INTEGRATING RENEWABLE ENERGY AND ECOSYSTEM SERVICES IN ENVIRONMENTAL AND ENERGY POLICIES

IRENES
Interreg Europe

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ANALYSIS AND MAPPING OF TRADE-OFFS BETWEEN RENEWABLE ENERGY AND ECOSYSTEM SERVICES

FIVE CASES FROM THE IRENES INTERREG PROJECT

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8. OVERALL PICTURE OF KEY ASPECTS FROM THE CASES

In this section, a summary from each case study's experience is provided. In particular, subsection 8.1. introduces **Policy demands and Policy instruments across the regions and RES development; subsection 8.2 discusses the Knowledge needs and State of the art across the different case studies, while subsection 8.3 presents the Methods for ES and RES Trade-offs and Synergies (TOs&Ss) used.**

8.1. POLICY DEMANDS AND POLICY INSTRUMENTS ACROSS THE REGIONS AND RES DEVELOPMENT

Each region was characterised by the presence of different policy demands. In the **UK**, the interaction between renewable energy and other ecosystem services is recognised as an important issue at a national level, but the policy landscape and associated instruments have changed appreciably in the past three years. The Industrial Strategy has been replaced by a new Plan for Growth (due to challenges associated with Brexit and post-Covid recovery). In addition, there has been a new Agriculture Act (2020), Energy White Paper (December 2020), Environment Act (2021) and Net Zero Strategy (2021). The UK Action Plan now focuses on implementation of the Net Zero Strategy because it is the key current policy that shapes the decarbonisation agenda at national, regional and local levels. However, the same issue of lack of guidance regarding renewable energy deployment and other aspects of land use still exists.

In **Estonia**, according to the action program Estonia 2035, the current government is developing the economy into a competitive low-carbon one by the mid-century and the IKA's representatives involved in the case study were especially keen on using trade-offs assessments for their RES-related spatial planning processes. The Ministry of Finance alongside regional and local planners were encountering difficulties in achieving balanced planning solutions, in the context of wind and solar energy development. The trade-offs and synergies maps produced by the Estonian team were therefore expected to be utilised to guide spatial planning processes for RES, at spatial scales relevant to local planning processes. Using these tools, the IKAs expected to overcome the current lack of information and guidance in **spatial planning for RES**, and eventually achieve policy change applications. The policy instrument being targeted is the Operational Programme for Cohesion Policy Funds. However, as a results of the SWOT, the SOTA and the ongoing work within IRENES, other instruments were also indirectly targeted. The Mapping and Assessment of Ecosystem Services (MAES) in Estonia has been implemented through the project ELME[2]. Concerning the current state of RES, renewable energy production in Estonia is mostly focused on primary solid biofuels (mainly fuelwood, although also wood residues, wood pellets), wind energy and solar. Solar photovoltaic has only recently experienced an increase in production, having doubled betwe-

2. Elurikkuse sotsiaal-majanduslikult ja kliimamuutustega seostatud keskkonnaseisundi hindamiseks, prognoosiks ja andmete kättesaadavuse tagamiseks vajalikud töövahendid

en 2018 and 2019. Spatial planning processes in relation to RES are now mostly focused in drafting potential locations for wind energy production, minimising their impact on natural resources, protected areas and the Green Network.

In **GERMANY**, the ERDF funding can provide marginal support for the energy transition, for example by supporting generation technologies that are not economically viable on the market but that are particularly compatible with nature. To this end, it is necessary and possible to open up the funding guidelines in order to promote the protection of ecosystem services coupled with innovative generation technologies. For this, it is important that the Lower Saxony strategy with the combination of environmental and climate protection is reflected in new funding directives. Financial support for the energy transition is mainly provided by the Renewable Energy Sources Act (EEG), which applies nationwide. This instrument defines development and expansion targets, differentiated according to the various energy sources. However, it does not make any statements on the spatial management that is compatible with humans and nature, so that the EEG cannot be used to manage the spatial impacts of wind or solar energy. The EEG has a great influence on the feasibility and economic viability of individual energy projects at the municipal level, in that it enables or prevents feed-in, sets the level of subsidies and thus also influences the technologies used. The planning procedures for each energy source are implemented by different actors and there is no overall concept for energy planning. Spatial planning mainly makes statements on wind energy: potential areas are identified and regional expansion targets are defined. Solar energy is not considered spatially relevant and is therefore not planned by overarching regions but by municipal planning authorities. The use of bioenergy is not regulated by planning. The construction of a biogas plant or the cultivation of energy crops is left to the farmers. Only the possibility of feeding electricity into the grid and its remuneration determines the individual decisions, so that incentive is at the federal level and the EEG. **Concerning the state of the RES in Lower Saxony,** in 2022, the share of renewables in Primary energy consumption (PEC) reached more than 16 % PEC. In 2019, the share of renewable energy sources in gross electricity generation in Lower Saxony has reached 52 %. Wind power generation (onshore and offshore) in particular increased sharply in Lower Saxony in 2018 and accounted for 69 % of total gross electricity generation from renewable energy sources. The forecast for 2019 expects up to 74 % of renewable electricity from wind energy. The shares of biomass (around 20 percent) and photovoltaics (6.5 percent) regress slightly compared to the previous year. Hydropower plays only a minor role in electricity generation.

In **ROMANIA**, the National Environmental Protection Agency have implemented the MAES process (Mapping and Assessment of Ecosystems and their Services) under the N4D Project (Nature for Decision-making or Nature in Public Decisions) the purpose of which is to carry-out the biophysical mapping and assessment of ecosystems and of services they provide to the society, at national level.. The NEPA expressed the interest from two points of view, one linked to the use of the results of the MAES project in Romania and the second with the use of an appropriate tool to evaluate the trade-off between RES and between RES and other ES. The development challenges identified at national level in terms of transport infrastructure, sustainable urban transport, environment, energy and risk prevention are addressed by the Large Infrastructure Operational Program (POIM). The programme will mainly invest in removing the main transport bottlenecks and developing sustainable, efficient and green transport modes in the country and introduce measures to increase energy efficiency and protect natural resources. To promote the production of electricity from renewable sources, Romania uses the system of mandatory quotas coupled with the trading system for green certificates. Based on this mechanism, suppliers acquire mandatory quotas of green certificates and the electricity is sold separately on the energy market. The acquisition quotas for green certificates are established in correlation with the targets and their values increase every year. The market energy has dispatching mechanisms that give priority to sales of electricity from renewable sources. **Concerning the state of the RES, in Romania**, the target for consumption of electricity from renewable energy resources represents 33% of the gross domestic consumption of electricity in 2010, 35% in 2015 and 38% in 2020. (See the "Romania's Energy Strategy for period 2007-2020", approved by Government Decision No 1069/2007).

Finally, in **ITALY**, policy makers have shown interest in understanding potential trade-offs and synergies about strategies and projects implementing RES production from solar energy. There is also a policy interest on agricultural biomass, and on considering its potential trade-offs with food production. The analysis of Veneto's team focused on the Programma Operativo Regionale- Fondo Europeo di Sviluppo Regionale(POR-FESR 2014-2020), while other instruments were indirectly targeted. However, the main objective of the work is to make use of the analysis and work undertaken under IRENES to provide useful inputs for the POR-FESR 2020-2027. Concerning the current state of RES, the Veneto Region met the burden-sharing targets before 2020, however, given the new panorama and the need to abate emissions and produce (clean) energy targets changed. In detail, the Veneto Region is one of the regions consuming the highest amount of energy in Italy, while ranking lower in terms of energy production from renewable resources than other Italian regions which are consuming less energy (PER-FER, 2017). At present, Veneto's RES production is led by hydroelectricity, followed by energy produced from solar and biomass. However, the hydroelectric contribution has reached its limits and cannot grow further. Hence, to meet the new targets derived from burden sharing, the region is betting on solar and biomass. For thermal purposes, the Regional Plan for Energy (2020), focuses mainly on biomass (expected to provide RES for 49% on the total target needed)- For electricity purposes, the Region mainly emphasises biogas and biomass (39% and 21% respectively), while solar is considered only for the 12% (PERFER 2017).

8.2 KNOWLEDGE NEEDS AND STATE OF THE ART ACROSS THE DIFFERENT CASE STUDIES

In the UK, recent discussions with officials in government departments and local authorities have highlighted a need for information on the spatial coincidence of RES potential and other ES across regions. This is to help identify strategic opportunities or problems (e.g. where infrastructure investment is required). Decisions regarding RES-ES interactions at the level of the individual project or site are regarded as appropriately handled within the planning system. However, somewhat more problematic are the issues regarding cumulative impacts of increased RES generation and the spatial scale at which these should be assessed. The UK has a long history of initiatives on the mapping and analysis of ecosystem services (ES). Examples of such initiatives are found in the reports of the National Ecosystem Assessment and the Natural Capital Committee. The latter recommended creating a 25 Year Environment Plan and,since this was published in 2018, it has stimulated the incorporation of ES assessments into a range of policy areas. Among the many projects to make spatial data on natural capital and ES widely available there is the work by the UK Centre for Ecology and Hydrology, atlases of data from Natural England and assessment tools such as Natural Environment Valuation Online.

In **ESTONIA**, there is a manifested need to access spatial data on the supply of ES, their hotspots and trade-offs among them. Data is needed at a local scale, so that it can serve as an input to ongoing spatial planning processes. Also needed are spatial data on the potential supply of RES, at the local scale, so that it can be combined with the ES one and jointly used in spatial planning processes. The objectives of the ELME project are twofold: to analyse ecosystem conditions and to assess the supply of ecosystem services (ES) in forests, agricultural land, grasslands and wetlands. A wide range of ES has been assessed, including carbon sequestration, primary production, microclimate regulation and erosion control among others. The supply of ES has been assessed using biophysical models and the outputs are raster maps with a resolution of 10m/pixel. These highly detailed ES maps allow upscaling and can feed in several spatial planning processes.

The key knowledge need for **LOWER SAXONY** is in defining an overarching energy mix that is compatible with nature and consists of the interaction of wind, solar or bioenergy. So far, the energy sources have been considered individually, as the actor networks and the responsibilities in the area of solar energy and wind energy are very different. Since there are few regional energy concepts available, the coordination of potentials and expansion possibilities is not yet part of regional planning.

The concept of ecosystem services is similar to that of German landscape planning, even if the assessment methods differ in detail. Landscape planning has a long tradition in Germany and delivers a large range of basic data on nature and landscape. It includes a systematic and area-wide ecological analysis at different spatial scales (federal state to municipality), with a concrete spatial reference and a defined mandate within the overarching spatial planning. Landscape planning is legally embedded and established in planning. It evaluates landscape statements on soil, water, climate/air, species and habitats as well as the landscape appearance. It presents concrete requirements and measures of nature conservation for the planning area that are necessary to realise its targets and is an important basis for determining the usage potential as well as the economic value of ecosystem services. Integration of the ES concept into landscape planning is currently limited to a few sub-sectors.

The challenge for landscape planning is therefore to expand its methodological spectrum, to standardise the data basis accordingly and to balance environmental services to a greater extent and prepare them for monetization.

In **ROMANIA** the identified knowledge requirements were to obtain: a spatially explicit distribution of ecosystem services, a spatially explicit distribution of RES exploitation and a plan for participatory meeting and landscape visualisation. At country level, the project "Demonstrating and promoting natural values to support decision-making in Romania" implements the MAES process in Romania and has the public policy aims to assess the level of integration of the concept of ecosystems and ecosystem services in public policy for the period 2014-2020 in order to develop recommendations on integrating the results of mapping and biophysical assessments in decision-making processes.

The areas of public policies analysed are: biodiversity, climate change, fishing and aquaculture, agriculture and sustainable development, transport, energy, regional development, tourism, and marine and forest areas.An inventory of the responsible institutions, an institutional map and a questionnaire to identify institutional needs related to the MAES process were made. This is done by taking the following directions: identification of data sources, analysis of the availability, analysis of the representativeness and of the update policies, data integration in the conceptual model and in the physical model of data organization. There were achieved major results regarding: mapping ecosystems at the national level, achieving "Ecosystems classification in Romania EUNICE 3" (intermediate version) the development of tools for updating this distribution (land field guide to identify the ecosystems, methodological guide for assessing the ecosystem services) and the selection of methods for assessing the ecosystem services that are carried out continuously based on the matrix of indicators and on the comparative analysis of existing methods.

Finally, in **ITALY**, based on the present state of policy instruments and energy strategy (PER, 2017), there is interest by the Managing Authority (MA) to further identify suitable areas and identify trade-offs related to the production of energy from solar farms and from agricultural biomass from left-overs (in order to choose among the two and/or identify combinations of solutions).

The largest source of RES in Veneto is currently derived from hydropower. Water represents a precious resource in the Region for energy production, however, the MA recommended not to increase the production of energy through hydropower. Wind speed does not comply with Eolic plants requirement in most of the region's areas: hence, there is no room to increase energy production through windmills either. Geothermal looks promising but needs further time and costly investigations. Biomass from woodlands provides a viable option for mountainous areas, but the Region needs strategies to face the energy demand of urban and industrialised areas located in the plains. Hence, given the urgent need to produce increasing amounts of energy from renewables, the MA' key knowledge's need is in understanding whether promoting either solar or biomass, without creating trade-offs with agricultural production, and possibly without compromising the landscape, with its negative effects on tourism.

In Italy, the MAES process has been implemented at national level from several initiatives from the Ministry of the Environment and from the Italian National Institute for Environmental Protection and Research ISPRA. The analysis of the state of the ecosystems and of ES is focused on understanding the relationship between ES and land consumption; the study was implemented at national scale and at regional scale.

In Veneto, the Regional Environmental Agency has supported the analysis of MAES on land consumption and soil ES in the provinces of Vicenza and Rovigo. Soil ES were mapped and assessed through a system of indicators representing the capacity of different soils to provide ES.

8.3 METHOD FOR ES AND RES TRADE-OFFS AND SYNERGIES (TOS&SS) USED

As mentioned in the introductory sections of the work, each case study selected its methods, based on the policy demand and needs, on the state of the art, data available, capacity and general constrains (budget, time, ...).

In the UK, the **RES** included Biomass crops, ground solar PV and onshore wind, while the **ES included** Food production, Timber production, Recreation & Habitat. The focus was on visualising and quantifying the spatial coincidence of potential generation from different RES and other ES. This was done through a GIS analysis using the RES-SOTA results and existing ES databases, leading to the generation of maps comparing potentials for 1 km grid squares across the East of England study area. Grid cells and administrative units (such as local authorities) were then classified on their relative potential for delivery of different RES and other ES. The UK Study included **Policy- regulatory constraints** considering the buffers around roads, rail, rivers, lakes, airfields, defence sites and residential areas.

In the ESTONIA's case study, the only **included RES** was wind, while there was a fine diversification of the **ESs considered**: - Fodder/bioenergy from grasslands, Edible mushrooms, Bilberries production, Agricultural yield, Spiritual value, Passive recreation, Active recreation, Microclimate regulation, Global climate regulation, Pollination, Genetic resources in grasslands, Genetic resources in mires, & Genetic resources in forests. A stepwise methodology was followed: first focussing on these ES hotspots and then bundling them performing a Principal component analysis.

The Trade-offs and Synergies were then identified using a Production frontier across a range of ecosystem conditions. The **Estonia** case study included **Policy- regulatory constraints** focusing on those for the protected areas.

In LOWER SAXONY the **RES** included Wind & Solar energy, while the **ES** included Cultural services, Habitat, Water provisioning, Soil provisioning. **Lower Saxony followed** an area-based approach, analysing those areas that can be used for the production of renewable energy in an environmentally compatible way by 2050. The focus of the analysis was on the production of electricity with wind energy onshore and solar energy on roofs as well as in open areas. With the data obtained, energy production plants in Lower Saxony can be optimally distributed according to natural potentials (trade-offs and synergies).The analyses can be transferred to the local level. In this way, the overarching goals of the state are to be considered at the local level and the community's responsibility to achieve the overall target (Germany's energy demand in 2050) becomes clear. In accordance with the requirements of the German Nature Conservation Act, the impacts of the energy plants on soil, water, landscape, biodiversity and people were considered in the analysis.

The **Lower Saxony** Study included **Policy- regulatory constraints** considering both legal regulations and legally derived requirement (Federal Nature Conservation Act; National Biodiversity Strategy).

Finally in **ROMANIA**, the RES included were: Wind energy, Solar Energy and Biomass energy, while the key ES were, Provisioning services and Cultural services. Policy and regulatory constraints included from protected areas.The analysis provides clear insights in terms of quantity and locations of suitable areas for solar, wind and biomass, setting the basis for policy design. Participatory methods were applied to identify potential synergies and trade-offs across space and time. Through active participation, local communities can inform researchers, and reciprocally , about the optimum renewable energy scenarios and local transition. Participatory mapping combines local knowledge from stakeholders with GIS techniques to assess the actual situation and to choose between future development scenarios. In particular regarding the cultural ecosystem services, the involvement of communities in participatory methods is the most relevant aspect, because participation protects the citizens and stakeholders contribution in defining the spatial distribution of cultural services and their level of supply.The interrelation between RES and ES was assessed through landscape visualisations, where people can perceive how the landscape will look according to different levels in the supply of other ES.

In the **VENETO** region, the **RES included** were: Agricultural Biomass and Solar farms , while the **ES included** were Water regulation, Habitat, Global Climate regulation, Food production & Aesthetic values . Also in the **Veneto**, a stepwise methodology is followed. It consisted in first mapping suitable areas based on ES trade-offs analysis for agricultural biomass from leftovers. Second, mapping suitable areas based on ES trade-offs analysis for solar farms, and finally in comparing mismatches and common highlights. The Veneto study included **Policy- regulatory constraints** for biomass and solar production from the Regional Energy Plan (PER 2017) - these were discussed with stakeholders throughout the process.