceptance and fostering perceptions of insufficient transparency concerning infrastructure impacts and long-term implications."* The case reveals how procedural streamlining can unintentionally narrow spaces for citizen input.

In the **Casimcea region in Romania,** engagement followed the national EIA procedure but remained formalistic. Since 2010 (after the development in Casimcea), Zonal Urban Plans are subject to four procedural phases that include public announcements, informative panels, and access to planning documentation, with voluntary participation through written comments submitted to the local administrative unit. However, stakeholder assessments indicate no evidence that these procedures have made participation more meaningful or influential in practice: *"There is a general lack of engagement of citizen groups or NGOs within public consultation procedures".* And: *"Citizen and NGO-input can rarely influence planning decisions, with public consultation often seen just as another formal procedural step which needs to be car-*

[3] According to Decree-Law No. 11/2023, 10 February, photovoltaic parks located outside designated sensitive areas, or with panel and inverter surface areas below 100 ha (potentially covering up to 300 ha in total project area), may be exempt from EIA, subject to case-by-case evaluation. Similarly, wind projects with fewer than 20 turbines outside sensitive areas, or fewer than 10 turbines in certain sensitive areas, may also be exempt following individual screening.

ried out". In Casimcea, some informal communication occurred when the developer funded small community projects, yet these actions did not amount to structured participation. The case shows the consequences of scarce local capacity and decision-making concentrated at higher administrative levels: consultation satisfies legal norms but rarely shapes outcomes.

In local participation processes a moderator who is independent from the developer perspective is an important success-factor. This moderator acts as communication facilitator and mediator between the different parties. Having this role in the process supports joint solutions and acceptance of project realisation (EC – DG Energy 2023:150f).

Conclusions about stakeholder engagement in the case studies

Overall, the cross-case evidence highlights three lessons.

- First, *early and continuous dialogue* fosters trust and reduces litigation. This is also one of the conclusions in the EC-DG Energy study (2023:148) which stress the importance of early, open-end engagement with thorough information as prerequisite.
- Second, *clear institutional responsibility* for consultation prevents participation from becoming symbolic.
- Third, *voluntary transparency* by developers can partially compensate for weak formal mechanisms but cannot replace structured, multi-level engagement.

5.2 Safeguarding local benefits

Generating and fairly distributing tangible local benefits emerges as the central pillar of social acceptance in all case studies. Communities are more likely to support renewable energy projects on their ground when they perceive direct and measurable advantages, e.g. financial returns, trainings and employment, improved infrastructure or enhanced environmental quality. Conversely, where benefits remain abstract or are channelled exclusively through municipal budgets, acceptance is low.

5.2.1 Types of local benefits

Financial participation and revenue sharing

Several case studies demonstrate that **financial participation and revenue sharing** strongly correlates with local support. This effect is even more pronounced when financial benefits reach citizens directly rather than being absorbed into municipal budgets, allowing residents to clearly see the link between the economic contribution of renewable energy projects and tangible local improvements.

In **Denmark,** the Vibbestoft case shows that *"at least 30% of project shares are reserved for local residents and businesses, and a dedicated community fund (1% of gross revenue) ensures that financial benefits are reinvested locally. National compensation schemes (such as payments to neighbours and the right to purchase shares) are communicated early to set expectations and build trust."* This supports the take on projects that they *"are viewed not only as interventions but also as resources".*

Similarly, in **Belgium,** the Ostende project offered a citizen investment scheme via crowdfunding: *"An eight years' loan with a fixed annual interest rate of 5% [...] with a minimum participation of EUR 250".*

Wörrstadt in **Germany** *"receives voluntary payments from wind farm operators within 2.5 km of turbines for existing turbines [...]. In 2025, these payments totalled approximately EUR 100,000".* For a few years there is also compulsory compensatory revenue sharing (around EUR 0.2

per kWh fed into the grid for municipalities within 2.5 km). On top of that there are also citizen energy cooperatives that enable residents to co-invest in projects. *"These models build ownership and trust".* Whereas *"where citizens or municipalities do not directly benefit (e.g. through tax reductions or cooperative models), acceptance remains low."*

Since 2023 municipalities and households in **Estonia** within a 2-3 km radius of wind farm (depending on the height of the turbine) receive a wind-turbine fee. In Sopi-Tootsi this adds up to *"approximately EUR 500,000, constituting 2-3% of the local government budget revenues".* There is evidence that *"people who receive the turbine fee as toleration fee under the environmental fee law tend to have a more positive attitude towards the wind farm than those living slightly further away",* which shows that while financial benefits might improve attitudes of those who receive it, households just outside the designated radius may feel unfairly excluded and hence foster resentments.

The hosting municipalities in Portugal, Spain, and Romania also receive financial contributions from renewable-energy developers, although the scope and impact of these measures vary.

The **Spanish** case study states that *"the project has provided a significant financial boost to the Talayuela town council, in municipal taxes alone"* which was subsequently used to significantly improved local infrastructure.

In the **Romanian** case study, local revenues are more pronounced: Around 135 wind turbines generate about EUR 750,000 annually for Casimcea commune – *"a large amount for a rural municipality with only 2,500 inhabitants",* complemented by land-lease payments to individual owners. These benefits lead to higher levels of social acceptance.

In **Portugal,** the legal framework has long required developers to allocate part of their revenues to host municipalities – initially *"2.5% of annual revenues".* For small rural municipalities, such contributions represent a significant fiscal inflow, yet *"no binding conditions govern their allocation",* leaving the use of funds largely at municipal discretion. More recently, the free transfer of *"a self-consumption generation unit equivalent to 1% of installed capacity"* for community facilities or nearby population is foreseen. Alternatively one-off payments can be chosen. This compensation is not tangible enough: *"There is a widespread perception among citizens and communities that they receive limited direct benefits, notably no electricity cost reductions. [...] The insufficiency of current compensation schemes has been acknowledged by developers and local government entities."*

Access to affordable renewable energy

Another strand of benefit concerns just mentioned **access to affordable renewable energy.** The Belgian case study demonstrates how local residents can profit from stable and affordable energy prices. The surplus electricity from the Ostend solar park is marketed to around 10,000 households through a fixed-price contract *("the scheme [...] guarantees access to locally produced sustainable electricity at a fixed price").* This initiative transforms abstract environmental goals into a concrete household advantage and strengthens the narrative of local self-reliance.

A similar though smaller-scale arrangement was observed in Romania, where *"a partnership with a developer whose wind turbines occupy municipal land has helped the local authority reduce energy costs for public lighting and energy use on its premise."* The municipality intends to extend such agreements to future projects to maximise community benefit.

Socio-economic and infrastructural benefits

Beyond fiscal compensation and energy-price advantages, many renewable-energy projects generate **socio-economic and infrastructural benefits** that strengthen their acceptance at local level. Several developers have concluded voluntary agreements with municipalities to deliver visible improvements for residents.

In Portugal, although not in the case study area, such arrangements have led to *"the refurbishment of cultural facilities, such as schools and care homes, and improvements to access infrastructure, including roads".* Other examples include scholarship programmes for students from low-income households, the promotion of tourism-related enterprises, and the development of vocational training in renewable energy, enabling the acquisition of relevant skills by local populations. Similar patterns appear elsewhere. In Denmark, local projects have supported *"recreational and educational facilities, [...) new green spaces, and improved access roads."* In Romania, partnerships with the main developer in Casimcea financed *"the renovation of public schools and churches and the construction of a kindergarten and a park".* In Spain, the *Talayuela II* photovoltaic plant exemplifies how social, economic, and environmental measures can reinforce each other. Building on the success of *Talayuela Solar,* the developer maintained continuous dialogue with the municipal council launched extensive *"training initiatives, especially for young people and women"* in a region marked by high unemployment, providing around 70 jobs during installation and operation and stimulating local suppliers in hospitality and services. Municipal tax revenues have financed upgrades to roads, public facilities, and community services, while cultural and civic sponsorship has strengthened local identity. Environmental integration was ensured through an extensive plan including native vegetation buffers, nesting sites, a 5,000 m^2 pond for bird species, and agrivoltaics practices. These combined actions have earned the project the *Seal of Excellence in Sustainability* from UNEF. As a result, "the project's level of social acceptance has been virtually complete among the population, administrations, and the productive sector."

In contrast, the Estonian case of Sopi–Tootsi shows that expectations for similar benefits are not always met: While *"a new road towards Tallinn was built,"* and revenues paid, the local community expected that the wind farm would bring in a new, large company and create local indirect jobs. *"The local residents' faith in the wind farm as a promoter of local life is fading, and this sentiment is being exploited by political parties and civic groups opposing wind farms."*

Together, these experiences underline that **tangible improvements to infrastructure, employment, and skills can enhance the perceived fairness** of renewable-energy projects – whereas unmet expectations can quickly erode public trust.

Environmental and landscape co-benefits

In several case studies, **environmental and landscape co-benefits** are documented. Developers have implemented environmental mitigation and enhancement measures aimed primarily at reducing ecological impacts and improving landscape integration. While these actions are not designed as direct local benefits, they can contribute indirectly to public acceptance by improving the visual environment and offering limited recreational or educational value (DK, ES, PT). Although primarily compensatory, such measures demonstrate attention to ecological aspects and can help reconcile renewable-energy infrastructure with the surrounding landscape.

5.2.2 Mechanisms to safeguard local financial benefits

Financial participation of the locally affected communities is key to increase local acceptance. It can take several forms, including national or regional funding for municipalities, operator fees or taxes linked to production, or voluntary payments to regional associations

(EC – DG Energy, 2023:145f). the case studies show that the extent to which local benefits are institutionalised varies markedly among countries, projects and type of benefit.

Legally defined payments

In Germany, Portugal, and Estonia, municipalities receive **legally defined payments** linked to renewable-energy production stemming from wind power. Germany's *Renewable Energy Sources Act (§6 EEG 2023)* entitles municipalities within 2.5 km of wind turbines to a fixed share (0.2 Euros cent/kWh of generated electricity) of turnover. In Portugal, historically wind power developers were required to contribute 2.5% of annual revenues to the municipality. The current legal framework – *Decree-Law No. 99/2024* – obliges developers to transfer the equivalent of 1% of installed capacity as a community self-consumption unit once and free of charge. In Estonia, the *Environmental Fee Law* establishes a mandatory wind-turbine fee paid to host municipalities and residents. In all three cases, the revenues flow into municipal budgets without earmarking, and their use for citizen-oriented or community projects remains at the discretion of local authorities.

Financial participation/crowd funding

Local acceptance can also be achieved through **local investment opportunities** such as RES cooperatives or energy communities. The Belgium case study highlighted the voluntary, project-specific offer of financial benefits through crowdfunding or fixed energy prices.

Individually negotiated local benefits

Beyond financial mechanisms, **socio-economic and environmental benefits** are not institutionalised in any of the cases. They are usually **individually negotiated** between developers and municipalities and implemented on a voluntary basis, e.g. through local training schemes, infrastructure improvements, or recreational measures. In Wörrstadt (DE) and Vibberstoft (DK), these arrangements are supported by municipal guidelines and planning practices that link informal dialogue with formal procedures, but these frameworks are locally specific and do not apply to other regions or projects within the same country.

In order to avoid the slightest appearance of corruption, the mechanisms of local benefit sharing should be transparently regulated (EC – DG Energy, 2023:145f).

5.3 Political backing

Across the case studies, the evidence confirms that stable and transparent political commitment is a decisive factor in legitimising renewable-energy deployment. Consistent political commitment at both national and municipal levels legitimises renewable energy expansion and shields it from short-term opposition. Conversely, fluctuating priorities can undermine its credibility.

National and municipal continuity

Where national and municipal **objectives are coherent and long-term,** planning authorities and developers operate with predictability, and citizens perceive projects as part of a broader territorial strategy rather than as isolated interventions in their community. In the Danish and German case studies this consistency is particularly visible.

Denmark's *"long-standing tradition of public support for the green transition"* coupled with Thisted's approach to the application of zoning principles while fostering structured stakeholder and community dialogue from the early stages has led to *"a noticeable shift from con-*

flict-prone dynamics towards a more constructive and dialogue-oriented approach." Similarly, Wörrstadt's (DE) consistent local energy policy since the 2000s, regular public information events and early political goal *"of covering its energy needs entirely from renewable sources by 2017"* created planning security and shaped a civic identity *"mittendrin und voller Energie."* (translates to "right at heart and full of energy"). The German case also highlights the importance of **taking responsibility at the local level.** Planners and municipal leaders are advised to *"avoid tendencies to shift responsibility to higher levels of government"* and instead *"take ownership, provide clear explanations, and make procedures transparent."* This proactive stance helps build trust and strengthens democratic legitimacy. Conversely, *"simply referring to federal decisions without local engagement risks alienating the public and undermining support for the energy transition."*

In both cases, the combination of a forward-looking policy, open communication and self-imposed moderation in site selection demonstrates how continuity and transparency turn political ambition into social legitimacy.

Variable commitment

At the opposite end of the spectrum, **political volatility and fragmented responsibilities undermine credibility.** The Estonian case study highlights this assessment: *"Political instability, prioritising national defence, softening climate targets and indecision at both national and local levels hinder renewable transition".* This frequent shift in the commitment has slowed planning procedures and weakened trust. When national targets appear unrealistic, they are often *"revised rather than the policies to achieve them."* This indecision trickles down to the local level, where municipalities *"lack mutual interest in promoting onshore and PV development,"* and decision-making can become *"opportunistic, especially before local elections."* Local governments are left to navigate conflicting interests with limited guidance or support, while state agencies tend to defend their own institutional mandates rather than facilitate coordination. The result is a fragmented governance environment in which risk aversion, legal caution, and scarce administrative capacity discourage renewable-energy implementation. The Spanish case study also emphases the importance of the political will that should be manifested in legislation *("clear and non-conflictive, avoiding over-legislation")* and tools ("spatial plans on renewables are very useful").

5.4 The role of information and the narrative

Another crucial dimension of social acceptance lies in balanced information and how the energy transition is framed and communicated. Acceptance is not only a matter of consultation and compensation, but also of who tells the story and with which arguments.

Telling the story to explain wind and solar park developments

Transparent and locally grounded storytelling fosters legitimacy and trust. Municipal leaders in Denmark and Germany emphasise that credibility depends on acknowledging not only the benefits but also the trade-offs of renewable energy development. Local energy groups in Denmark, for instance, *"offer a platform where the benefits and drawbacks can be openly discussed, with developers, landowners and residents present."* Openly discussing impacts signals respect for local experience. Similarly, the experience in the case study region in Romania, where *"social acceptance levels have been higher due to the local community's clearer understanding of benefits and advantages".* The German case study points to a best practice in Baden-Württemberg, *"where a comprehensive information paper was developed for regional planning bodies".* Public concerns are not ignored but addressed through *"scientific-*

ally grounded responses to common objections," enabling planners to engage respectfully and factually. This balanced communication builds trust and signals that the municipality treats citizens as partners rather than passive recipients of information.

Another tier of transparent communication is the information on the progress or haltering of the RE deployment. In Estonia, the *"Environmental Agency continuously monitors renewable energy planning and development, and the information is publicly available. The benchmarking increases transparency expressing progress or stagnation."* The Danish case study deduces that *"digital data, mapping tools, and visualisations further enhance participation and social acceptance by providing transparent, accessible, and location-specific information [...]. These tools enable citizens and stakeholders to understand how projects may affect their surroundings, thereby fostering more informed dialogue and trust in the planning process".* In the other cases no evidence has been found in the case studies that the medium through which information is conveyed – whether via maps, digital platforms, or printed materials – has a significant impact on acceptance. What matters more is that participation occurs early, is transparent, and offers genuine opportunities for dialogue and influence, as highlighted throughout this and the preceding chapters.

Framing a positive narrative of wind and solar parks

The **narrative** plays a central role in shaping public perception. In Germany, framing wind energy as *a responsible alternative* – reminding citizens to *"see what the alternatives are – look at the damage done in lignite mining areas"* – helps clarify its relative advantages despite localised impacts. This narrative focuses on tangible benefits and comparative responsibility rather than ideology, showing not only what renewable energy delivers, but also what it replaces – polluting industries, landscape degradation, or energy dependency. In Wörrstadt the narrative is strengthened through **local identity building.** The slogan *"at the heart and full of energy"* was co-created with citizens, translating technical goals into civic pride.

Maintaining this balanced communication and positive narratives requires institutional capacity and professional communication that help transform abstract targets into tangible and relatable messages.

The demonstration effect

The **demonstration effect** further reinforces this process. Experience shows that people who live near renewable-energy sites are often less opposed than those who do not. In Belgium, *"only a minority of people (around 10%) remain opposed once projects are deployed,"* – resistance decreases as residents see the installations function without major disturbance and as they get used to their sight. Spanish evidence confirms this dynamic: the *Talayuela II* project benefited greatly from *"the successful previous experience of Talayuela Solar, which paved the way and exerted a significant demonstration effect among the population."* Findings from Austria point in the same direction. A representative study by the University of Klagenfurt (Hampl et al, 2021) shows that acceptance among residents living near a wind farm reaches 88%, compared with 78% among the wider Austrian population, underscoring how familiarity and direct experience often translate into higher support. Once citizens witness functioning examples and local benefits, scepticism tends to evolve into acceptance, and in some cases even pride.

5.5 Conclusions

Across the MAK-RES case studies, social acceptance is shaped by the interaction of procedural quality, perceived fairness of benefit distribution and the broader governance context in which projects are developed. Several consistent factors emerge.

First, the **design and timing of engagement processes** strongly influence trust. Early, continuous and well-structured dialogue helps clarify uncertainties and reduce litigation, whereas late or symbolic consultation reinforces scepticism. Systems with clearly assigned institutional responsibility for participation avoid the impression that engagement is merely formal. Developers' voluntary transparency can support acceptance where formal mechanisms are weak, but it cannot substitute for structured, multi-level participation. Case evidence from Denmark also shows that time invested in dialogue can accelerate later phases: *"Nevertheless, by addressing potential conflicts, filtering out unsuitable projects, and fostering early consensus, the approach may ultimately reduce later delays, appeals, and cancellations."*

Second, the distribution of **tangible local benefits** plays a central role. Communities are more inclined to support renewable-energy projects when they perceive concrete advantages such as direct financial returns, employment opportunities, improved infrastructure or targeted environmental enhancement. Where benefits are diffuse, abstract or channelled solely through municipal budgets, acceptance tends to be low. Results also point to a **demonstration effect,** which reinforces this dynamic: residents living near existing installations often report fewer concerns over time, suggesting that experience with real, visible outcomes can reduce perceived risks.

Third, **alignment across governance levels** and **territorial narratives** shapes how projects are interpreted locally. Where national and municipal objectives are coherent and long-term, planning authorities and developers operate with clearer expectations, and citizens perceive projects as part of a broader territorial strategy rather than isolated interventions. Conversely, misalignment or fragmented responsibilities undermine legitimacy and heighten contestation. Acceptance is therefore not only about procedures or compensation, but also about how projects are framed: who tells the story, with which arguments, and how convincingly these narratives resonate with local identity and development paths.

Overall, the case studies show that social acceptance arises from the combination of credible governance, fair benefit-sharing, meaningful engagement, and coherent territorial framing. These factors together determine whether renewable energy deployment is viewed as an imposed burden, a negotiated compromise, or an integrated component of local development.

6 Recommendations

This chapter synthesises the key lessons emerging from the MAK-RES case studies and complementary analyses. It outlines practical recommendations for strengthening the governance and instruments of spatial planning, enhancing social acceptance of renewable-energy deployment, addressing persistent research gaps, and guiding future policy development at national and EU level.

6.1 Spatial planning governance and instruments

Strengthening the link between energy targets and territorial planning

Across the case studies, a central challenge is the weak link between national renewable-energy objectives and the spatial-planning frameworks responsible for implementing them. Only in a small number of case studies, a fully traceable chain of responsibility that translates national targets into territorial obligations could be identified. Others rely on regional or municipal levels without clarifying how much capacity each tier is expected to deliver. To ensure more predictable and coordinated deployment, Member States should **link national ambitions with explicit responsibilities for the regional tiers,** supported by transparent expectations for the amount of renewable energy each territory is anticipated to accommodate.

Improving coordination across levels of government

The need to improve the coordination between different sectors and government-levels contributing to the development of renewable energy plants was emphasised by most case studies. Misalignment between ministries responsible for energy, environment, and spatial planning can prolong procedures and complicate the deployment of RE. **Strengthening strategic oversight at national level, while ensuring flexibility for local adaptation,** can help ensure that zoning, permitting and environmental procedures are mutually reinforcing rather than operating in isolation.

Spatial decisions on renewable energy often transcend municipal or regional boundaries. For this reason, **cross-municipal coordination** emerged as a recurring need across the case studies. Joint planning forums, shared benefit schemes and harmonised zoning templates can help to prevent neighbouring jurisdictions from adopting contradictory approaches or shifting responsibilities onto each other. In some contexts, particularly where local capacity is limited or national frameworks are fragmented, **shifting parts of renewable energy planning from the local to the regional or national authorities** can provide greater coherence.

Enhancing zoning frameworks and suitability assessment

At the same time, clearer national frameworks are essential for supporting municipal decision-making. Renewable-energy deployment requires *"shared responsibility between national and local level",* and local authorities should not be left alone to interpret national ambitions without guidance (Perera, 2025). This evaluation closely reflects the findings of several case studies: The absence or limited maturity of zoning instruments results in case-by-case siting with insufficient strategic direction.

Strengthening suitability and exclusion zoning can provide early clarity on where renewable energy development is appropriate, where it is incompatible, and where it may proceed under certain conditions. Such frameworks enable municipalities and regions to move beyond reactive assessments and develop a forward-looking understanding of their territorial contribution. They also help structure the relationship between sectoral constraints, such as biodiversity protection, landscape heritage or defence restrictions, and the need to identify viable areas for wind and solar deployment.

Where statutory plans are revised or regional frameworks are updated, **renewable energy provisions should be systematically integrated** to ensure alignment with broader land-use and environmental policies.

Streamlining permitting and administrative processes

The complexity of permitting systems continues to impede deployment in several case studies. Disjointed responsibilities, divergent legal interpretations and inconsistent requirements across municipalities often lead to lengthy delay. Streamlining procedures requires not only **legal simplification but also improved cooperation between permitting authorities.** One-stop-shop structures or dedicated permitting taskforces, as emerging in some countries (e.g. in Portugal), can help ensure consistent application of rules and avoid duplicated or contradictory requests.

Local capacity plays a crucial role in the effectiveness of these processes. Municipalities need to take responsibility for the green transition in their area (van Noordt 2025)[4]. However, many municipalities lack the staffing, technical expertise or financial resources to assess environmental documentation, process developer proposals or engage constructively in zoning updates. Targeted support – whether through national funding, EU programmes or shared regional capacities – can significantly reduce administrative bottlenecks. Furthermore, a cooperation between municipalities can increase their capacity (van Noordt, 2025).

A further lever for improving permitting efficiency lies in **the quality of projects entering the system.** Several case studies highlight the value of upstream filtering or prioritisation mechanisms that reduce administrative pressure by ensuring that only credible, high-quality proposals advance to full permitting.

Deepening the role of digital mapping and data infrastructures

Reliable spatial data is the foundation of evidence-based siting. Several case studies highlight that fragmented geodatabases and outdated biodiversity information systematically hinder the identification of suitable areas and the preparation of robust environmental assessments. Member States would benefit from **high-quality, open-source digital mapping platforms** integrating environmental, land-use, technical and grid information. Such tools strengthen both the analytical basis of zoning and the transparency of siting decisions.

Improved GIS-based tools also facilitate the early screening of proposals, reducing the burden of complex assessments at later stages. Digital overlays have proven valuable in many case studies for filtering projects and enabling planners to focus on locations with realistic prospects for implementation. **Harmonising geospatial datasets across administrative levels** remains an important precondition for such approaches.

[4] Van Noordt, A. from the Regional Government of Flanders, Belgium, was presenting at the ESPON Seminar in Aalborg, on 19th November 2025, regarding Flanders quest for space for renewable energy transition

Balancing public and private initiative in site identification

In many case studies, developers play an active role in identifying sites, conducting preliminary assessments and initiating land-use changes. This can accelerate deployment, particularly in systems where energy planning frameworks are still developing. However, overreliance on developer-led siting may lead to geographically uneven outcomes and place a heavy analytical burden on local authorities. **Clearer rules on how and when developers may propose areas, combined with structured early dialogue with planning authorities and grid operators,** can help ensure that privately initiated proposals align with territorial priorities and available infrastructure.

Supporting multifunctional land-use approaches

Filtering and exclusion alone will not be sufficient in many territories. Multifunctional land-use concepts, as e.g. agrivoltaics, hybrid parks, biodiversity-friendly PV installations or brownfield redevelopment, offer opportunities to reduce spatial conflict and create additional value. Their deployment depends on supportive **planning guidance and zoning mechanisms that recognise integrated uses** rather than treating energy production and existing functions as mutually exclusive. Strengthening planning frameworks to enable such approaches can broaden the portfolio of feasible sites, particularly in densely used or environmentally sensitive regions.

6.2 Fostering social acceptance for RE deployment

Building shared territorial visions

Across the case studies, social acceptance depends fundamentally on whether local communities perceive renewable-energy deployment as part of a **shared territorial vision** rather than an externally imposed intervention. Vision-oriented planning instruments, as e.g. local climate strategies, municipal development plans, territorial dialogues, can anchor RE deployment in broader debates about local development, land use, landscape change and just transition. They help shift public discussion from individual projects to long-term visions.

Experience from the German case suggests that planning should **start and iterate.** Early, achievable steps, as e.g. pilots, demonstration parks or community dialogues, help avoid paralysis through over-planning. Iterative approaches allow authorities and communities to “learn by doing”, progressively building confidence and trust (Kremlj, 2025).

From late consultation to continuous, structured engagement

A recurring challenge is that public engagement begins far too late, often only when projects enter formal planning or EIA procedures. At this stage, key decisions have already been made, limiting the scope for meaningful influence and reinforcing perceptions that participation is often just symbolic. Case evidence consistently emphasises the need for **early, continuous and structured involvement** beginning at the stage of site search, not at the point of statutory hearings. Danish cases show that people often support RE facilities locally if included early and if local benefits are clear (Borch, 2025).

Effective approaches include local referenda, citizen-defined siting criteria, open calls for proposals, citizen advisory groups and facilitated workshops. Such mechanisms help ensure that communities feel ownership over both the process and the outcome. Stakeholders repeatedly noted that structured early dialogue also filters out unsuitable proposals and prevents later conflict, reducing appeals, delays and cancellations.

Digital tools as e.g. mass notifications, participatory mapping platforms and visualisation tools, are increasingly important for reaching a wider population and ensuring transparency at early stages.

Enhancing the quality of information and public debate

Information deficits and misinformation remain major drivers of resistance. Concerns about health, landscape, wildlife impacts or property values often arise in the absence of accessible, fact-based materials. Several case studies highlight the value of **credible, independent information resources,** such as guidance documents responding to frequent public concerns, or expert-reviewed summaries of environmental and technical impacts.

Public acceptance often increases once projects are operational; **residents living near existing facilities tend to report lower concern over time.** This “demonstration effect” can be amplified by systematically gathering and communicating experiences from host communities. Opening wind and solar installations for educational visits (schools, tourists, local associations) has proven effective for explaining technical issues, trade-offs and realised benefits.

Communication must also recognise emotional and place-specific attachments. Effective messaging frames renewable energy as contributing to local identity, prosperity and resilience, rather than focusing exclusively on national climate goals.

Benefit-sharing and fair compensation

Across all cases, **tangible local benefits** are essential to acceptance. Communities are more willing to support RE projects when they do not just see the local impacts of energy plants, but also improvements in their quality of life, as e.g. such as lower municipal energy costs, investment in local infrastructure, training opportunities or long-term financial participation. Benefit-sharing models (e.g. revenue-sharing, energy cooperatives, local investment funds) enhance distributive fairness and anchor RE development in local economies. A case in Flanders shows that that citizens being part of an energy community have higher acceptance of onshore Wind Energy (De Pauw, 2025).

Fair compensation also includes recognising the **structural impacts** of large-scale projects. Renewable-energy deployment implies long-term changes to landscapes or perceived quality of life. A just-transition perspective requires compensation frameworks that address these deeper territorial changes, not only short-term mitigation.

Acceptance has a price. As Connie Hedegaard (2025), former EU Commissioner for Climate Action from 2010-2014 sets forth, it is rarely achieved with the cheapest technological option. For example, offshore wind, although more expensive, can generate fewer local conflicts than onshore projects in visually or ecologically sensitive areas. Similarly, solar projects designed with ecosystem benefits may be more acceptable than cheaper layouts with limited environmental integration. Acceptance thus requires a willingness to balance cost efficiency with societal preferences.

Mitigation as part of the social contract

Technical and ecological mitigation play a dual environmental and social role. Credible mitigation measures, as e.g. shutdown-on-demand protocols for bird protection, biodiversity-positive PV designs, habitat restoration, limits on project clustering etc. signal that developers and authorities take impacts seriously. Such measures help transform RE projects into **negotiated compromises,** a core condition for acceptance.

Standardising mitigation requirements and validation protocols strengthens predictability and avoids disputes over the adequacy of individual measures. Regional or national guidance documents can support planning authorities and improve the transparency of decisions.

Aligning political leadership, narratives and local development

Social acceptance is also shaped by political leadership and public narratives. Unclear or inconsistent political messages undermine trust and fuel scepticism. Conversely, **sustained political commitment, combined with transparency about trade-offs, helps stabilise expectations.**

Local leaders play a decisive role: Clear explanations, openness about constraints, and visible local engagement strengthen democratic legitimacy. Framing the transition around **pragmatic benefits** (lower energy bills, local value chains, energy security, skills) rather than ideological debates can reduce polarisation. Municipal branding around renewable energy, visible demonstration projects and consistent communication cultivate local pride and shared purpose. Embedding RE deployment into **broader development strategies** ensures that projects are understood not merely as energy infrastructure but as contributors to local economic diversification, resilience and territorial identity. This framing is particularly effective in rural areas undergoing demographic or economic transitions.

6.3 Main research gaps

The study highlights several research gaps that, if addressed, would significantly support the efficient, predictable and socially acceptable roll-out of renewable energy installations.

Improved biodiversity and sensitivity datasets

Up-to-date, standardised data on species distribution and ecological sensitivities is often lacking. Strengthening monitoring frameworks is essential for robust SEA/EIA processes, the delineation of suitability and exclusion zones, and credible cumulative-impact assessments.

Enhanced core spatial datasets

Gaps in soil quality maps, ecological corridors, official land-use geodatabases and grid-capacity information continue to slow planning procedures. More consistent datasets would reduce reliance on ad-hoc, project-by-project assessments.

More robust cumulative-impact assessment methods

There is limited understanding of how multiple RE installations interact across landscapes. Research is needed on indicators, thresholds and the effectiveness of mitigation strategies – such as shutdown-on-demand systems or habitat offsets – when applied at scale and across different ecological and geographic contexts.

Standardised criteria and mapping tools for PV and wind siting

Further work is required to develop spatially explicit siting criteria that integrate environmental, technical and social considerations, particularly in contexts with weak or inconsistent zoning frameworks.

Evidence on agrivoltaics and multifunctional land use

Key questions remain around effective agricultural practices beneath PV installations, including which crops benefit, how management practices need to evolve, and how dual-use systems can be scaled while maintaining productivity and biodiversity.

Comparative assessments of technology choices

There is insufficient evidence on the full life-cycle, spatial and socio-economic impacts of different RE technologies (e.g. offshore vs. multiple onshore wind farms), which is essential for informed and socially acceptable investment decisions.

Socio-economic and distributional impacts

Additional research is needed on compensation models, benefit-sharing mechanisms, energy-justice considerations, impacts on energy poverty and effects on local public finances and services.

Behavioural dimensions and societal readiness

Better understanding is required of behavioural change, perceptions of quality of life, community readiness and the narratives that shape acceptance or opposition to renewable-energy projects.

6.4 Future policy development

Future policy development will need to address several structural challenges that cut across administrative levels and sectors. While many issues originate at national scale, a number of enabling conditions can be shaped at EU level to ensure coherence, comparability and predictability across Member States. The following sections outline the main directions for future policy development at the two levels.

6.4.1 EU-level priorities

At EU level, an important lever lies in the strategic use of **funding and support instruments.** EU policy can ensure that relevant programmes remain open and accessible for the systematic collection of biodiversity and environmental-sensitivity **data and for its integration into national and regional geodatabases.** Funding calls could more explicitly support field-based ecological surveys, long-term monitoring schemes and the harmonisation of data standards across Member States, while requiring that resulting datasets are made publicly available in interoperable formats. In parallel, EU instruments should invest more consistently **in administrative capacity at subnational level.** Many municipalities lack the staffing, technical skills and financial resources to interpret complex spatial datasets, update zoning frameworks and engage in demanding participation processes. Targeted EU support for local authorities (for training, technical assistance, shared planning units and cross-border peer learning) can help to foster the energy transition on the ground.

The EU can continue to **foster interregional and cross-country learning.** Demonstration projects on multifunctional land use, especially agrivoltaics, advanced mitigation protocols or innovative citizen engagement models have shown considerable potential in individual locations. Scaling these lessons across borders, through structured exchange mechanisms and joint research efforts, would allow Member States to benefit from accumulated experience rather than developing isolated solutions.

Future EU policy development should give greater prominence to the principles of a just transition. As renewable energy deployment reshapes rural and peri-urban areas, EU policies can help **ensure that compensation, benefit-sharing and social safeguards become integral parts of planning and permitting frameworks,** and not merely optional add-ons. Embedding such principles more firmly in EU climate, energy and cohesion policy would reinforce fairness across regions and help reduce uneven territorial impacts.

6.4.2 Member State–level priorities

At national and subnational levels, the priority is to translate the European frameworks into concrete procedures, legal instruments and organisational capacities. For many Member States, this begins with strengthening the integration of renewable energy into statutory spatial plans. Rather than relying on more or less defined exclusion criteria and project-by-project decisions, national and regional authorities will need to **develop proactive renewable-energy spatial plans that identify suitable, low-conflict areas** in a transparent way. A special case are the RED III acceleration areas. A forward-looking policy priority for Member States is to ensure that the emerging RED III mapping and acceleration-area frameworks evolve into coherent, durable and well-integrated elements of national planning systems.

National governments also have a decisive role to play in **building robust, anticipatory grid planning.** As the case studies show, grid constraints are increasingly shaping the feasibility of projects. Treating grid development as a spatial-planning issue – rather than a purely technical matter – will require closer coordination between transmission system operators, planning authorities and environmental agencies. Anticipatory planning of reinforcements and substations can prevent bottlenecks and better align infrastructure investments with territorial deployment strategies.

Administrative capacity remains another critical challenge. Many municipalities and regional authorities face shortages in technical expertise, staffing, GIS competence and environmental assessment skills. **National support, through better guidance, capacity-building programmes, shared regional planning units or targeted funding,** will be necessary to ensure that local authorities can play their role in the RE roll-out.

Coordination across municipalities and regions should also be a future policy topic. Large-scale energy projects can impact multiple jurisdictions, and uncoordinated decision-making slows down development and increases conflict. Member States can facilitate co-operation through joint planning forums, shared zoning templates and benefit-sharing arrangements that distribute costs and advantages more evenly.

Ensuring fairness in the territorial distribution of renewable-energy infrastructure remains a central task. **National frameworks for benefit-sharing, compensation and revenue distribution** can reduce competition between municipalities and foster broader acceptance. Likewise, embedding multifunctional land-use concepts, such as agrivoltaics or hybrid parks, into national planning guidance can help reduce land-use conflicts and broaden the range of viable locations.

Finally, national **legislation will need to keep pace with technological change.** Repowering, larger turbine dimensions, storage integration and hybrid project designs are becoming the norm. Updating planning and building laws accordingly will be necessary to avoid long-term lock-in and ensure that regulations remain fit for purpose.

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Annex: Case Studies (separately)

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