Transnational report on state of play in spatial planning for renewable energy in the participating regions:

Creating space for renewables

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Creating space for renewables

Contents of this report

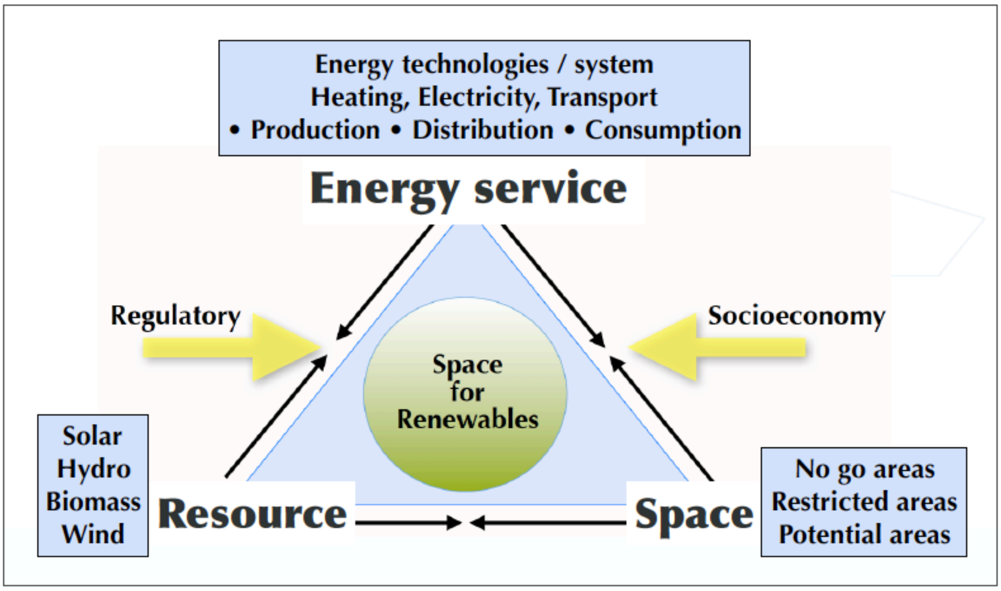
Summary

The purpose with this assignment (WP 2.1) is the collect information on spatial planning criteria, conflicts, methods and information on the interaction (positive or negative) between spatial planning and promotion of renewable energy projects.

The main focus is on renewable energy and on how the implementation of renewable energy can be supported by spatial planning. Therefore, this report deals with the regional and/or government regulation and methods on spatial planning for implementing renewable energy sources that replace energy production based on fossil fuels.

The study is based on three main elements. Firstly, the understanding the territorial dimensions of the relevant renewable energy sources (chapter 3). Secondly, the basic planning criteria, which are divided into three issues, namely the renewable resources, technology and technology systems, as well as the spatial dimension, that is area and location (chapter 4). Thirdly, the regional analysis of the technologies chosen to illustrate national framework conditions and requirement in the partner countries (Germany, Sweden, Finland, Estonia, Latvia, Lithuania. Poland and Denmark).

The investigation points the important interaction between three elements: The renewable resources, the energy technology and energy system and as a third issue the spatial planning. The investigation can be summarized with the following:



In addition to the conclusions, three recommendations are presented: (1) Development of a comprehensive and longterm perspective on the specific renewable energy investment; (2) Establishment of a dynamic interaction between resources, technology and spatial planning, and (3) the dynamic interaction through involvement of stakeholders and interest groups.

1. Introduction to the report

1.1. The topic of the report

This synthesis report is a part-analysis of the project Baltic Energy Areas - A Planning Perspective (BEA-APP), and is part of Work Package 2. The report has gathered empirical material from project partners in order to map and analyse the existing planning criteria and methods for designating best suitable areas for different type of renewable energy sources and technologies.

The main focus is on renewable energy and on how the implementation of renewable energy can be supported by spatial planning. Therefore, this report deals with the regional and/or government regulation and methods on spatial planning for implementing renewable energy sources that replace energy production based on fossil fuels.

The project partners have decided to concentrate on several specific renewable energy sources and technologies, namely wind energy onshore, wind energy offshore, biogas, biomass for district heating, solar energy for power and heat (together in one).

The planning process for renewable energy is affected by a variety of circumstances, which may vary from technology to technology, but also vary from country to country. Therefore, a bottom-up approach has been chosen to identify how the current planning process for renewable energy takes place in partner countries for each of the selected, individual technologies.

It is described more in detail in Sections 3 and 4. Section 3 deals with understanding of the territorial dimensions of RES, whereas Section 4 deals with general planning criteria for RES. In this report, we will make a synthesis of the various planning regimes from the regions of the project partners (see sections 5).

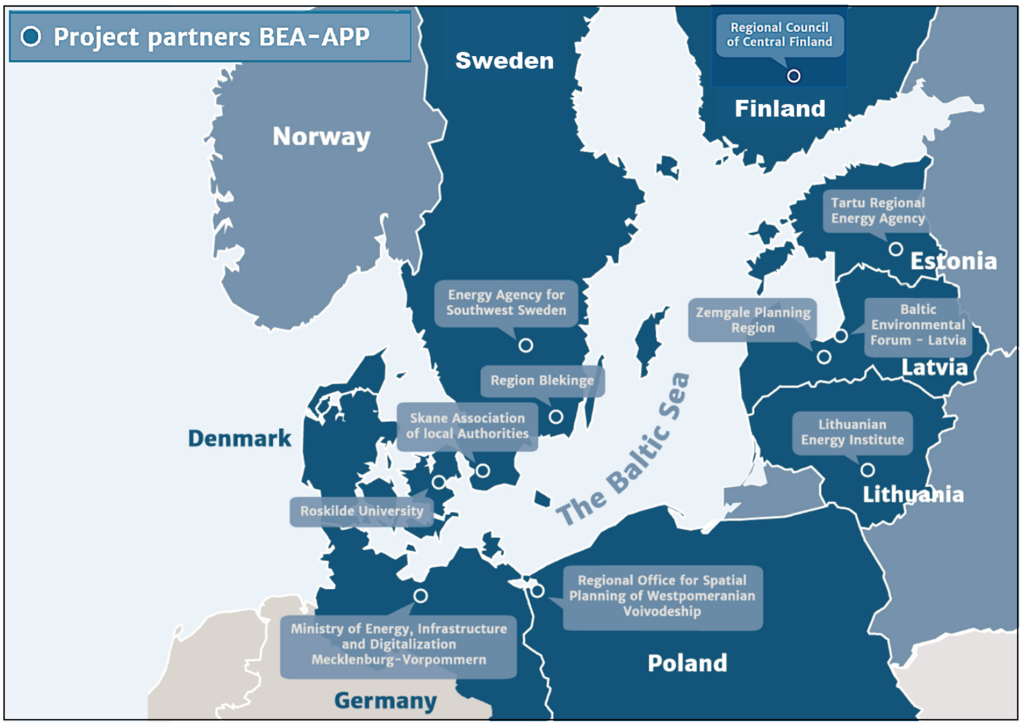
At the partner meeting in Finland in October 2017, it was decided that this report should provide a basic approach for renewable energy planning. This is described in the »Recommendations« in Section 6.

However, we will begin with a description of the methodology used to provide data on the different renewable energy technologies in partner regions. (See Section 2 on methodology).

1.2. The project participants and the empirical input

Contributors in this report are the project partners from eight countries with eleven regions, surrounding the Baltic Sea. The project partners have from theses eight countries contributed to the data material that the report analyses. The following illustration shows BEA-APP's project partner (dark blue areas).

Figure 1. Location of the BEA-APP project partner.



(BEA-APP and CONVIS Consult & Marketing GmbH., "Flyer", 2016)

Six out of eight countries are each represented with one partner, whereas Sweden is represented with three partners and Latvia with two partners. As consequences some partners have submitted empirical material together (Sweden and Latvia). Therefore, empirical material on an overall level will not consist of 11 datasets, but instead of eight datasets.

We at Roskilde University would like to thank our project partner for their empirical datasets, for processing our draft for this report and for their comments on the further process of this report.

2. Methodology

2.1. The approaches

One of the tasks in WP 2.1 is to develop a methodology and a template to collect information on spatial planning criteria, conflicts and methods and information on the interaction (positive or negative) between spatial planning and promotion of renewable energy projects.

The developed methodology contains two elements: Firstly, a thorough examination or in-depth study on spatial planning criteria, where the project partners have been given the opportunity to describe their region/nation on spatial planning for renewable energy (Spring 2017). Secondly, a follow-up online-based questionnaire regarding five selected renewable energy resources (Autumn 2017).

Between the first and the second research, the project partners discussed priority and choice of the different renewable energy technologies at a partner meeting in Kanuas, Lithuania in March 2017. At the meeting it was decided to focus on four renewable sources (biomass, wind, solar and biogas), where theses four energy sources were divided into the following technologies: wind turbine (on-shore and offshore), solar installations on roof or in park (heat or power), biogas and biomass to district heating.

The studies were organized so that it covers both negative and positive interaction between spatial planning and promotion of renewable energy projects. This was possible through the open questions contained in the questionnaire, which gave respondents the opportunity to provide an in-depth explanation. Both the first questionnaire and the second questionnaire can be found in in the annex (see Appendix 1 and Appendix 2).

2.2. The spatial planning experiences

Another task under WP 2.1 was to analyse and update existing comparisons of spatial planning systems (among others based on COMMIN project). We have examined the previous comparison of the COMMIN. The COMMIN was finished in 2007, and much has happened in the EU since 2007. The work in COMMIN will be elaborated in the following section.

The Promoting Spatial Development by »Creating COMmon MINdscapes« (ths is the COMMIN) project was started in September in 2004 and was completed in August 2007, and worked towards a common understanding of spatial development and spatial planning in the Baltic Sea Region. The project aims were to among other things to improve transnational experience exchange and to make transnational communication more efficient, qualify professionals and to promote innovative approaches in the field of spatial development.[1]

The project COMMIN did not come to any conclusion, that was neither their target in any of their surveys. They have presented their responses from each country in the essential report. Several of the countries (regions) that are part of this project joined the EU in 2004 and have in the following years adapted their regulation to EU legislation.

Since 2007, there have been a several of EU laws and regulations that have an impact on spatial planning such as »An Energy Policy for Europe«, »The First- and Second

1 http://commin.org/upload/General/COMMIN_project_flyer.pdf

Strategic Energy Review«, »The European Union's Third Energy Package« (on gas and electricity), »The European plan on climate change« (focuses on emissions cuts, renewables and energy efficiency), and The European Strategic Energy Technology Plan (The SEP-Plan).

However, there is a number of other studies spatial planning that have been used and have been supportive for this report. In particular, the »EU compendium of spatial planning systems and policies« should be pointed out. There is a general survey from 1999 and a number of national studies, for example Finland (1999), Germany (1999), Denmark (1999) and Sweden (2000).

The concrete content of these studies is - like the COMMIN project - of course not up to date; but the studies provide an understanding of the dynamic development of spatial planning, which is very useful. For example, the general EU Compendium of 1999 points out the following four different systematic approaches to spatial planning: [2]

There are mentioned four main forms of spatial planning: (1) a regional economic planning method, (2) integrated physical planning method. (3) An area of application-oriented planning method (4) urbanism planning tradition, based on a number of pre-determined rules for buildings and types of buildings in specific neighbourhoods (zoning).

As mentioned, the project's purpose is to investigate how spatial planning can support the implementation of renewable energy. This implies that the first mentioned main type of spatial planning - the regional economic planning process - is of particular interest.

There are many current contributions focusing on the develop of the spatial planning to support implementation of renewable energy sources, for instance different types of regional and urban regeneration plans, brownfield development plans and, and not least, a number of Eco planning, especially the type of plans working with a combination of spatial planning with energy production and consumption. The various development trends in spatial planning have been usefully in the subsequent studies.

2.3. Empirical materials

The empirical material consists of two different investigations as mentioned before. In the first investigation, Roskilde University had prepared a detailed instruction with examples of how the partners could conduct the investigations (appendix 1). The results were presented in temples, working as empirical basis for this report. It was as-

[2] Cf. The EU Compendium of Spatial planning systems and policies; European Commission, June 1999.

sumed that technologies should be selected according to own priorities of the project partners. The following overview shows the material provided of the different project partners for the respective renewable energy sources.

Figure 2. The in-depth investigation.

	Germany	Sweden	Finland	Estonia	Latvia	Lithuania	Poland	Denmark
Biogas		X	X		X		X	X
Wind Onshore/offshore	X	X	X		X		X	X
Solar Power / heating		X		X	X		X	
Biomass District heating					X	X		X

An "X" indicates that a survey has been submitted on the RES. It is noted that the project partners from Latvia has been submitted a total survey covering all the different RES in one.

The renewable energy source best represented is wind energy and the least represented is biomass for district heating. The answers we received at Roskilde University have described how a typical planning process takes place. The study is divided into six main focus areas:

(1) *The Flow:* flows from submitted application to granted building permit for the construction of the renewable energy plant. The project partner was invited to present example including a description and a process diagram to exemplify these approaches.

(2) *The level:* It is expected that not all spatial decisions are taken at the same level. Partner must therefore also specify at what level decisions are taken, including the division of labour between the different the authorities.

(3) *Criteria:* Likewise, partners should describe the planning criteria and methods employed in designating suitable areas for the renewable energy sources.

(4) *Conflicts:* In the survey, the partners were also asked to relate typical conflicts for the selected technology

(5) *Interaction:* The project partners should furthermore describe the typical interacttion between the spatial planning process and the promotion of renewable energy, including how does the spatial planning promote or hinder the implementation.

(6) *The regulatory framework:* Finally, the partners are asked to describe the regulatory framework and provide a brief reference to the legal framework for spatial planning.

The follow-up study had a far greater coverage of renewable energy sources from the partners. See the figure below:

Figure 3. The follow-up investigation.

	Germany	Sweden	Finland	Estonia	Latvia	Lithuania	Poland	Denmark
Biogas	X	X	X	X	X	X	X	X
Wind Onshore	X	X	X	X		X	X	X
Wind Offshore	X	X	X		X	X	X	X
Solar In park heating	X	X				X		X
Solar On roof / power	X	X	X	X	X	X	X	X
Biomass District heating	X	X	X	X	X	X		X

An "X" indicates that a survey has been submitted on the RES and an empty field, means that no information from this region has been received in relation to this particular RES.

In the online survey the project partners were ask to answer a number of questions regarding the selected RES. Including the importance of prioritizing the physical resources, the priority of the RE-source of integration into the energy system?

Furthermore, the partners were asked about the importance of local authorities', the local terms and conditions, including additional possibility to apply for a dispensation from existing rules. This was followed by questions about the environmental impact assessment (EU regulation), including questions about requirement/non-requirement of the environmental impact assessment (rules and practice).

Corresponding was automatically collected and together they give an overview of the local conditions for renewable energy planning in relation to what terms that are being prioritizing, mandatory or possible.

2.4. The methods of the comparative synthesis

The method used to make a comparative synthesis consists of two steps. The first step is divided the empirical data from renewable energy sources into the following dataset from all the responding project partners: Wind energy onshore, wind energy offshore, biogas, biomass for district heating, solar energy for power and heat (together in one).

The next step has been to analyse data within the six focus points in which the study is divided in order to point out similarities or differences in the available data information, and then highlight the most important points.

2.5. Critical assessment of the available data

Not all regions in the Baltic Sea area have equal availability for renewable energy sources. Likewise, not all project partners have experience with planning criteria for all renewable energy sources. Therefore, it has been up to the individual project partner, which empirical data sets they would deliver to Roskilde University for further analysis.

This gives some unanswered questions for some of RES and thus also some »holes« in the empirical data set in the subsequent analysis. Furthermore, some of the project partners have not fully completed the online questionnaire and some partners have given more than one response per region and therefore this will affect the outcome of the survey, which can create clarity and uncertainty about the analysis.

3. Understanding the territorial dimensions of the relevant renewable energy sources (RES)

3.1. Introduction

Fossil energy sources (coal, oil, natural gas) can typically be transported over long distances; they can function as easily transportable energy carriers due to the high energy intensity per unit weight. The same is not the case for renewable energy sources. They are localized sources of energy. The primary application of the renewable sources is bound to the site.

This difference in the energy sources is of major importance for the specific territorial or spatial dimension of the different renewable energy sources. There is also a difference among the renewable energy sources there is also a difference. It will be presented below.

3.2. The territorial dimension of the renewable resources

The renewable primary energy source will typically be tied to a particular site as the primary source of energy. They can then be used to produce heat, cooling, power fuels such as biogas and biofuels, which can then be distributed. The spatial constraints of renewable energy put a particular focus on the spatial planning. There is a difference between the different renewable energy sources that will first be presented.

The bio-resources

Bio-resources (energy carrier) are typically residues from agriculture, forest, industry, and households, typically used in three technologies. The technologies are about combustion, fermentation (biogas), thermal gasification. The spatial dimension is the accessibility that is the crucial element (distance). Wood pellets and other wood products can be transported over longer distances than other, because they have a relatively high energy content per unit weight.

Geo-resources

The geo-resources are generally related to water (hydro, tide, wave), wind and solar energy. They are primary sources of energy and cannot be characterized as energy carriers. The spatial dimension is also about accessibility, but in another form – hydropower: sufficient altitude difference and precipitation; wind power: sufficient wind speed, limited or no shadowing from the landscape; and solar energy: sufficient sun hours, optimal roof slope (on roof), etc.

The renewable energy technologies have very different requirements concerning the size of the area that must be available for the energy plant. The largest direct area requirement occurs for photovoltaic parks (solar power parks); followed by wind turbine plants, which requires a relatively small building area, but have a large impact area. The biomass plants on second-generation biomass (bio-waste and leftovers) have modest area requirements. The building-integrated solar systems (heat, power) make little or no area requirements. The issue will be highlighted in a following section.

3.3. The territorial dimension of energy production

The renewable resources have a territorial dimension. The same also applies to final consumption, which can typically be described as follows: Energy consumption largely follows the population. Cities have by far the largest energy consumption. The fossil energy sources and the easily transportable bio-resources (wood pellets) can be consumed in the cities; but most of the renewable energy sources cannot be placed in the cities. The territorial dimension is thus as follows: Renewable energy will mainly be consumed in the urban areas but be produced in the rural districts.

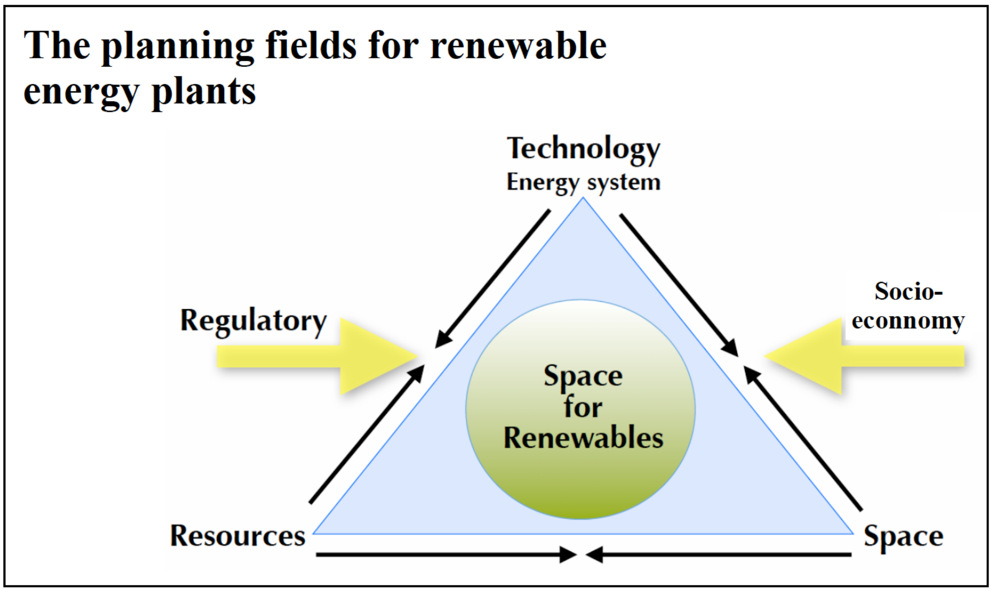
When a coal-fired power plant is shut down, a new power plant will not typically be built in the city. New production capacity - in the form of wind turbines, hydropower plants, solar power parks - must find their space outside the cities where a number of area restrictions will eventually be applied.

Due to the mentioned territorial characteristics of renewable energy, physical planning faces a number of new requirements and challenges, which can be described in figure 4 (on the next page).

Renewable energy development should not only be assessed in the short term. The decisions taken now will have long-term consequences and therefore also consequences for the realization of the objectives of a safe and cheap energy supply based solely on renewable energy by the year 2050. The energy plants planned today will also be in operation towards the 2040s. Renewable energy plants are no longer a supplementary energy plant to be integrated into a fossil energy system. Renewables have gained such an extent that they have become dominant for the functioning and development potential of our energy systems.

The large-scale implementation of renewable energy contains three main elements to create space for renewables, illustrated by the figure below.

Figure 4. The three main elements of the planning for renewable energy.



The three main elements can be briefly described as follows:

- ***The renewable energy resources***: It is about the location, accessibility, and size of the resource. The utilization of resources depends on the availability and the economy of a given technology, and the possibilities of locating the energy plant on a relevant site.
- ***Technologies:*** The focus is on a wide variety of technologies that can exploit water, wind, solar or biomass. It is typical that a number of technologies are being scaled-up, i.e. the standard renewable energy plant is getting bigger and bigger, which can provide better resource utilization but sharpen the difficulty of finding suitable sites.

The energy technologies cannot be considered isolated. The more dominant the share of renewable energy sources becomes, the more important it is that each of the renewable technologies becomes a part of a whole – that is a part of ***local energy system***. It is not sufficient to have electricity when the sun is shining or when the wind is blowing.

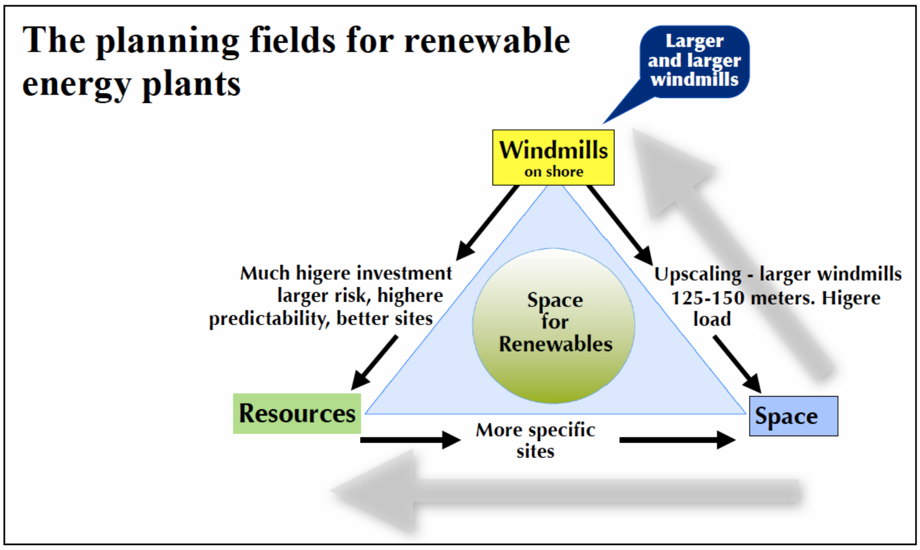
- ***Space:*** is by nature about the possibility of finding a location for a given renewable energy plant, where location opportunities will often compete with a variety of other purposes and considerations.

From the figure it is pretty clear that knowledge of existing and potential renewable resources is an important prerequisite for implementing a spatial planning. The figure marked two other elements that are important for the implementation of renewable energy, namely the regulatory regime and the socio-economic benefit, which will be briefly described as follows:

- ***The regulatory regime:*** The most important regulatory area in relation to renewable energy is undoubtedly technology development and financial support for renewable energy. The resource-poorer location of the facilities, the greater will the subsidy requirement be, if given targets for implementation of renewable energy has to be achieved.
- ***Socio-economic benefits:*** An unconditional prerequisite for the deployment of renewable energy is to contribute to the realization of a number of multilateral benefits. Renewable energy plants are not only energy plants, but can also contribute to local development (employment and revenue), provide a basis for local investment, and contribute to up scaling the local environment and resources. Socio-economic benefit is a question of, how to provide a basis for the realization of the potential multilateral benefits in the community.

The three elements - resources - technology - space - are considered to be three important elements in creating optimal conditions for the implementation of renewable energy plants. However, the relationship between the three elements is dynamic. This can be illustrated by the development of the ever-larger wind turbines in the figure 5:

Figure 5. The technology development increases the pressure on spatial planning.



The figure should illustrate how a technological development over the last decade has increased the pressure on spatial planning: Over the last 10-15 years the height of a standard onshore wind turbine has gone from 75 to 80 meters to 150 meters.

The impact area of the wind turbine, that is, the size of the area that is included in the spatial and environmental assessment has increased by a factor of 4, due to the increased height of the windmills, going from 75 meters to 150 meters (from impact area on 28 ha with a windmill on 75 meters to an impact area on 113 ha with a windmill on 150 meters height). It obviously creates a series of spatial planning issues and challenges for the previous procedures in spatial planning.

Wind turbines are not the only renewable technologies that have grown in size. The same goes for the biomass and photovoltaic parks. Upscale - larger and larger plants - are not necessarily the most appropriate technological responses. For many of the renewable energy technologies there are other options.

With the scale-up of fixed sizes also means considerably higher contract prices, higher risk and increased demands for predictability, which may well increase the requirements for the location and thus increased requirement for the spatial planning as illustrated with figure 5.

3.4. Summary on the territorial dimensions – the planning criteria

Three elements are each essential element in the construction of renewable energy plants: Resources, technology (energy system) and space. These three elements are regarded as crucial planning criteria, each of which must be met to ensure the successful implementation of renewable energy facilities. Without resources, even the most ideal location from a planning point of view will not lead to the implementation of renewable energy plants.

4. The basic planning criteria

4.1. Introduction

The basic planning criteria are resources, technology (including the energy system) and the location or space for the renewable energy facilities. This section will present general perspectives on 1) resource, 2) Technology and Energy system, 3) Area and location, 4) Regulation regime and 5) Socioeconomics, with some examples for from the project partner regions.

The purpose is to give a more detailed review of the items included in figure 4, including findings and underlying the concepts and approaches.

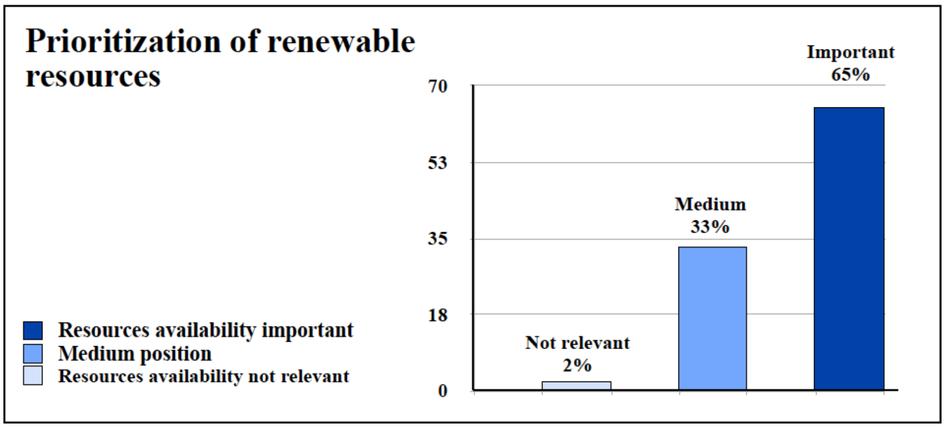
4.2. Resources

In production for power from wind resources the location according to wind conditions is an essential factor. The same applies to the height of the wind turbines to reduce shadow effects from the landscape. The technology to utilize the wind resource developed and integrated into several local energy systems at local and regional level. The problem is finding locations in the countryside that do not bother neighbours and among others not go against the protected area with environmental and nature considerations.

Energy production from solar (heat or power) is a relatively predictable resource. Solar heating, especially solar collectors, has long been technically and economically advantageous. Energy radiation is more advantageous the further south you come; while the number of sunshine hours varies from site to area, although with a relatively fixed pattern from year to year within the same area. The development of solar technology (costing of the solar cells) makes the conditions suitable for solar power in the Baltic area.

The resources for biomass used in biogas, have a local or regional perspective, since it is not realistic to transport biomass to biogas over larger distances. The raw materials used for biogas should, in principle, be sustainable, implying that substances used for biogas production are residues and waste substances. The possibilities here are many, both from residues and waste products from industry, agriculture and households. In the case of biogas production, it must be ensured that agriculture can extract the residual product from which biogas production derives.

Figure 6. What role does the resource mapping play in spatial planning? (Online partner survey).



The figure 6 (previous page) shows the responses from the project partners in the online survey, where all the RE technologies is calculated together in one figure. It shows that 98% agree that RE-resource' availability is important or medium important to prioritize in planning requirements.

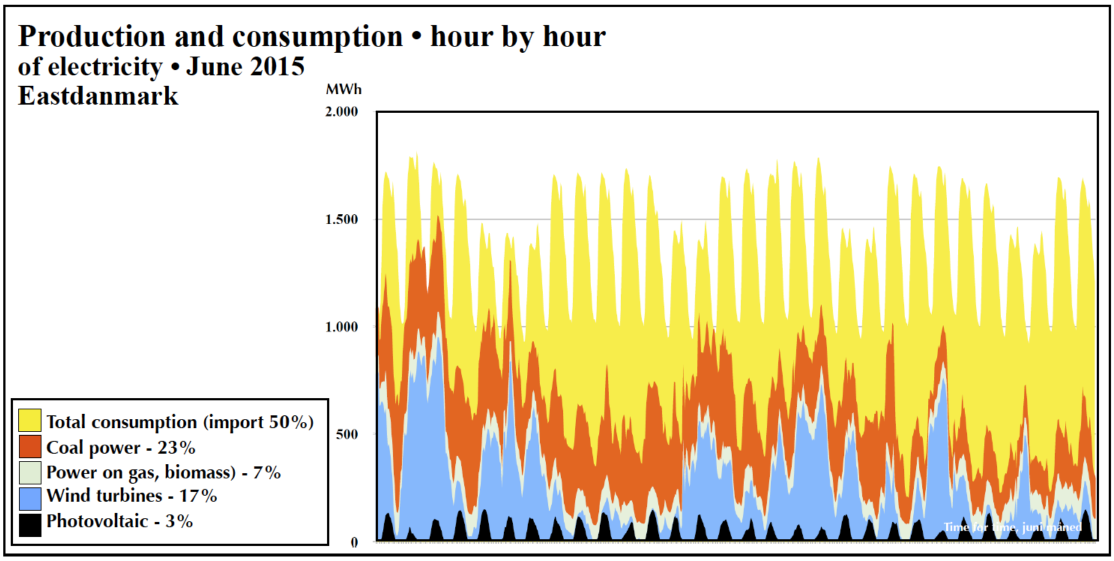
Biomass resources like wood pellets, are not local dependent or a localized resources as other biomass resource. The wood pellets can be transported over a wide distance, completely in line with coal. The water resource (hydro-power) requires sufficient height difference and precipitation. There will be no deeper analysis of hydropower in this project, as the project partners have deselected the hydro-power.

4.3. Technology and the energy system (power)

Three is a need to develop of an energy system (power), capacity and technologies to integrate fluctuating sources. The main reason is that electricity needs to be in balance in the system depending on the fact that production and consumption must be matched instantly and with consistency to achieve a balanced system. There must be a balance between the more predictable resources like water and biomass and at some lever solar, as well as the less unforeseeable resource that wind is.

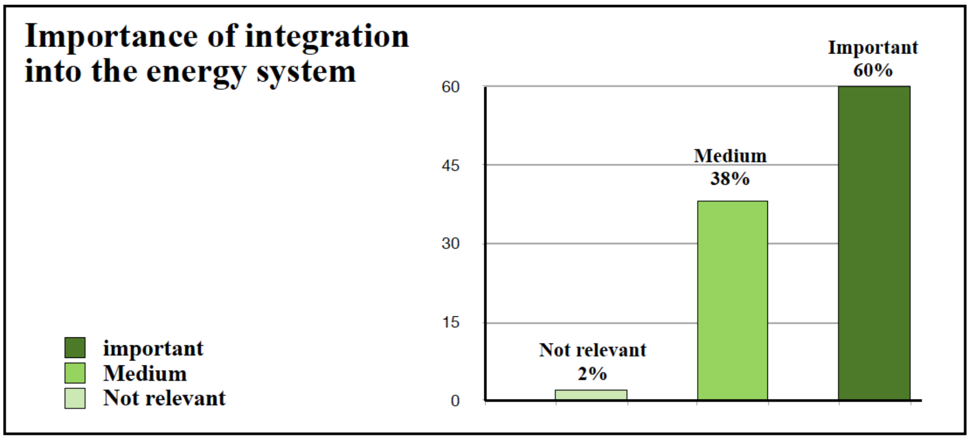
There are several challenges in the energy system in relation to the relationship between energy consumption and production. It could partly be handled through imports of electricity and partly supported by smart grid solution and smart energy systems. Consumption is almost predictable; it follows a daily rhythm as well as a seasonal curve. The challenges of renewable energy systems can be illustrated with the daily el-production and consumption (the yellow curve) in East-Denmark in figure 7.

Figure 7. Illustration of the size and duration of the fluctuating sources: Windmills (blue) and photovoltaic (black fields).



As the renewable energies cover a larger part of the energy supply, it becomes more important and more important to incorporate the effects on the local and the regional energy systems. This is also reflected in the project partner's answer to this question on the online survey (see next page).

Figure 8. The importance of the requirement of RE-source of integration into the energy system. Online partner survey.



The figure 8 shows the responses of the project partners in the online survey on to what extent they focus on the importance of integration the renewable energy sources into the energy system. The figure shows that 60% thinks it is important and 38% medium important with that requirement of RE-source of integration into the energy system.

4.4. Area and location

Technical installations for generating solar-, wind-, and biomass energy, requires a certain area and some areas are suitable and others less suitable locations for a given facility. There are areas where the wind blows advantageously in relation to producing wind power, there are areas where biomass is available to produce bioenergy, as well as for solar energy. Of course, it is possible to import for example wood pellets and solid wood biomass and produce heat and power, but it still needs spatial planning for the renewable energy.

First and foremost, some geo-resources (wind and solar) must be present within the area if you want local supplies, but there is of course an opportunity to import biomass. Secondly, all the remaining items in the area must be considered like companies, housing, roads, etc. and for the third there are several restrictions that must be considered. These restrictions can be divided into three main zones, regulated and assessed by municipality, states zones and other authorities.

Each of these authorities has different planning considerations that must be addressed before a site can be designated for the establishment of a given renewable energy plant.

There are two approaches that characterize the planning of the installation of renewable energy technology. One planning approach is based on the areas remaining for the installation of RE after the state, municipality and other authorities have screening for their registrations. Another planning approach is based on the area where the renewable energy source is available and this planning process seeks through compensation and dispensation to build RE installations.

Renewable energy technology has different area requirements. The following numbers can illustrate some key differences for the technologies (yearly production):[3]

- Large wind: 35,760 MWh production per ha (site)
- Large wind: 89 MWh production per affected area (safety and noise distances)
- Small wind turbine (80 meters): 22,500 MWh production per ha (site)
- Small wind turbine (80 meters): 88 MWh per affected area (safety/noise distances)
- Photovoltaic park: 762 MWh production per ha (site)
- Biogas plant: 15,250 MWh production per ha (site).

The above figures show that wind turbines have highest production per areal, namely more than 35.000 MWh per ha per year. The next highest is the biogas plants. The most area demanding technology is photovoltaic parks.

It should be noted that the calculated area for the wind turbines only is the production site (the wind turbine site). However, the wind turbines are affecting larger areas. According to Danish rules, the affected area is an area with a diameter on 4 times the height of the windmills.

In this way, taking into account the affected area, the wind turbine production is considerably lower per area. Calculating on the affected area the production of the large wind turbine will go from 35.000 MWh to 89 MWh per ha. Building-integrated photovoltaic systems can be characterized as non-area-consuming technology.

4.5. Regulatory regime/framework

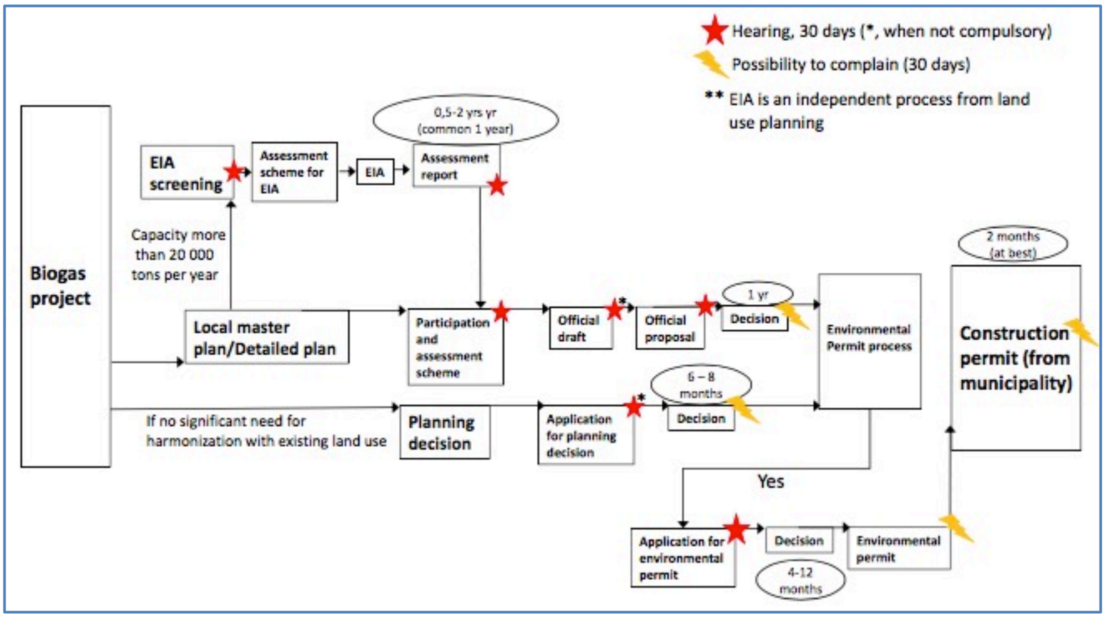
There seems to be two approaches that characterize the regulation and planning of the installation of renewable energy technology. One planning approach – the remaining area approach - is based registration of the remaining land for renewable energy plants when all other considerations of land use has been done by the state, municipality or other authorities.

Another planning approach – the optimal resources approach - is based on selection of areas, where the renewable energy source is available. This planning process then seeks to include all necessary nature and the environment considerations; however, with starting point in the valuable renewable energy resource.

3 The calculation is based on specific Danish renewable energy projects in Kalundborg, Odsherred and Solrød municipalities, and thus based on Danish wind and solar conditions in the mentioned areas.

Regulatory regimes are different among project partner countries, but there are also many similarities. It will be illustrated in the following by comparing an approval process for a biogas plant in Finland and Denmark.

Figure 9. The regulatory framework for biogas in Finland.



Pakarinen, O., 2016, Regional Council of Central Finland

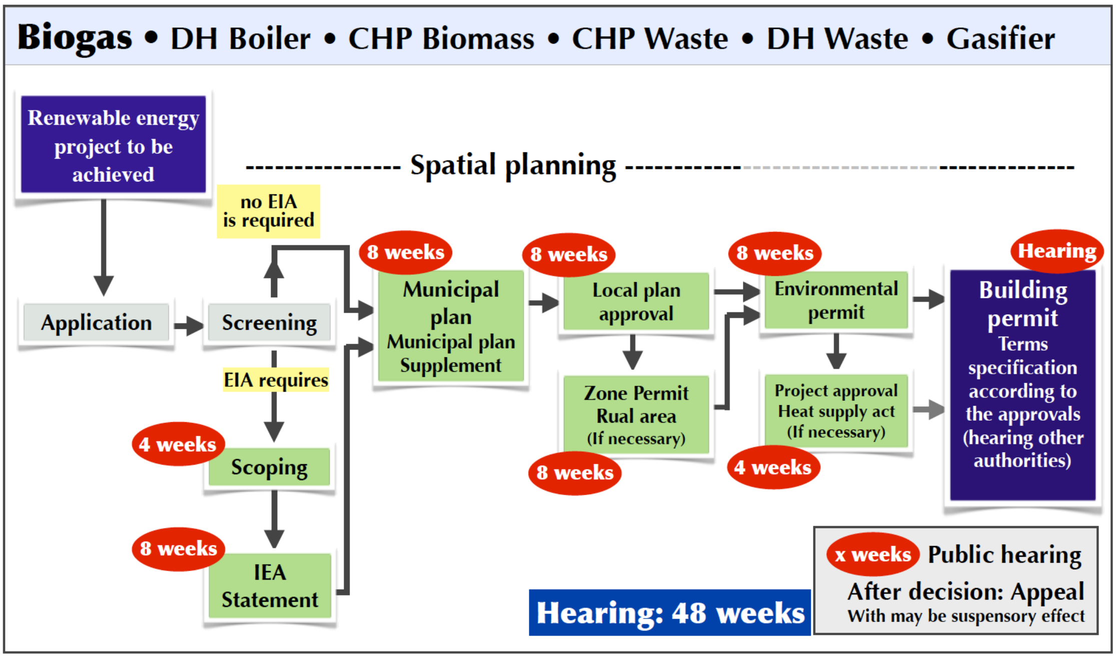
Figure 9 shows the planning process and regulatory framework for biogas plant in Finland. The red points indicate hearings that have a duration/length of 30 days each. The yellow points indicate an option for appeal against the decisions. An EIA-process (an Environmental Impact Assessment process) has to be included, if the capacity of the plant is over 20,000 tons per year. The EIA process may depend on the results from an initial EIA screening. EIA is an EU regulation on environmental impact assessment. These rules must be used for environmental assessment of plants, but also for evaluating plans.

There are many similarities between the Finnish and Danish frameworks for planning of biogas facilities. There are obviously many similar when it comes to the common EU rules (EIA rules), but in addition there are also other similarities in the construction and approval of plants, especially the decision-making process.

In both cases the regulatory regime consists of an elongated step-by-step decision-making process, resulting in a relatively long approval process with great uncertainty about the outcome.

Figure 10 shows the planning process and regulatory framework for biogas plant in Denmark. A screening will be performed to determine whether an EIA is required just as in Finland. However, the EIA is always required if the plant has more than 36,000 tonnes of raw materials per year. With or without an EIA-process, the RE-project will be implemented through a municipal plan or a supplement for this. The municipal plan has to be followed approval of a local plan approval and in some cases a rural district zone permit. Whether this is the case, the next step is an environmental permit, etc. On top of the spatial approval, follows the preparation and approval of an environmental permit.

Figure 10. The regulatory framework for biogas (and other energy facilities) in Denmark.



Kjær, T., 2017, Roskilde University.

The total hearing process can take up to 48 weeks or just under 2 years. Alone consultation periods correspond to two years. The overall approval process can hardly be shorter than 4-6 years, depending on the course of the case processing.

4.6. Socioeconomics

The socioeconomic benefits are significant importance for the area, where the renewable technology facilities are established. As mentioned earlier the renewable energy plants are not only energy plants, but they may also contribute to local development (employment, revenue, etc.). The renewable energy plants may provide a basis for local investment, and contribute to up scaling the local environment and resources, and thus contribute to a number of Eco-system services that extend beyond the production of renewable energy. Socio-economic benefits from renewable energy are a question of, how to provide a basis for the realization of the potential multilateral benefits in the local community.

The socioeconomic benefits can also help to change local people's perception of the establishment of renewable technologies with local ownership. The socioeconomics differs from technology to technology, and they should further be elaborated on each of the selected renewable energy technologies.

Biogas

A socioeconomic benefit from biogas can be summarized as follows: Biogas plants contribute to employment and local economy through the construction and operation of the facilities. Biogas plants contribute to employment and local economy through the construction and operation of the facilities. In addition, a number of other effects: Possibility to allocate additional organic material from agriculture, industry and households (local income), recycling of nutrients such as high quality and well-fertilizer products, and function as a balancing energy producer.

Biogas facilities contribute to reduction of greenhouse gas emissions not only in the production of renewable energy, but also by removing methane from deposited organic matter. The biogas plant supplies the following eco-system services: renewable energy, resource efficiency through circulating economy, as well as a number of environmental services.

Biomass to district heating

Local produced biomass contributes to employment and local economy through the construction and operation of the facilities. By moving from fossil energy sources to local biomass, and by moving from individual heating to district heating sector this technology contribute to: Resources efficiency by recovery of an otherwise unused residual product from forestry, stabilization of forestry income, and increased rational and efficient energy supply in benefit for local consumers

District heating on biomass contribute reduction of greenhouse gas emissions, including reduction of methane from unused forest material. The plant will also contribute to reducing local air pollution in comparison with, for example coal and coke-fired stoves. District heating on biomass provide the following eco-system services: renewable energy, increased resource efficiency, and offers possibility of more stable and appropriate forestry.

Solar energy

In principle, solar energy contributes to employment and local economy through the construction and operation of the facilities. However, the effect is less in comparison with other technologies, as a relatively large part of the production of solar facilities takes place in Southeast Asia, especially the photovoltaic part. It is expected that building-integrated solar facilities will have a significant positive impact on the local or regional construction industry.

District heating on biomass provide the following eco-system services: renewable energy, increased resource efficiency and replacement of biomass, which can reduce the expected increased pressure against all the limited biomass.

Wind turbines

Wind turbines contribute to employment and local economy through the construction and operation of the facilities. Regions with the wind turbine industry have also experienced a number of industrial development effects of the wind turbine industry. Wind turbines - onshore / offshore - must be considered as one of the key building blocks of large-scale transformation of the local energy system. The eco-system service from the wind turbines: Renewable energy and energy efficiency savings from the renewable but not infinite biomasses.

5. The regional analyses of the chosen technologies

5.1. Introduction

This section is based on the project partners and their answers in the questionnaire (Appendix 1). The section is divided according to the technologies that the project has chosen to concentrate on in this work package. Which is:

- Solar energy (power and heat).
- Biomass to district heating - heat / cooling
- Biogas
- Offshore wind turbines
- Onshore wind turbines

It has been up to the individual project partners too chose which of the technologies to answer the questionnaire. It implies that there is more empirical material on some technologies and less on others as described in section 2.5. At each technology, we provide an overview of the planning criteria, describing the differences and similarities of the regions involved, and, based on these, create the innovative ideas and emphasize if there are intelligent examples that make the planning process easier.

5.2. Solar energy (power and heating)

Project partners who have chosen to answer this technology are: **Estonia** (Tartu Regional Energy Agency), **Poland** (Regional Office for Spatial Planning of Westpomeranian Voivodship) and **Sweden** (Skåne Energy Agency). Our partner from Tartu Regional Energy Agency has chosen to take a specific case for solar energy installations, the empirical date is here case oriented.

In Sweden, the spatial planning process consists of three steps, whereof the second step concerns a building permit if necessary. In Poland the spatial planning process is divided into three approaches, depending on the size of the installation (less than 40 kW, between 40-100 kW and over 100 kW); the process also includes a building permit and the local spatial plan. In the case from Estonia concerning 200 kW facility the process consists of seven steps, including construction permit.

There is reason to emphasize that Sweden has an advantageous approach, where many of the local authorities have developed guidelines for solar installation and building permission in solar power facilities.

In all three regions, the level of authorities is predominantly the municipality, where other authorities (national) may influence planning (particularly the environment part). In relation to planning criteria and methods for designating suitable areas, Sweden gives an opportunity to discuss the installation of solar energy in the municipality's comprehensive plan (although not many do), and more municipalities use tools like solar maps or solar potential studies and further they have their guidelines.

In Estonia, the main criteria are to find suitable areas: Industrial development areas, close to the grid, and areas for customers the off-grid. In addition, the national plan is working to find areas of low value for other uses. In the Poland, there are no precise criteria for finding areas for solar energy; therefore, it is based on economic premises for investment.

Generally, there are no conflicts in connection with the installations of solar energy in any of the regions. The planning criteria in Estonia, interact with other plans including city plans (cultural heritage sites), and rural plans and rooftop installations are encouraged by the authorities. In Poland, there is an interaction with the head of municipality as well as the municipal institutions and bodies (assessment and approval), and in the end a local spatial plan is published.

Summing up on solar energy

The empirical data shows that in Sweden it is less complicated to set up solar cells. There is not much regulation in Sweden regarding the physical planning process for solar energy, while regulation in Poland depends on the installed kW, and in Estonia has recently decided regulation aimed at low value areas as a basis for solar facility planning.

In general, Sweden has some good solutions for solar energy in the planning criteria, such as the guideline for the installation of solar energy and its building permit, as well as the use of solar potential and tools such as »solar maps«.

5.3. Biomass to district heating (heating/cooling)

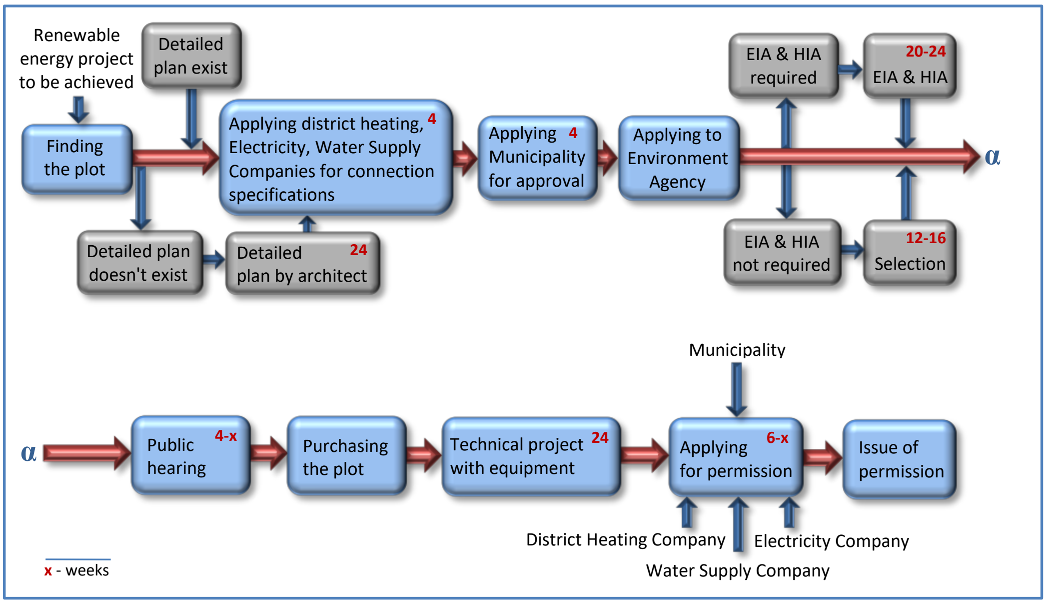
Project partners who have chosen to answer this technology are: **Lithuania** (Laboratory of heat equipment research and testing, Lithuanian Energy Institute) and **Denmark** (Department of People and Technology, Roskilde University).

Lithuania: In Kaunas City Municipality have develop and adopted several plans regarding renewable energy for district heating (DH). This contributes to the spatial planning process, because the aim of these plans is, among other things, to reduce the proportion of fos-sil fuels in district heating, so that the proportion does not exceed 50% (the actual situation in 2010 was 90%).

The Kaunas City Municipality spatial plan (2013-2023) has defined zones assigned to district heating and contains 19 plans. Kaunas municipal DH company (AB Kauno Energija) performs operational planning of district heating system construction of new facility and connection of new own production capacity and capacity of independent heat producers.

The figurer below (figure 11) is an illustration of the planning process defined under the Regulations for Installation of Boiler-houses Equipment.

Figure 11. The spatial planning process for District Heating Boiler (Biomass Fired) in Lithuania.



Pedišius, N., 2016, Lithuanian Energy Institute.

Most of planning process illustrated in figure 11, are completed at the municipal level, in cases the future boiler-house is designed to be operating and supplying heat into municipal integrated district heating network. The constructions permission is, however, providing by State Territorial Planning and Construction Inspectorate under the Ministry of Environment. If the district heating plant also produces electricity to the national electricity network, the Ministry of Energy must approve the plant.

The main criteria and methods for designating suitable areas are: Areas assigned to industrial development; sites close to a grid; the price and other specific criteria e.g. close neighbourhood of residential etc. In Kaunas number of stakeholders were participating in the process (started around year 2000), including RES producers, developpers, traders, forest owners and operators, also ministries, energy agencies and academic communities, as well as in municipal and national levels.

The regulatory framework in Lithuania consists of five overall regulations; The Law on Renewable Energy Sources; The Municipal law; The Heat Law; The Law on Spatial Planning and Environmental Impact Assessment Act for the Planned Economic Activity.

Denmark: District heating plays a major role in the heat supply in Denmark. In Region Zealand, the district heating system supplies up to 40% of the total heat supply. In some cities in the region, for example Roskilde, district heating is very dominant, covering 88% of the heat the total demand, mainly based on biomass and waste.

The oil crisis in the early 1970s was a major factor in the expansion of district heating. During this period an overall national heating plan was developed, which was based on the following principles: All geographical areas were divided into four areas: ***Area 1*** was to be supplied with district heating from the major power plants that had to be converted from oil to coal. ***Area 2*** should be supplied with natural gas from the North Sea, either with district heating boilers or surplus heat from power gasengines, based on natural gas.

Area 3 was intended for smaller district heating systems, primarily based on biomass, or to be supplied through individual heating. The last area, ***area 4,*** was intended for individual heating or very small district heating systems (neighbor-heating).

Area breakdown is primarily based on the size and heat demand-density of a given area. Area 1 has the highest heat-demand density, etc., followed by area 2, etc. This planning system was modified and developed during the 1990-2010s, with increased emphasis on promotion of the Danish natural gas from the North Sea.

The planning steps for at given plant is presented in Figure 10: First detailed application, then EIA (Environmental Impact Assessment. With a positive EIA, the next step is a Municipal plan (or supplement to the Municipal plan) and a more detailed spatial plan (local plan). If approved, the next steps are related to the energy legislation, in which particular attention must be paid to the assessment the ***social economic*** (national economy) of the given energy plant.

Social economic means that the plant must be economically advantageous in comparison with alternatives, where the economy is calculated without taxes, grants, etc. but with the recognition of externalities (cost of CO_2 emissions, primarily).

In recent years, there has been a greater flexibility: It is possible to deviate from the original area breakdown. As a result of district heating, the supply in a number of cities have easily be able to move from fossil to renewable energy supply. It has been largely due to the fact that coal-fired power plants have been shut down and replaced by new power plants based on wood pellets, wood chips or straw, and that the natural gasfired plants have been replaced to some extend by biogas.

However, it must be noted that the conversion of the heating sector is relatively slow - especially in area 2 and area 3, partly due to the regulation and partly due to technical and economic challenges

Summing up on district heating

In Lithuania the spatial planning supports the development of district heating plans and the dissemination of district heating. The planning process must be characterized as elongate, similar to the situation in other project partner countries. The Authority is divided into several levels in the decision-making and approval process.

The largest part of the planning process takes place locally - at the municipalities in cooperation with utilities. Building permission is given at another authority level, namely by both state planning and state environmental authorities; In case of power generation at the plant, approval must also be obtained from the state energy authorities.

In Denmark: There is a clear need for modernizing of the regulation and planning, if the major political expectations of the transition of the heating sector from fossil to renewable energy should be achieved.

5.4. Biogas

Project partners who have chosen to answer this technology are: **Finland** (Regional Council of Central Finland), **Poland** (Regional Office for Spatial Planning of West-pomeranian Voivodship), **Sweden** (Skåne Energy Agency) and **Denmark** (Department of People and Technology, Roskilde University).

Spatial planning for biogas and planning criteria is in Sweden, Denmark and Finland based on facility input in tons. In Poland, the criterium is based the amount of power produced by the facility.

In Sweden the biogas plants are divided into three categories (A, B, and C) related to the size of the facility. A and B facilities must have a permit and subject to the »Land and Environmental Court« and »Environmental Impact Assessment Committee«. For C plant the approval authority located is with the local authority.

A permit process in Sweden consists of three steps: 1) a pre-study consulted with the municipality, county administrative board, 2) a formal application is carried out (EIA, environmental impact assessment) and Technical description), and 3) the hearing.

In Denmark, the spatial planning process consists of six steps: 1) an application to the municipality; 2) the EIA screening; 3) approval and local plan supplement; 4) an environmental permit for installations over 30 tons per day; 5) the subsequent utilization of biogas for heat/power and 6) building permit.

In Finland, the EIA-process must be performed and an environmental permit issued, if the organic matter is over 20,000 tons per year. In Finland, they have a legal authority (ELY-Center) handling all environmental impact assessment activities. However, there is a possibility of large plants in the rural area, if the general plan in the area supports waste management.

In Poland, the spatial planning process consists of five steps, which may contain several steps within each step. The first decision is the location of the biogas plant in relation to the local spatial plan or land development & management conditions. The location is based on a study and can lead to a procedure for changing the local plan.

Here it must be determining the type of energy that will be produced (heat / power / gas) and the amount expected to produce, as these conditions are decisive for approval and fur-ther permission. If the capacity is larger than 0.5 MW, an EIA procedure is required. Then contact the local energy provider, add to the local management plan and building permit.

In relation to the level of authority, it is in Sweden handled by the County Administrative Board; for smaller installations the authority is the local municipality. In Denmark the municipalities handle the issues, except for very large biogas plants handled by the Ministry of the Environment.

In Finland, as described above by ELY-Centres and a regional state administrative agency is the authority in relation to environmental permit, but it is still the local municipality that is responsible for local planning process and decision as well as building permit.

Poland has local decision-making in relation to land development and »changes in the study«, but several municipalities, and Regional County are involved in assessment and approval. In some cases, it may involve a central level.

Poland has a policy on required distance for biogas plants in relation to residential areas and distance requirement with establishing biogas plants near Nature 2000 areas. The empirical evidence from the other three project partners shows that the general used approach to find suitable areas for biogas plants is based on access or distance to the raw materials, and in some cases also the relation to agriculture or access to the heating market. Finland has an advantageous approach in which they are based (they actually con-nect the small variations among partners): 1) Logistics and location and input, 2) Use and biogas and 3) Logistics of the digestate.

The typical conflicts concern odours, air pollution, noise, increased transport and the impact on the landscape. Several people report about conflicts of social nature such as comfort of life (also in cottage areas) and value of the property.

The interaction with other regulations is for most partner makes the process complicated and prolonged. Several partners (Finland and Denmark) describe a method by which the process could be harmonized and could shorten the process. Both project partners describe methods to deal with regulations, consultations and approvals on co-operation. According to Finland, this will increase the potential for investment in biogas.
In relation to the regulatory framework see the figures and the description of the framework from Finland and Denmark in section 4.5. Besides this there is consists in Sweden of about eleven different laws and permits, in Denmark of eight, in Finland of seven and in Poland of 13 different regulations.

Summing up on biogas

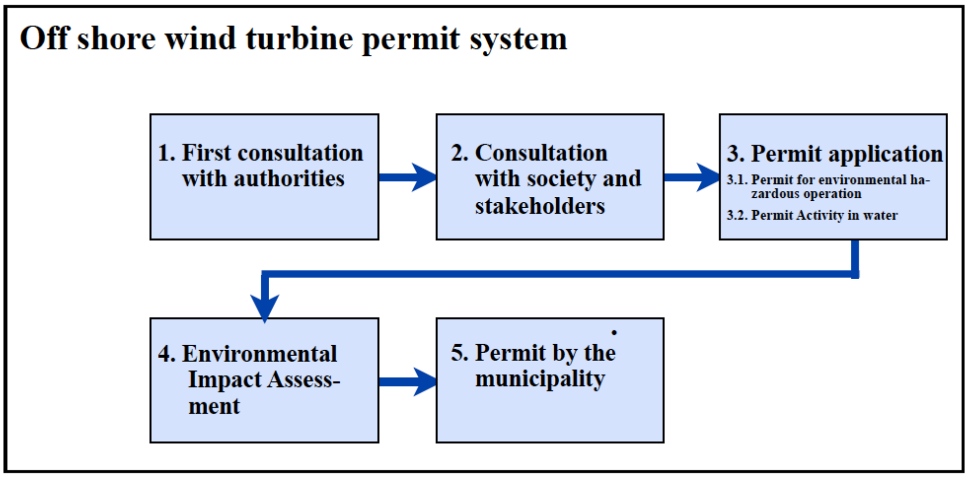
Both in Sweden, Denmark and Poland have a large number of regulatory frameworks that affect planning whereas Finland has a simpler framework regulation. There are similarities in the conflicts between biogas plants in the four countries where odour, increased transport and the impact on the landscape are noted as the main problems.

The two innovative methods described by Finland and Denmark should be strongly considered in a future approach, because it can increase investment in biogas and can significantly shorten the process.

5.5. Offshore wind turbines

Project partner who have chosen to answer this technology are: **Sweden** (The Energy Agency of Southeast Sweden) and **Denmark** (Department of People and Technology, Roskilde University).

Figure 12. The spatial planning process of offshore wind turbines in Sweden.



Månsson, A., and Lindh, A., 2017, The Energy Agency for Southeast Sweden.

Sweden has a five step in the spatial planning process of offshore windmill (see the figure 12 above). The Swedish government gives the permit to build wind farms after an application is sent to them. It is necessary to have a permit for both the construction of the windmill, for submarine cables and pipelines and it required an EIA. Levels of government are at both the national authorities (government) and the municipality in which the wind turbine is to be located. The municipalities have a strong mandate and their decisions cannot be appealed.

Almost 70 % in the Swedish municipalities have a wind power plan. »During the planning process in the municipalities certain areas more or less suitable for wind power is pointed out. To get at good holistic view neighbour municipalities are obliged to coordinate their plans« (Ibid).

In the methods for designating suitable areas often included:
- Wind conditions
- Physical and technical preconditions
- National interests
- Health and safety
- Maine environment
- Fishing industry
- Buildings and infrastructure

The Swedish government allocated some years ago, planning support for the wind power planning in the municipals. The most typical conflict in Sweden is the consideration of the national defence, civil aviation, maritime and civil telecommunications, which can be affected by wind power.

Also, in tourism and fishing industry can be possible conflicts. It can take between 4-7 years from planning to construction but if the municipality has a comprehensive plan, is shows that the authorities is positive for a possible establishment, this makes it easier to develop wind turbines facilities. Interaction is important in Sweden as it may affect the construction of wind turbines very positively.

»If municipal officials and the developer can create an atmosphere and a dialogue, in which all stakeholders can feel involved and have the possibility to influence the process, it can benefit the process«. (Ibid). The regulatory framework consists of four overall regulations; Planning and Building Act, Environmental code, Protected areas and Kulturmiljölagen.

There are two ways to get permission in Denmark or two ways set up an offshore wind farm: the one is through ***tender*** and the other is by the so-called ***open-door procedure***. The total Danish wind turbine capacity is almost 1,300 MW. With already launched new offshore wind farms, there will be approximately 2.300 MW in operation in 2020. In addition, there are a number of smaller coastal wind turbines of 350 MW.

In case of a tender, the state provides a project with a typical predetermined location and a certain size of the planned offshore wind farm. In the open-door procedure, a potential wind turbine owner applies for the permits at a designated location. For example, by submitting an unsolicited application to be authorized to initiate the planning at a self-chosen site.

In the open-door procedure, three different approvals must be obtained. The **first** permission is a permission to conduct a preliminary investigation. Typically, permission is given for preliminary examination by the Danish Energy Agency for one year. Within this timeframe, an environmental impact assessment (EIA) must be submitted to assess the environmental impact of the proposed facility. In the case of international nature conservation area (Nature 2000), an impact assessment of the effects on nature must first be prepared.

The ***second*** permission is an establishment permit. The Danish Energy Agency shall approve the EIA report. The environmental assessment should typically illustrate the visual impact of the project on the area and its impact on population, fauna, flora, soil and sea bed, mammals in the sea, etc. After approval of the report, the Danish Energy Agency issues an authorization for the establishment of the offshore wind farm.

The ***third*** permission is a permission to utilize the energy. If all the terms and conditions of the EIA are met, the Danish Energy Agency issues a so-called electricity production permit), before the wind farm is put into operation.

During the three steps of the application, the Danish Energy Agency keeps all other relevant authorities informed and, if necessary, consulted. From the applicant's point of view, this approval system implies the one-stop shop.

The open-door approval also includes approval of the so-called coast-near wind turbine facilities. For the wind turbines located close to the coast, special rules apply: A municipal council may object to the approval of permission to conduct a preliminary investigation for offshore wind turbines planned to be located up to 8 km from the municipality's coastline.

Summing up on offshore wind turbines

Approval of offshore wind turbine plants may take a long time. It can take up to 4-7 years in Sweden and even longer in, for example, Denmark. The reason for the relatively long decision-making period is due to the fact that many stakeholders has to be involved in the decision-making process. This is also related to the fact that a number of different national governmental authorities have to be involved in the decision-making process together with the municipalities.

There are in particular two factors that need to be emphasized on the basis of Swedish regulations and experience. Project approval has only to run through five decision steps, and it is possible through dialogue with stakeholder and in cooperation with the authorities to shorten the process and make it easier to establish wind turbine projects.

The Danish approval system contains - as it appears - only three decision steps. This makes the process more manageable together with the one-stop-shop principle, but the practical experience shows that it has not led to a faster approval system of offshore wind turbines.

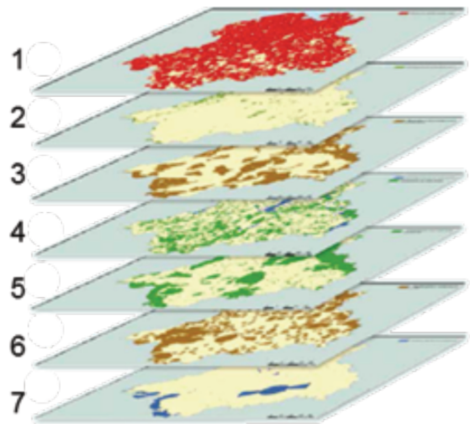
5.6. Onshore wind turbines

Project partners who have chosen to answer this technology are: **Finland** (Regional Council of Central Finland), **Germany** (Ministry of Energy, Infrastructure and Digitalization Mecklenburg-Vorpommern), **Poland** (Regional Office for Spatial Plan-ning of Westpomeranian Voivodship) and **Denmark** (Department of People and Technology, Roskilde University).

Wind turbine onshore planning in Finland, Germany and Poland has in general a large number of regulation and procedures. Mecklenburg-Vorpommern has this well-developed procedure involving the private sector, municipalities and federal / state government - where everyone must make a statement. At the same time, it seems as if the spatial planning process in Mecklenburg-Vorpommern approach is based on an exclusion criteria, where terms like »here under no circumstances«, describe one of the first step in the procedure of planning criteria and methods designating suitable areas.

Figure 13. Planning criteria and methods for designating suitable areas for wind in Germany.

Planning criteria and methods for wind in Germany



Legend:

- **1 - Residences with distance zones**
- **2 - Priority areas according to the Regional Spatial Development Programme**
- **3 - Landscapes that are particulary worthy of protection**
- **4- Forets and waters**
- **5 - Protected areas according to the nature conservation law**
- **6 - Breeding sites for birds with distance zones**
- **7 - Areas with restrictions on building**

Hoffmann, G., Mossbauer, M., and Grünes, J. 2017, Ministry of Energy, Infrastructure and Digitalization Mecklenburg-Vorpommern.

In Finland, there is four most significant criteria for planning and methods designating suitable areas which is: Land use of the area and its surroundings, environmental issues, grid connection possibilities and land lease agreements which seems simpler than the Mecklenburg-Vorpommern approach.

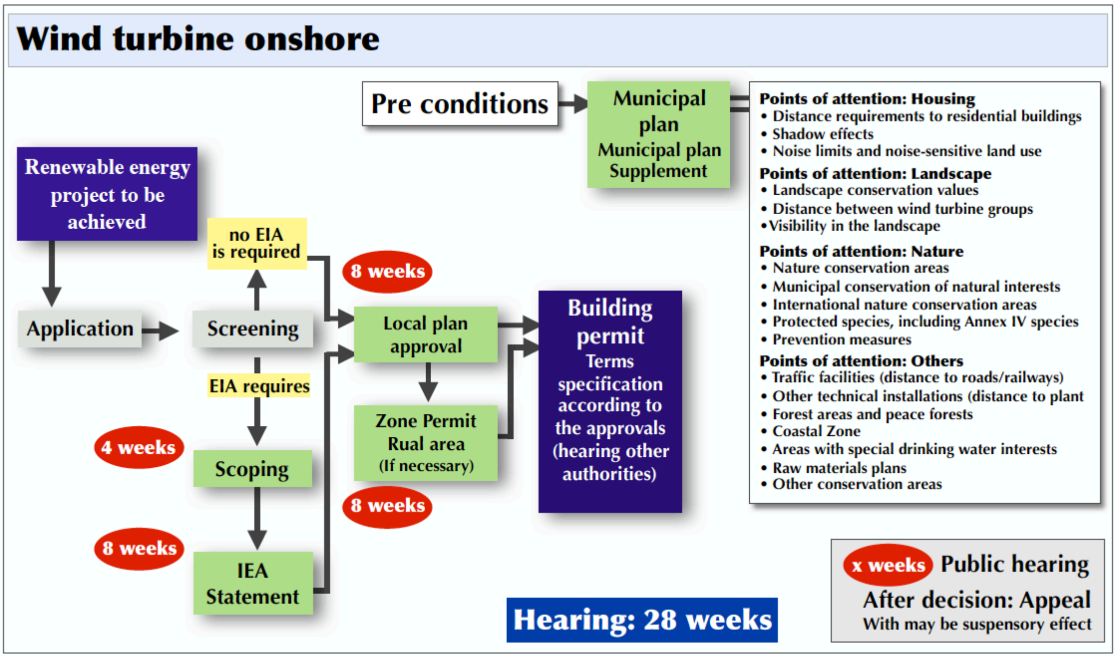
In Mecklenburg-Vorpommern in Germany takes the spatial planning for wind turbine development based on in a precautionary principle, wishing to avoid disturbances and disruptions caused by wind turbines as early as possible in the planning process.

It is considered where wind turbines should not be allowed and where they cannot be excluded as the first step, which results in a list of criteria for the area selection (see figure 13 at previous page). Due to this approach, only a small proportion of the area is suitable for wind farms (< 1%). However, in some cases, deviations from the procedure may occur if there are one or more good reasons.

The list of criteria is prepared by the State Spatial Planning- and Nature Conservation Authorities, which the Ministry of Energy, Infrastructure and Digitalization Mecklenburg-Vorpommern suggests these criteria as a recommendation to the four Regional Planning Associations. This ensures a consistent approach throughout the federal state Mecklenburg-Vorpommern. (Hoffmann, G., Mossbauer, M., and Grünes, J. 2017, Ministry of Energy, Infrastructure and Digitalization Mecklenburg-Vorpommern).

In Denmark: When establishing onshore wind turbines, careful consideration should be given not only to the opportunity to exploit the wind resource, but also to neighborly housing, nature, landscape, cultural heritage values and to the particular agricultural interests. Onshore can only be established turbines with a total height of up to 150 meters (apart from test mills). The Danish planning process is described in the figure below:

Figure 14. Planning process and criteria for onshore wind-turbine in Denmark.



The consultation period for onshore wind turbines is shorter than other renewable energy plants, only 28 weeks. (Compare figure 10 with the above figure 14). However, it is a prerequisite that the municipal contains specific wind turbine location plans. If the municipal plan does not contain these wind turbine plans, a supplement must be prepared for the municipal plan before the approval process can be started, see the preconditions on the above figure.

The specific wind turbine's location plans included in the municipal plans has to be based on a number of so-called ***attention points***, namely housing, landscape, nature and a number of other attention points (traffic facilities, technical installations, forest, coastal zone, plans for mineral extraction, etc. These attention points are very similar to those from Germany (see Figure 13).

Summing up on onshore wind turbines

A typical point of view, often put forward by project developers is a desire to know in advance all conditions and requirement. In this way, project developers can avoid waste of time and money, and developers can focus on the projects that can be implemented.

This issue could be addressed in the approach presented in the spatial planning process in Mecklenburg-Vorpommern, and should be applicable for a number of different requirements that the authorities can foresee for a given location.

Of course, it cannot be applied to all criteria, but only for criteria that can be determined immediately as mandatory criteria. However, a number of criteria arise along the decision process.

It is characteristic for the methodology of in the EU rules for environmental impact assessment (EIA) that the criteria arise under the process. First through the screening, then through the initial consultation (scoping), see at the review and public hearing of the EIA document and at the approval, especially if the decision raises further assessment requirements.

6. Conclusion and recommendations

6.1. Conclusions

The purpose with this assignment (WP 2.1) has been the collect information on spatial planning criteria, conflicts and methods and information on the interaction (positive or negative) between spatial planning and promotion of renewable energy projects.

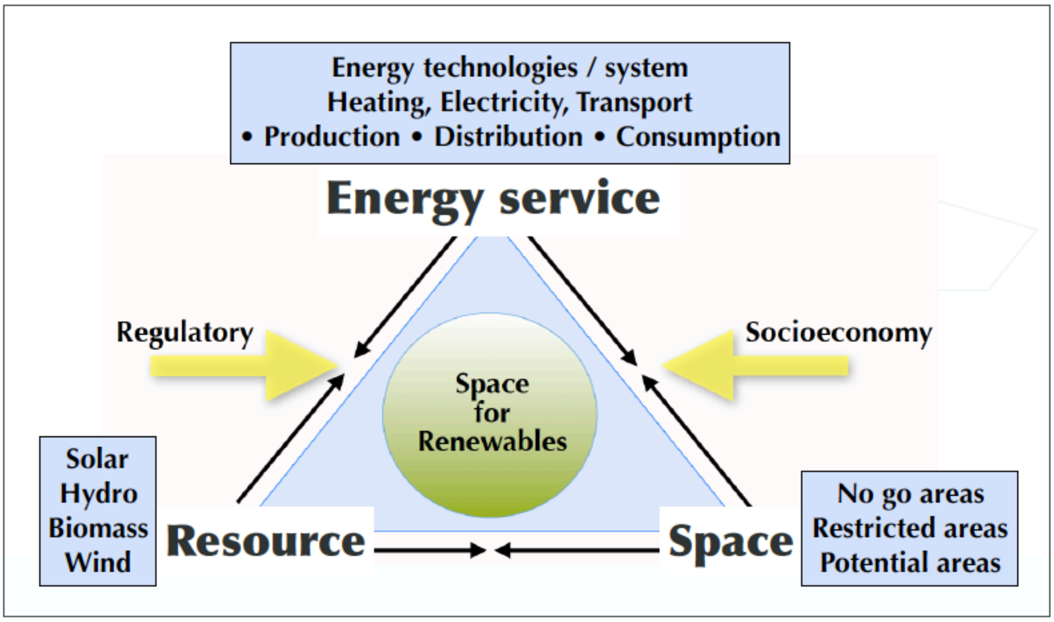
The main focus is on renewable energy and on how the implementation of renewable energy can be supported by spatial planning. Therefore, this report deals with the regional and/or government regulation and methods on spatial planning for implementing renewable energy sources that replace energy production based on fossil fuels.

The study is based on three main elements. Firstly, the understanding the territorial dimensions of the relevant renewable energy sources (chapter 3). Secondly, the basic planning criteria, which are divided into three issues, namely the renewable resources, technology and technology systems, as well as the spatial dimension, that is area and location (chapter 4). Thirdly, the regional analysis of the technologies chosen to illustrate national framework conditions and requirement in the partner countries (Germany, Sweden, Finland, Estonia, Latvia, Lithuania. Poland and Denmark).

It's hardly wrong to say that the empirical material (the section above) indicates complicated spatial planning processes in all the participating regions of the project. The general picture of state of play in the project-countries is that the regulatory regime consists of an elongated step-by-step decision-making process, resulting in a relatively long approval process with great uncertainty about the outcome for the involved investors and stakeholders.

However, the review of spatial planning also shows that different types of modernization are on its way and these modernizations can ensure greater transparency in planning and a greater degree of dialogue and public involvement in the spatial planning, related to implementation of renewable energy. The main results can be summarized by the use of the following figure:

Figure 15. The dynamic interaction between resources, energy service and space.



The figure shows an important interaction between the three elements. None of the three elements can be determined or planned independently. Take for example the resources: The renewable energy resources are distributed and must be utilized where they are situated or generated. The bio-resources may be transported to a certain extent, but the geo-resources cannot; they must be used where they arise or where they are generated.

On the other hand, the renewable energy resources cannot be considered independently of the spatial conditions. There will be areas or spaces where it will be impossible to place renewable energy plants, for instance no-go-area (Nature 2000) or restricted areas (housing areas). It is necessary to ensure an interaction between resources and space. As pointed out in chapter 4 the renewable energy technologies have different spatial requirement. For instance, large wind turbines could produce nearly 36,000 MWh per year per hectare; biogas plant may produce around 15,000 MWh on at space of one hectare, and photovoltaic park around 760 MWh per year on at site of one hectare.

Even with the best interaction between resources and placement will not necessarily represent the optimal solution. It is also necessary to involve the desired energy service and the function of the local energy system in the two others issue: resources and space.

The review of the planning experiences and conditions for the various resources and technologies (Chapter 5) shows a high degree of complexity. It cannot be ruled out that the planning process my contributed to creating conflicts that do not only related to the renewable energy sources as such, but also related to the function of the planning system itself.

Based on the analyses and assessments carried out, it can be concluded that there is a need to develop a planning system that can ensure a dynamic interaction between the three major key components - resources, technology and space. This conclusion shall form the basis of the following recommendations.

6.2. Recommendations

Our energy systems have undergone a major change. At the beginning - 10-20 years ago - the question was: How can renewable energy sources be successfully integrated into the existing fossil energy system? Now it is more relevant to ask how to develop an energy system fully based on renewable energy?

It is not any longer a matter of integration, but a matter of the formation of a comprehensive renewable energy system. It requires long term thinking with a long-term planning perspective in order to avoid bad investments, and slow-going transition to renewable energy, etc.

The ***first recommendation*** will be: Develop a comprehensive and long-term perspective on the specific renewable energy investment. Will the specific project contribute to an overall transition process? Will it be a part of the future energy system?

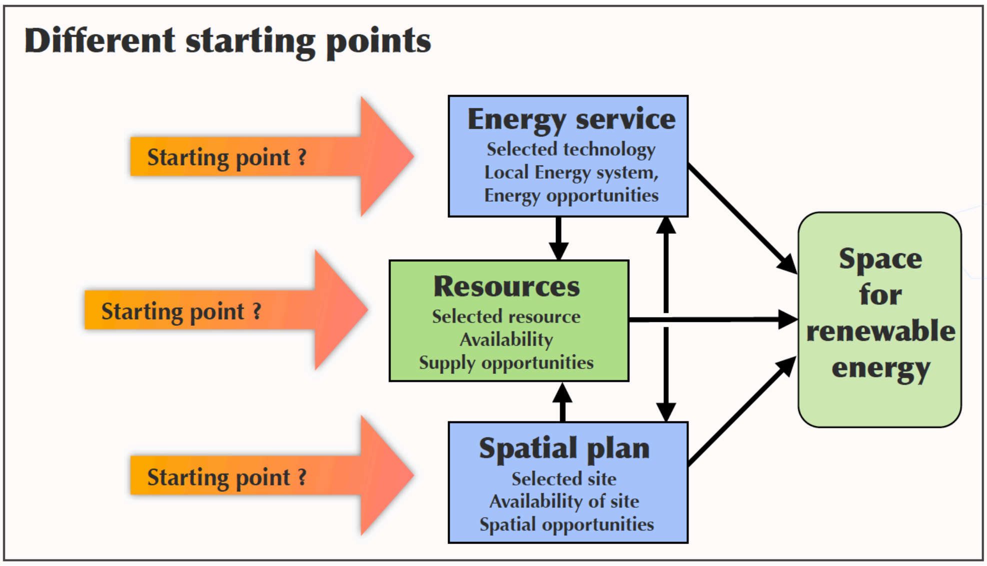
It is necessary, as mentioned in the summary, to create a dynamic interaction between the three main components: resources, the energy system and spatial planning. This interaction will depend very much on the specific context.

If a new residential area is planned, it will be natural to ask how the new buildings could be constructed to reduce energy consumption and develop the area's self-supply - for example - combining different small-scale energy sources. If, however, to task is to establish a large wind-power generation unit, the interaction between spatial planning and energy plans will have to start with assessment of the optimal wind turbine site, and then assess the spatial opportunities.

The ***second recommendation*** will be: Establishment of a dynamic interaction between resources, energy technology and spatial planning.

This recommendation seeks to formulate some new principles for spatial planning and integration of spatial planning and planning for implementation of renewable energy. The recommendations for spatial planning should be based on problem-oriented approaches or problem-orientated opportunities, which the partners in the project decided at a partner meeting in Finland in 2017. The dynamic principles can be illustrated with the following figure.

Figure 16. Formulating new principles for the spatial planning, related to implementation of renewable energy.



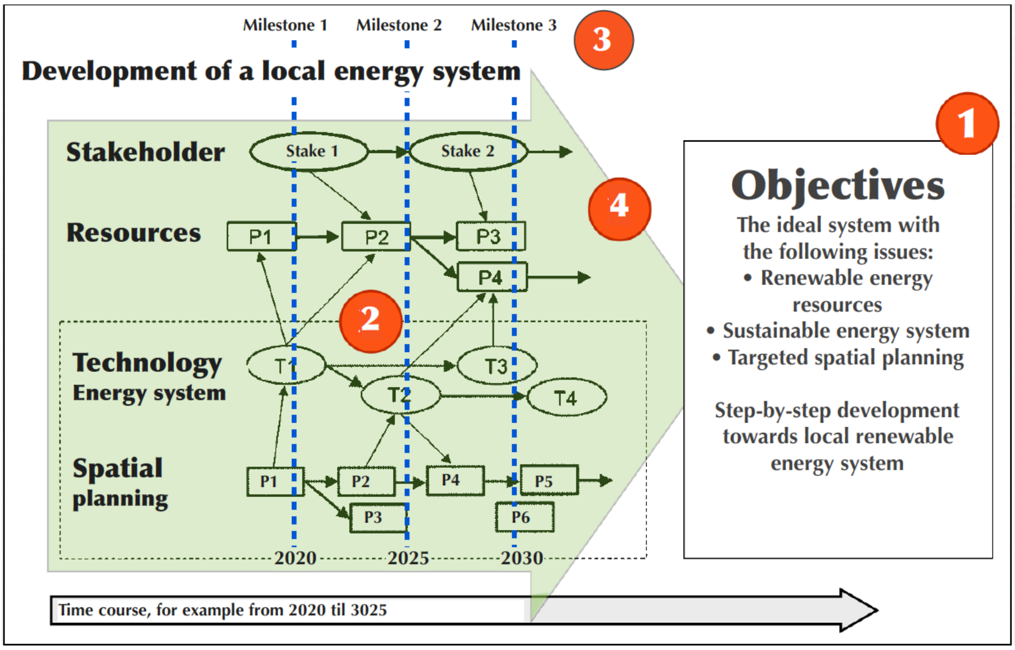
The figure should illustrate that you can have different ***starting points***. It will depend on the problem and the opportunities you are working on. In some case it will be necessary to start with the resources, then you could turn toward the spatial planning and afterwards focus on the energy system. Or, perhaps, the starting point is a desired local energy system. Once determined, you could work on the renewable resources and then spatial planning.

The dynamic interaction is about a thematic interaction, but especially about an interplay between stakeholders representing the different elements. The questions might be: Which stakeholders does already exist? How can different groups be involved? Energy stakeholder, city stakeholder, utilities, local politicians, interest groups, etc. What advantage will the different stakeholders achieve through the socio-economic benefits?

If the starting point is a desire to change the entire energy supply to renewable energy when the possibilities allow it, then it may be an idea to involve stakeholders in a more systematic and long-term approach. One possibility for this is to establish a ***roadmap*** changing of the local energy system.

The ***third recommendation*** will be: Development of a dynamic interaction through involvement of stakeholders and interest groups. One way to do that is by setting up a roadmap as illustrated in the following figure 17 below.

Figure 17. Formulate a long-term program by using the roadmap concept with at least four topics: Stakeholder, resources, technology and energy system and spatial planning.



The numbering in the figure indicates a typical course in preparation of the roadmap, which consists of four main parts: (1) Objective: The start consists of formulating a goal or vision for the development of renewable energy. involving the whole community.

The next step is: (2) Selection of themes: In order to reach the goal, you have to back-caste from the goal for instance in 2030 to the present situation and asks the question: Where are we now? What is needed to achieve the goal? Which themes are important for stakeholders, renewable resources, energy system and spatial planning. Other themes can of course be added. The arrows on figures show a series of relationships between the chosen themes that need to be further developed in order to create the dynamic interaction between the various issues.

The third step is: (3) Milestones: Milestones are intended to divide the activities and the development efforts into a number of bids. The fourth step is: (4) Roadmap: Based on the objectives, development themes and milestones, a comprehensive roadmap can now be formulated.

7. References

This reference list includes the documents that the project partner has prepared in connection with the collection of information topics on the spatial planning criteria:

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Roose, A., Tartu Regional Energy Agency, »Photovoltaic power station, State of play in spatial planning for renewable energy«, 2017.

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8. Appendix

8.1. Template: State of Play in spatial planning for RE-technologies

BEA-APP
BALTIC ENERGY AREAS
A PLANNING PERSPECTIVE

BEA-APP: WP 2

Template

April 2017

State of play in spatial planning for renewable energy:
RE-technology:

1. Project partner *Fill in project partner name, number and contact information (e-mail).*
2. Selected technology *Write a short description of the technology (see list in template instructions).*
3. The spatial planning process *Description of the spatial planning process, by one of the following options:* *A short text description – step by step* *A flow diagram* *A Gantt diagram showing the sequence and time consumption* *The description can be based on general experience or be based on actual experience (construction process).*
4. Levels of government *How is the authority division of the various decision steps, mentioned above in the description of the spatial planning process?*
5. Planning criteria and methods for designating suitable areas *Describe the planning criteria and methods employed in designating areas suitable for the specific renewable energy sources under study.* *Describe whether your country has a negative approach or positive approach to planning for renewable energy, i.e. start your country with a planning approach to investigate what you cannot do - or do you in your country start with investigate what is possible.*
6. Typical conflict related to the selected technology *Specify the typical conflict related to the specific technology and to the different steps in the spatial planning process.*
7. Interaction *Describe the typical interaction between the spatial planning process and the promotion of renewable energy. Does the spatial planning promote or hinder? Does the spatial planning improve the renewable energy project?*
8. The regulatory framework *Brief description of the legal framework.*

8. Appendix
8.2. Template: Online questionnaire – State of Play of RES – page 1

Template WP 2.1

Instructions

State of play in spatial planning for renewable energy

This is instructions on how to fill out the additional WP 2.1. template. The purpose of these is to make one supplement the previous questionnaires. These should provide an overview of the planning criteria for the five selected renewable energy technologies.
Since we decided at the meeting in Kaunas that all partner should fill out templates for each of the five RE technologies (Biogas, Wind (offshore and onshore), Solar (in park and on roof) and Biomass to district heating) that were selected at this meeting, this is instructions for these templates.

Based on the previous questionnaire fore WP 2.1. we have chosen to simplify the templates, but we still know that there is a big difference between the different technologies and therefore is important that you complete a questionnaire for each of the five technologies. The technologies have different influences and relationships in the spatial dimension. This means that it may be useful to examine the spatial planning process, broken down by main types of technologies. Therefore, you will first have to choose which technology you want to answer this theme. It is expected that you respond to all the five selected technologies and therefore sending five templets back to RUC.

The questionnaire is structured so that you will not be able to proceed to the next question before answering the question on the current page. This also means that on several pages where there is room for writing a paragraph, you will have to e.g.: "-" or "0" in text box if you do not have anything else to add, so you can move on to the next question.

Insert name, number (PP) and contact information (e-mail) for the project partner filling out the template:

____
____
____
____
____
____

8.2. Template: Online questionnaire – State of Play of RES – page 2

Please select a technology from the list below, for which to fill out this template:

(1) ❑ Biogas
(2) ❑ Wind turbines (onshore)
(3) ❑ Wind turbines (offshore)
(4) ❑ Biomass District Heating
(5) ❑ Solar installations in the park
(6) ❑ Solar installations on a roof

In the following answers, explain the importance of a number of possible requirements for establishing the chosen renewable energy source. What is the meaning of physical relationships and legal issues, this concerns the next few questions.

How do you think that one prioritizes the requirements for the chosen renewable energy source, relative to the physical resources?

(1) ❑ Resource availability important
(2) ❑ Medium
(3) ❑ Resource availability not relevant

How important is the requirement for the RE-source of integration into the energy system?

(1) ❑ Important
(2) ❑ Medium
(3) ❑ Not relevant

8.2. Template: Online questionnaire – State of Play of RES – page 3

How are the criteria for establishing renewable energy plant or facility in relation to legislation?

	Yes	No
Are the local terms and conditions the most important?	(1) ❑	(2) ❑
Is there a possibility to apply for a dispensation with local authorities?	(1) ❑	(2) ❑

Criteria from legislation:

	Yes	No	
Are there other authorities' requirements? If yes, which?	(1) ❑	(2) ❑	_____
Are there mandatory requirements? If yes, which?	(1) ❑	(2) ❑	_____

Requirements arising in the (EIA) process:

____
____
____
____
____
____

Thank you for your reply.
Roskilde University