Advancing Public Participation and stakeholdeR engagement
fOr the improVement of renewable Energy policies

# REPORT ON GAPS, NEEDS AND CHALLENGES

*September 2019*

Territorial partners


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# INTRODUCTION

**ABOUT APPROVE**

Since the adoption of RES Directive in 2009, most Member States have experienced significant growth in renewable energy production and consumption, and both the EU and a large majority of Member States are on track towards the 2020 RES targets. At the same time the cost of energy from renewable energy sources has decreased significantly and the performance and market penetration of these sources has increased. Nevertheless, there is still a lot of market potential to be exploited. This potential is recognised in the "Clean Energy for all Europeans" package adopted at the end of 2016, which sets renewable energy targets for 2030 and introduces modifications in the energy market design, while empowering individuals or communities to participate actively to the energy system transformation. Furthermore, in June 2018 member states agreed to set an overall EU renewable energy target of 32% by 2030. Challenges exist for renewable energy to realise its full potential in all sectors and accelerate the clean energy transition, playing a crucial role in leading to an increased share of renewable energy consumed in the EU and to a more active role for the consumers.[1]

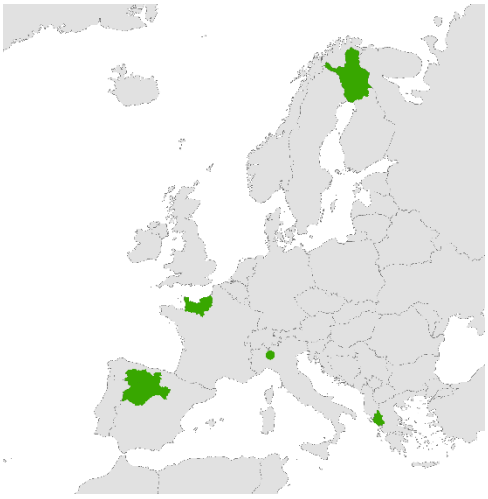
The Interreg Europe project APPROVE tackles barriers to the development of **Renewable Energy Sources (RES)** such as:

- low level of knowledge in the general public,
- lack of expertise of RES proponents and civil servants dealing with permitting procedures
- issues of public opposition within approval procedures.

In line with the revised Renewable Energy Directive, APPROVE considers **awareness raising, capacity building and stakeholder participation** as ways to enable and promote RES.

The project will lead to the improvement of **4 Structural Funds operational programmes** with the aim to promote RES development, considering investment priorities related to TO4 “Supporting the shift towards a low-carbon economy in all sectors”, and addressing regional innovation strategies for smart specialisation.

The partnership is composed by **3 regional authorities** (Regional Council of Lapland, Region of Epirus, Normandy Regional Council)**, 1 regional energy entity** (Regional public energy entity of Castilla y León)**, and a research centre** as advisory partner (Poliedra)**, covering 5 countries** (Finland, France, Greece, Spain, Italy).



Through interregional cooperation, the territorial partners will identify, share and transfer good practices to improve their policy instruments. Such interregional learning process interests the partners and **groups of regional stakeholders** that are involved throughout the life of the project.

[1] https://ec.europa.eu/info/funding-tenders/opportunities/portal/screen/opportunities/topic-details/lc-sc3-res-28-2018-2019-2020

**ABOUT THIS REPORT**

The aim of this report is to **analyse and compare the territorial situation** of the regions involved in APPROVE as regards the specific contexts and the RES development status and policies with a focus on the specific themes addressed by APPROVE. Knowing better and sharing with the APPROVE partnership and with the regional stakeholder groups the issues that characterise each region is an essential step of the interregional learning process, since it will allow to focus together on the aspects that need to be improved and to guide the search for good practices to be transferred and adapted from one region to another.

The report has been fed by four regional reports produced by the territorial partners with the methodological support of the advisory partner. Such reports have been developed on the basis of a template (see Appendix) that required to provide both short qualitative information and quantitative indicators. The level of completeness and detail of the regional descriptions is not homogenous, reflecting the different availability of data and analyses that the project partners could count on and the different degree of experience in the field of renewables. When possible, the partners have involved their respective regional stakeholder groups in the preparation of the report, integrating multiple information sources and points of view.

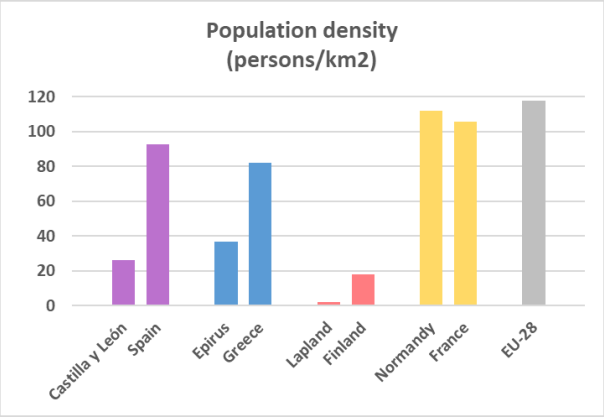
The produced regional reports are included in the **REGIONAL ANALYSES** chapter of the present report.

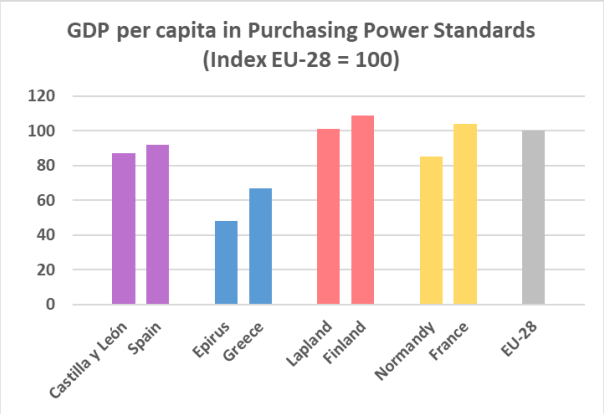
The chapter **OVERVIEW OF PECULIARITIES AND COMMON ISSUES OF THE APPROVE REGIONS** introduces the main characteristics of the regions and highlights some of the most interesting elements resulting from the regional analyses.

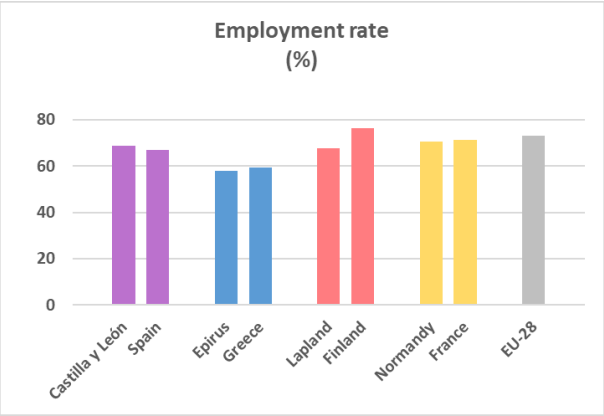
# OVERVIEW OF PECULIARITIES AND COMMON ISSUES OF THE APPROVE REGIONS

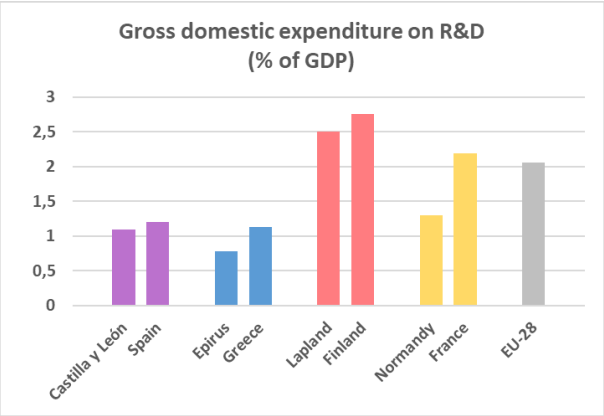
The APPROVE partner regions (with an area ranging from 9.203 of Epirus to 100.366 km² of Lapland) have **very different geographical, demographic and economic characteristics**, as can be seen from the following pictures, showing the population density, the gross domestic product (GDP) per capita in purchasing power standards, the employment rate, and the gross domestic expenditure on R&D (GERD).

Such indicators are reported both for the regional level and the respective national level. The average value for the Member States of the European Union (EU-28) is also shown for comparison. The source of the national and EU data is Eurostat, year 2017 (with the exception of employment rate, 2018). The regional data were provided by the APPROVE partners as the most recent data available (2015-2017).



A regards the level of **development of RES**, it is possible to characterise in a nutshell the four APPROVE regions as follows:

- Castilla y León is the Spanish region with the most wind and hydro power installed, interested in developing also the bioenergy and geothermal sectors;
- Epirus is a mountainous region rich in natural resources with a large potential in hydro and a farming sector that could allow the development of bioenergy;
- Lapland is an arctic sparsely-populated region with high technical potential in the bioenergy, wind and hydro sectors; it has a regional decentralised renewable energy plan;
- Normandy has a heterogeneous territory with a potential in the wind and biogas sectors and is the first French region in the wood energy sector; it has regional wood energy and biogas programmes.

Lapland and Castilla y León lead the Smart Specialization Bioenergy Partnership[2].

*Solar thermal panels on an hospital roof in Ponferrada - León, Castilla y León (EREN)*

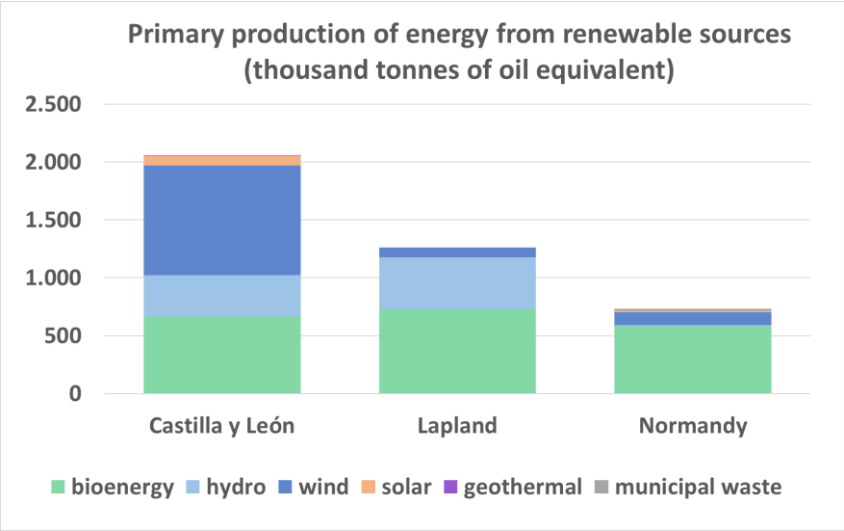
*Liapatis biogas plant in Epirus (Lliapatis photo gallery)*

*Stora Enso paper mill in Lapland, producing its own energy (Lapland Material Bank)*

*Wind turbines in Normandy (Stéphane Lobbedey)*

[2] https://s3platform.jrc.ec.europa.eu/bioenergy

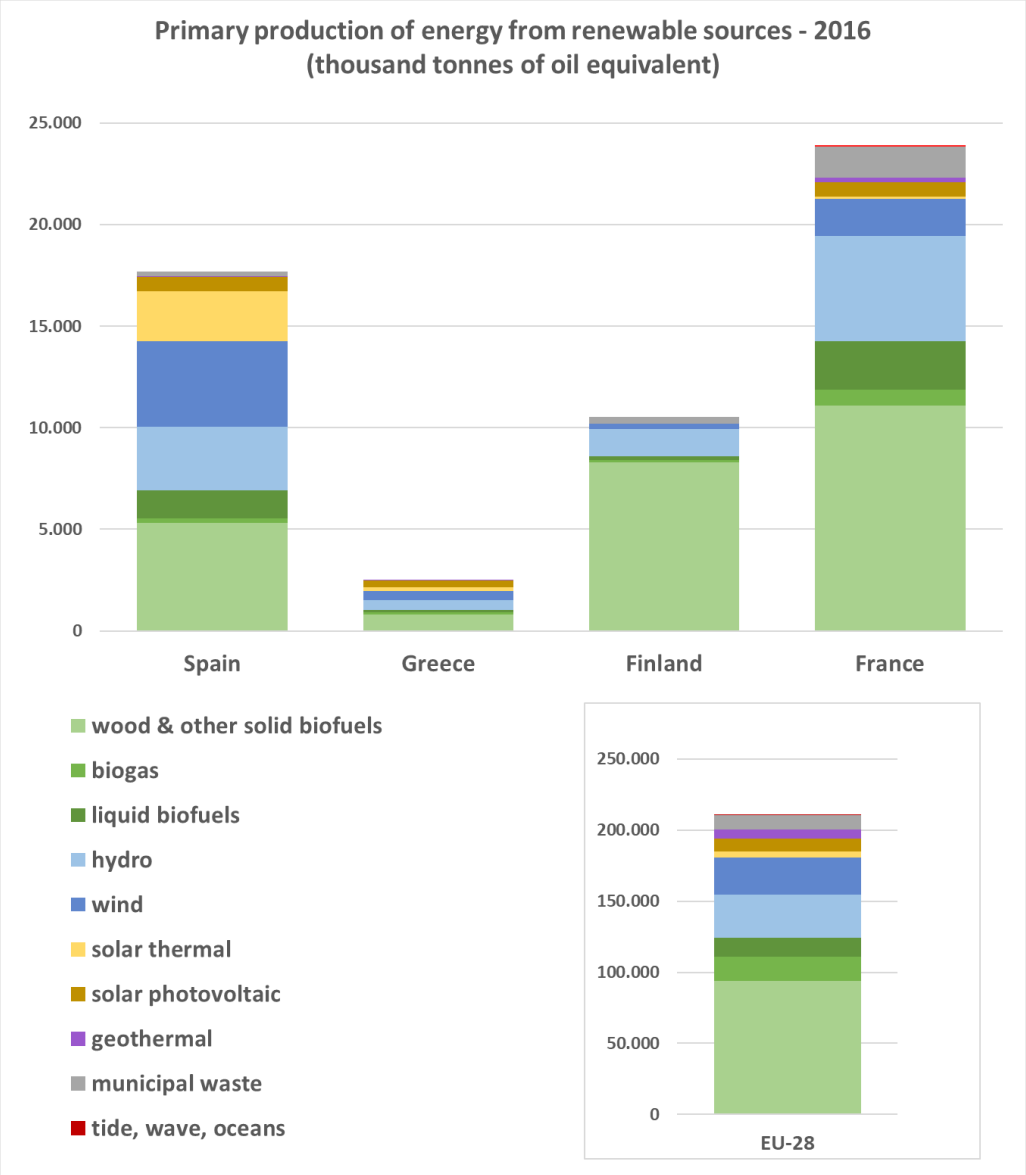
In the **REGIONAL ANALYSES** chapter, it is possible to find some partial data about the regional situations provided by the APPROVE partners, but such data are not complete nor homogeneous. In the following, we propose a selection on them for comparison purposes. The data concern the mix of renewable sources in the production of primary energy, the RES share in gross final energy consumption / in electricity generation / in heating and cooling / in transport, the Installed capacities for electricity generation. Regional data for Epirus are not available.



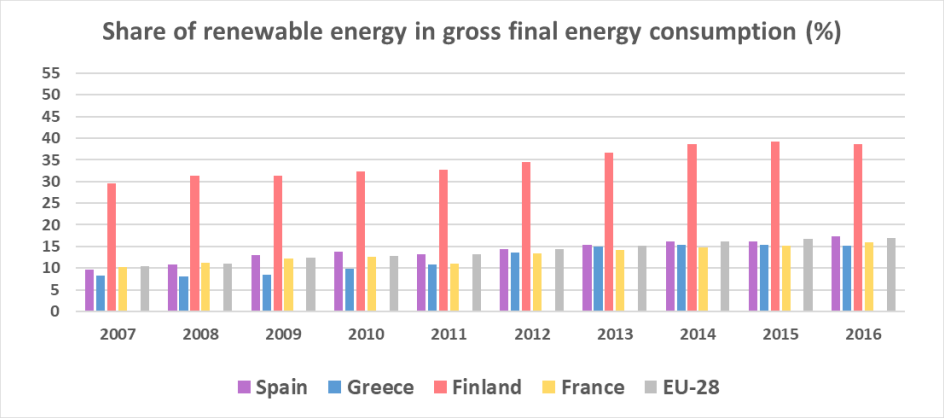

*Castilla Y León 2015 (thermal) - 2017 (electricity), Lapland 2017, Normandy 2018*

| | Castilla y León | Lapland | Normandy |
|---|---|---|---|
| **RES share** | In electricity generation: 65,1%<br>Heating and cooling of buildings: 21,1%<br>Biofuels in transport: 4,55%<br>*(2017)* | RES in district heating: 80% *(today)*<br>Share of building floor area heated via RES and electricity: 75% *(today)*<br>Biofuels in transport: 12% *(2017)* | In gross final energy consumption: 8,1% *(2014)* |
| **Installed capacities for electricity generation** | Biogas & biomass: 47 MW<br>Hydro: 4.401 MW<br>Wind: 5.591 MW<br>Solar photovoltaic: 495 MW<br>*(2017)* | Hydro: 1.000 MW<br>Wind: 265 MW<br>*(2017)* | Biogas: 23 MW (co-management only)<br>Hydro: 50 MW<br>Wind: 670 MW<br>Solar photovoltaic: 130 MW<br>*(2017)*<br>Solid biofuels (wood): 250 MW - hybrid heat and electricity<br>*(2018)* |

As an integration to the partial data seen above, it can be useful to look at the Eurostat data available for the national level. The following picture shows the data on primary production of energy from renewable sources, **year 2016**.




The following pictures show, again at the national level, the dynamics in the period **2007-2016** as regards the share of renewable energy in gross final energy consumption, in electricity, in heating and cooling, and in transport. In all countries it is possible to see the increasing trend, with the exception of the share in transport, where the less stable trend reflects the evolution of sectors such as liquid biofuel, hydrogen and biomethane.


Share of renewable energy in gross final energy consumption (%)
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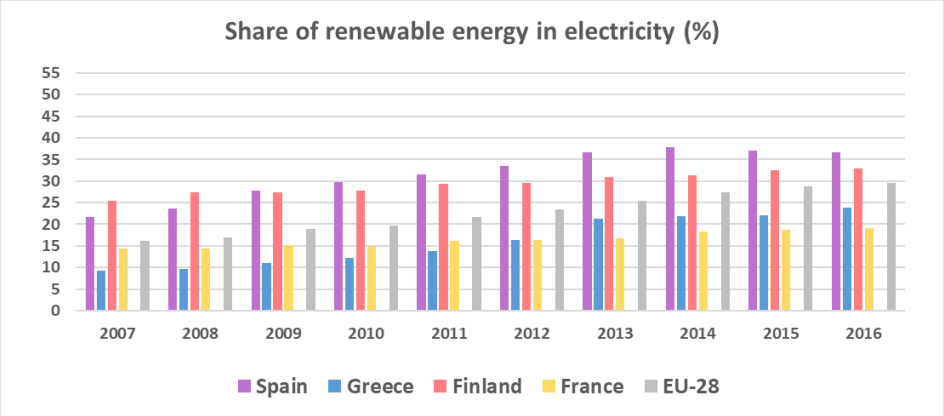
Share of renewable energy in electricity (%)
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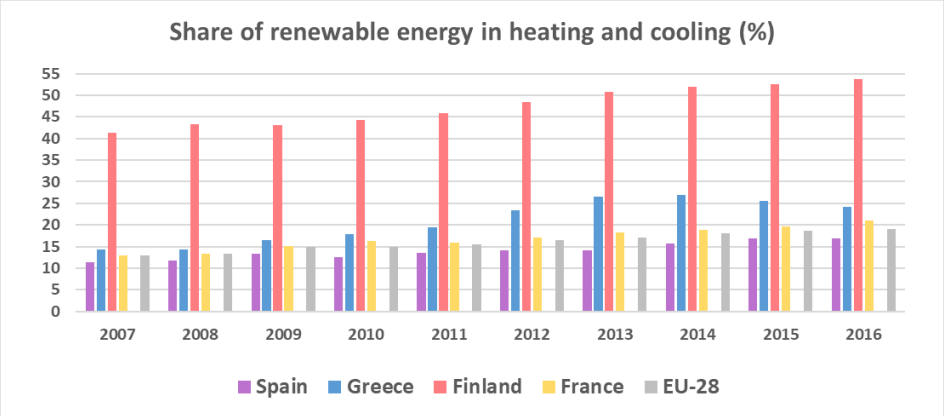
Share of renewable energy in heating and cooling (%)
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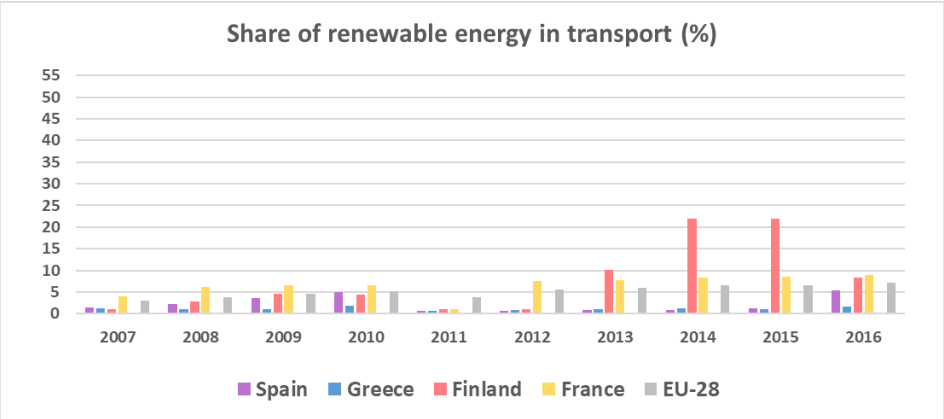
Share of renewable energy in transport (%)
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When asked about the main barriers to RES (besides the technological/funding ones), **opposition of the public and specific stakeholders** to new RES plants results the most cited in the regional analyses, with the following comments.

| | |
|---|---|
| Castilla y León | especially **wind** (instances by conservation groups especially about avifauna, by managers of potentially impacted public forests, by real estate developers) and **hydro** (instances by conservation groups about endemic species, ecological flow, visual impact) but also **district heating** (instances by local population about risks on air quality, resistance of fossil fuel gas company and natural gas installers) and large **biomass** power generation plants (instances by conservation groups about potential risk of local deforestation and impacts on air quality) |
| Epirus | especially **wind** and **biogas** projects (also for risks of accidents), limited availability of adequate sites (since 40% of Region's surface is represented by protected areas), general fear of new technologies among the aging residents of small settlements |
| Lapland | especially major projects of **wind** plants (perceived as a potential threat for traditional livelihoods, tourism, quality of life of the local residents) and **hydro** (biodiversity conservation instances, land use conflicts) |
| Normandy | especially **wind** (visual and environmental impact) and **biogas** projects (fear of smell propagation, and at some point, increase in road traffic) |

Some partners underline also the following aspects:

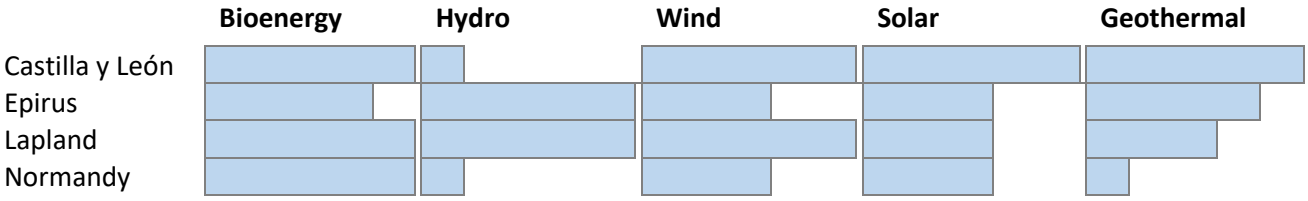
- RES projects are not perceived as contributing enough to the **local economy** / there is a lack of benefit for the local population;
- there is a **poor communication** from owners and developers towards the public authorities in the early stages of the projects / elected official protest against the way wind farm developers contract directly with land owners before consulting the local public authorities;
- permitting procedures do not allow a correct exchange with the locals / **public consultation** remains low since it comes up at the end of the project, once it has been decided and the project launched; the flexibility of the project remains low at this stage of the project and the public opinion has a weak impact / some difficulties in managing the complexity of the involvement of many stakeholders and their contributions;
- lack of adequate **data** that can support regional/local authorities to embark on their energy transition.

As regards the level of **awareness about RES among the general public**, Lapland evaluates it as high, Epirus indicates a diffused scepticism, Normandy indicates a mixed situation (depending on type of energy, size of the community, methods employed to promote and inform about RES), in Castilla y León it can be seen some prejudice among the general public about the link of RES projects with “obscure business interests” (not so for photovoltaic self-consumption systems).

As regards the **level of knowledge/skills of potential proponents**, generally a mixed situation is perceived. Normandy indicates that it is getting improved due to the implementation of committees gathering different types of actors and an active communication between stakeholders involved in funding of RES projects.

The following picture shows the declared degree of regional interest as regards the different RES types, according to the territorial characteristics and the existing and foreseen policies. Bioenergy results to be globally the most interesting type for the APPROVE partnership.

**DECLARED DEGREE OF REGIONAL INTEREST**




When asked to focus on the type of RES with the highest degree of interest, Lapland and Castilla y León chose **bioenergy** in general, with particular attention to **wood** and thermal uses, while Epirus and Normandy focused on **biogas** (in the case of Normandy this is also due to the high level already reached for wood energy). The following main issues emerge from the regional SWOT analyses, besides public opposition and funding aspects. Among the threats, both Lapland and Castilla y León cite also the future of bioenergy in RES accounting (zero-emission status in EU's climate rules).

| | | |
|---|---|---|
| Normandy | **BIOGAS** | - Immature structure of the biogas sector (lack of organisation of the supply chain, lack of stakeholders – e.g. equipment traders)<br>- Dimension of projects related to economic rentability (current economic conditions encourage project developers to size them bigger to achieve acceptable profitability; thus, they also need more funds to invest)<br>- Passiveness in public authorities (generally there is no strong support)<br>- Slowness in project engineering (due to several factors: farm inputs availability, authorizations for the spreading zone, solidity of the project and its financing; then the administrative procedures are quite heavy for project holders)<br>- Possible raw material competition when there are many projects in the same area |
| Epirus | | - Existing electricity transmission lines inadequate to accommodate new RES developments, although a modernization of the transmission system is foreseen by the National Power company plans for 2017-2026<br>- Legislation should be simplified |
| Lapland | **WOOD** | - Forest management of private-owners is sporadic and lacking<br>- Lack of demand for fuelwood especially in sparsely populated areas where the supply would be the best<br>- Long transportation times and forest roads in bad condition<br>- Competing land-use claims (tourism, agriculture including reindeer herding, mining, etc.)<br>- Lack of capital for building new decentralised plants in remote areas<br>- Relatively lower value of forest land (forest-owners do not manage their forests leading to lower amount of forest side streams to be used in bioenergy production) |
| Castilla y León | | - Forest roads in bad condition<br>- Low educated work force with good knowledge of forest management practices |
| | **OTHER** | - Almost absolute disinterest in the energetic use of livestock waste<br>- Scarce development of biofuels marketing network |

# REGIONAL ANALYSES

## CASTILLA Y LEÓN (SPAIN)

### REGIONAL FACTS

**Basic geographical, demographic and administrative characteristics of the region**

The autonomous community of Castilla y León has a land area of 94.224 km$^2$ (the largest in Spain). The region is divided into 9 provinces.

Castilla y León borders with nine other Spanish autonomous communities and with Portugal, making this region a major centre of communication in Spain and strategically located on the north axis of the country and the south-west of Europe.

From the demographic point of view, Castilla y León has a population of 2,41 million representing about 5% of the total Spanish population (Source: INE, Spanish Institute of Statistics).

The average population density in Castilla y León is 26 inhabitants/km2. The most population is distributed in the capitals of the 9 provinces and additionally 12 municipalities more have more than 10.000 inhabitants of population.

Given this considerable extension and population distribution, it is considered a sparsely populated region, particularly in rural areas. It has a total of 2.248 municipalities distributed throughout the entire geography; livestock, agriculture, mining and forest have determined the location and life of these municipalities.

The different industrial revolutions and the consequent urban development have motivated the progressive growth of cities, which in the 21$^{st}$ century means that 56% of the population live in urban areas.

This configuration was due to the growth of the industrial sector and services, located mainly in urban environments. However, Castilla y León continues to contribute to the whole of the Spanish national resources such as agricultural, industrial products or electricity production, extracted and distributed from the rural and peripheral areas from the region.

Castilla y León's administrative capital is Valladolid (which is the most populous municipality city), except for the authority in energy (Dirección General de Energia y Minas y Ente Regional de la Energía - EREN), which is located in León. The main industrial areas are Valladolid and Burgos.

The autonomous community of Castilla y León is governed by the “Estatuto de Autonomía” (developed by Organic Law 4/1983 approved by the General Courts of Castilla y León).

**Current and prospective economic structure of the region**

Castilla y León has suffered a transformation in its economic structure: the modernization has implied a loss of importance of the agricultural & farm sector and a process of tertiary transformation.

In the last 20 years, industry and energy have had an important and balance role, services have increased a little and construction has decreased.

| | Castilla y León | Spain[3] |
|---|---|---|
| **Land area**<br>*km2* | 94.224 | 505.990 |
| **Climate typology**<br>*Köppen climate classification[4]* | Csa, Csb[5] | Warm temperate |
| **Population density**<br>*inhabitants/km2* | 26<br>*(2017)* | 92,7<br>*(2017)* |
| **GDP per capita in Purchasing Power Standards (PPS)**<br>*Index (EU28 = 100)* | 87<br>*(2016)[6]* | 92<br>*(2017)* |
| **Energy intensity of the economy**<br>*kilogram of oil equivalent per thousand EUR* | NA | 115,0<br>*(2017)* |
| **Share of RES**<br>*% share of renewable energy in gross final energy consumption* | 65,1 electricity<br>21,1 thermal<br>*(2016)* | 17,3<br>*(2016)* |
| **Employment rate**<br>*% of the population aged 20 to 64* | 68,9[3]<br>*(2018)* | 67<br>*(2018)* |
| **Gross domestic Expenditure on Research and Development (GERD)**<br>% | 1,10<br>*(2016)[7]* | 1,2**<br>*(2017)* |

** provisional

## RENEWABLE ENERGY SOURCES DEVELOPMENT AND POLICIES

### Analysis of the regional situation as regards RES development

**Short relevant history of RES, status quo of RES production, different technologies and resources used**

Castilla y León is the Spanish region

- with more renewable power capacity, being 21,9% of the total
- with the most hydro power installed with almost 26% of the entire national power, since it has exclusivity in the Duero basin, the second most important in the Iberian Peninsula
- with more wind power installed capacity with more than 6000 MW, which means that Castilla y León could cover the 80% of the electricity demand of region with only wind energy.

Short relevant history of RES…

**Hydro**

The small hydroelectric plants managed by local companies were the initial method by which the towns and cities were electrified.

[3] Eurostat, https://ec.europa.eu/eurostat/data/database

[4] World maps of Köppen-Geiger climate classification, http://koeppen-geiger.vu-wien.ac.at/

[5] Castilla y León has a continental Mediterranean climate, with long, cold winters, with average temperatures between 4 and 7ºC in January and short, hot summers (19 to 22ºC), but with three months of summer aridity, as typical of the climate Mediterranean. Rainfall, with an annual average of 450-500 mm, is scarce, accentuating in the lower lands.

[6] https://ec.europa.eu/eurostat/documents/2995521/8700651/1-28022018-BP-EN/15f5fd90-ce8b-4927-9a3b-07dc255dc42a

[7] https://estadistica.jcyl.es/web/jcyl/Estadistica/es/Plantilla100/1284159004214/_/_/_ -- Goal for 2020: 1,50

Since the 1960s, electricity demand and interconnections have increased and the interest for such small hydro power plants has begun to decline, while large production plants, many of which hydroelectric, were preferred.

Since the mid-eighties there was a movement of recovery and creation of new small hydroelectric power stations that lasted more than a decade; the interest then decreased **due to long administrative procedures, the opposition of conservation groups and the lack of further profitable places**.

**Wind**

In Castilla y León the first installation dates from the beginning of the nineties and was a wind turbine of 150 kW located next to a factory of wind turbines in Medina del Campo - Valladolid.

The first wind farms were started with wind turbines from 300 kW in Soria and Burgos at the end of that decade based on a sufficiently generous feed in tariff system.

At that time, the first environmental problems began to appear, basically due to avifauna and the use of natural areas with some legal protection. These problems disappeared in general terms with the Wind Plan of Castilla y León where **environmentally inappropriate areas** for the development of wind farms were clearly established.

From that moment the development during the 1st decade of this century was spectacular, not only in installed capacity, as **second European region**, but also in industrial development, reaching more than 1.500 workers in manufacturing blades, multipliers, nacelles, carcasses, towers, brakes, etc.

In the last decade, as in the rest of Spain and due to the change of regulation, the new installed capacity and industrial employment have been substantially reduced.

**Solar thermal**

The development of solar thermal energy has traditionally been very moderate.

After the oil crisis in the seventies and eighties there was a kind of facilities ”bubble” that lasted almost 3-4 years but had no continuity due to the low quality of the facilities and the drop in oil prices.

At the end of the last decade (2007-2009) it became mandatory to install solar energy in the new houses (under certain circumstances) with the new technical building code.

However, at that time the construction of new houses suffered a spectacular fall. This fact, together with the picaresque of the builders, frustrated the expectations of increasing the installed solar capacity.

In addition, the cuts in state expenditures ended with the subsidies paralyzing the installation of new equipment, maintaining that situation until today.

**Solar electricity**

As in the previous case, photovoltaic installations up to 2006 were based on servicing isolated electrical demands in rural areas, in some cases accompanied by small wind turbines, and financed with a subsidy program of the regional government.

In 2007-2008, the Spanish photovoltaic bubble left around 300 $MW_p$ in the region. From that moment, the installation of new facilities were significantly reduced, increasing the installed power mainly in facilities for isolated uses.

However, in the last six -twelve months we are observing that two factors (the decrease in prices and the great capacity of connection of our electricity network) are causing a kind of photovoltaic bubble in our region that could be estimated at several thousand $MW_p$.

**Biomass thermal**

The use of biomass during the last 30 years has been stable as a way to heat homes in the rural environment, through traditional stoves.

The presence of boilers/stoves of biomass in the cities was practically residual and more with ornamental character in fireplaces than as an energy solution.

On the other hand, the line of subsidies from the regional government to biomass boilers never had a particularly relevant demand.

However, during the last 7-8 years, interest in biomass boilers has increased. The following factors have contributed: the perception of very high prices of diesel, an improvement in the quality and availability of pellet, as well as a certain environmental awareness.

The falling price of diesel three years ago gave a momentary scare to sales, although they are now recovering.

Regarding district heating, its presence has been marginal, although facilities such as the Cuellar district heating of 1998, or the facility built in 2015 for the University of Valladolid, are some very worthy projects.

**Biomass electricity**

The use of agricultural and forestry waste for electrical production has been limited to a few plants, either owned by logging companies (Tafisa in Valladolid) or by energy companies (Acciona - Briviesca and Valoriza - Garray).

On the other hand, a large 50 $MW_e$ plant is currently being built in Cubillos del Sil for the use of forestry and agricultural residues (straw).

The presence of biogas is marginal: it is worth it to highlight an installation in Salamanca from livestock waste and another in Salamanca with landfill gas.

**Geothermal**

In Castilla y León, except for some spas, there has been hardly any use of geothermal resources that, on the other hand, are limited in our region.

Only very recently (3-4 years) an interest has been detected about heat pumps and low enthalpy.

Status quo of RES production…

**Hydro**

Hydraulic installed capacity will remain stable in the medium and long term. The large facilities viability will be based exclusively on the pool price and the mini - hydro plants

will be based on the incentivized economic regimes of the past that, in the coming years, will gradually disappear.

**Wind**

The installed wind capacity will increase by 20-30% over the current level in the medium term and another 20% in the long term as a result of the replacement of the old wind turbines after their useful life of 20-25 years.

Part of the new capacity viability will be based exclusively on the pool price, while all the already installed plants and a small part of the new ones will be sustained in the incentivized economic regimes of the past that, in the coming years, will gradually disappear.

**Solar thermal**

The solar thermal capacity is expected to be limited in the medium and long term.

In this process there will be a competition with the photovoltaic in terms of roof occupation in the sense of optimizing their economic contribution, in the other hand the sector will be affected by the electrification process later discussed for the biomass sector.

**Solar electricity**

The installed photovoltaic capacity will multiply perhaps by 10-20 in the medium and long term.

The development of new large facilities will be based exclusively on the pool price and the capacity of the national transport network to manage this amount of electricity.

On the other hand, the facilities based on self-consumption (in its many technical and business variants) will depend on a regulation that is favourable, at least today. While this use will make, perhaps in the long term, all buildings (or at least their roofs) covered with a photovoltaic film, their actual energy contribution is not very relevant either.

Finally, those photovoltaic installations connected to the network of the past based on incentivized regimes will be lost by the middle of the next decade.

**Biomass thermal**

The installed capacity in thermal biomass will increase moderately in the medium term especially due to the demand in single-family homes and in some apartment buildings in the urban environment.

In the long term, the foreseeable electrification of the heat demand will probably suppose a limitation to its growth, not being unlikely that in the furthest future there will be biomass installations replaced by heat pumps in an environment in which electricity is increasingly more renewable.

In all cases, these biomass facilities will be based exclusively on a competitive price of heat generation, which in turn will depend on the choices of boiler and pellet manufacturers, taking for solved the emission problems of particles, which, in the opinion of the author, is mostly a product of the propaganda of fossil natural gas industry[8].

[8] The possible damage of the particle emissions is associated to three elements: the spatial density of emitters (boilers), the amount emitted (or not filtered) and the capacity of the environment to disperse that emission.

Regarding the heating networks, it is expected that their development will be very moderate, having to face the risk of the aforementioned electrification.

Also note the very recent interest of the fossil natural gas sector for the possibility of injecting biogas from landfills or slurries into gas pipelines. In any case, Castilla y León's production capacity of such gas will not make it energetically relevant.

**Biomass electricity**

Installed capacity in biomass will increase by very short term by 80% due to the large facility currently under construction, while in the long term the prediction is partly uncertain due to political instability but also (and this is more important) due to the preference of the regulation of incentives for cheaper renewable electric production modes such as photovoltaic and wind.

It is not expected that the prices of generation in biomass will fall so much that they can be financed only with the pool price, so that all the production will be based exclusively on the economic incentivized regimes of the past (and those that could be established in the future), which, in the coming years, will gradually disappear.

Except for surprises (more due to environmental reasons than for energetic ones), a development of the generation plants with biogas is not foreseen for electrical production.

**Geothermal**

The installed capacity will multiply so much that, perhaps in the future, heat pumps will represent the most common method of heating a house or an apartment, supported, in addition, with a higher proportion of renewable electricity.

In any case, in the future it is expected that technology will be able to overcome the problems of low performance in the case of large temperature gap in the early morning[9], as well as to increase the performance of the facilities.

**Any territorial-specific opportunities for the development of certain RES**

**Hydro**

Our hydraulic resource is associated either with the presence of important rivers such as the Duero or Sil rivers (high flow, low head) or in mountain areas (low flow, high head).

**Wind**

In Castilla y León, the type of wind used is associated either with ridges of mountainous areas, or with areas of high altitude plateaus.

On the other hand, technology has made possible the profitable use of so-called "low wind" areas with larger rotors and increasingly higher towers, which has especially benefited our region.

**Solar**

In Castilla y León the density of biomass boilers is non-existent. Where there is high population density there are hardly any biomass boilers and where there is a low density of population (rural environment) the density is not particularly high either.

[9] Heat pumps work better the less the thermal jump they have to overcome. Thus, early in the morning, when it is most necessary to heat a building, there is the circumstance that the temperature difference between interior and exterior is higher, this being the condition in which precisely the heat pump works worse.

The geographical distribution of solar radiation is basically the same throughout Castilla y León with some areas of higher radiation, such as the surroundings of Valladolid.

For photovoltaic use, the existing solar radiation is more profitable in certain areas especially cold as a result of its high altitude and the loss of performance of photovoltaic cells by heat.

**Biomass**

Castilla y León has the largest biomass production capacity in all of Spain, as a result, among others, of its large dimension.

Its use to provide heat is not dependent on whether there is more or less biomass in the area or whether it is of one quality or another. Thus, it is the case that biomass produced in Castilla and León can be exported to Italy, while in the supermarket we can find French pellets.

In the case of electrical use, or biofuel production (both solid as pellets or liquid as biodiesel) meaning large consumption of biomass, each plant will depend on a very specific area. Thus, the straw plant of Briviesca, will depend on the cereal area of the Bureba region or the forest waste of Garray, the forests of the province of Soria, for example.

**Geothermal**

The geographical distribution of geothermal energy is basically homogeneous throughout Castilla y León, taking into account the heat pump technology mainly used[10].

**Any territorial-specific environmental issues related with the development of certain RES**

Territorial-specific environmental issues with the development of…

**Hydro**

The large hydroelectric plants existing in Castilla y León were designed and built mainly in the 1950-1980 period with environmental considerations that were not very demanding.

The possible alterations of nature that may have occurred are, decades later, integrated into the current environment.

The smaller plants that were built more recently had to pass a rigorous procedure of environmental impact where the main problem used to be the establishment of the ecological flows and, secondly, other problems of acoustic impact on the avifauna, or the disturbance of wild species.

**Wind**

In this case, the main problem arose with respect to birdlife, visual impact and respect for the environmental legal frames of environmental protection, reaching in some cases some trials. The 1999 environmental legislation developed by EREN and the environmental authority helped a lot in clarifying the right areas for wind installations.

**Solar thermal**

Irrelevant issues, except for some problems of installation of visible panels or panels located in buildings or areas of high heritage value (e.g. Camino de Santiago).

[10] Except for a specific problem with very low conductivity soils, low enthalpy geothermal resources usables with heat pumps are generic taking into account the gradient (3ºC per 100 m) and thermal inertia of the earth.

**Solar electricity:**

On a global scale there could be some kind of debate about the environmental conditions with which photovoltaic panels are manufactured in China.

At local scale unimportant issues in small installations, while in the large ones the problem would basically be visual impact.

**Biomass thermal:**

Irrelevant issues at the moment. Maybe in the future, a possible massive use of this technology could arise problems of:

a) emissions of particles that would be solved by limitations to the cumulative effects and by corresponding filters,
b) deforestation in some areas, which can actually be excluded because the demand will never reach those levels.

On the other hand, the use of agricultural waste as a biofuel favours a better treatment of such waste, preventing its uncontrolled burning. Likewise, the energetic use of waste and forest resources favours the care of the forests, avoiding their dirt that is the origin of pests and forest fires.

**Biomass electricity**

Unimportant. Maybe in the future a possible massive use of this technology could give problems of:

a) risk of use with unauthorized waste, which is however impossible due to the strict environmental control of these plants and
b) deforestation in some very specific areas and close to the power plant, which will never happen because the demand will never reach those levels.

Same reflection as the one made for the agricultural and forestry residues of the immediately previous section.

At present, several 50 MW power generation plants and almost 300.000 t/year of biomass consumption are being built in Spain. Until recently there was a consensus in the sector that these plants had little technical viability as a result of the management of the huge amount of biomass. If the operators are not especially careful with the environmental but also social management of these plants, we can find an environment that is very contrary to these projects for the next plants.

**Geothermal**

Irrelevant issues at the moment. Maybe in the future, a possible massive use of this technology could generate impacts on subsoil.

**Socio-economic added value**

**Hydro**

Its presence does not imply a reduction in the prices of electricity purchase of the locals, although at some point it was thought to include in the regulation a canon to charge for the areas where they are located.

On the other hand, it should be noted that in Castilla y León some years ago a new regional special environmental tax was created on hydroelectric (and wind farms) facilities.

The impact on employment is very moderate given its high degree of automation, although it is true that the reservoirs generated by large facilities give the opportunity to generate a new economic activity based on tourism and leisure.

**Wind**

Similar to what exposed for hydro, except for the generation of a new economy based on tourism and leisure.

**Solar thermal**

In the best cases, some improvement in family and business incomes, due to the economic savings generated by the installation, as well as the presence of specific installers and maintainers that, in part, will replace those already existing and associated with fossil sources.

**Solar electricity**

We have to distinguish between large and small installations.

The large photovoltaic installations will resemble what is expressed in wind (although the need for employment in operation is much less than for wind farms).

On the other hand, small installations based on self-consumption will more closely resemble what has been said for solar thermal energy.

**Biomass thermal**

Similar to what exposed for solar thermal.

Although the theory says that facilities usually use the biomass of the area, the reality is that pellets from Spain are being exported to Italy and that the distribution of this biofuel is more associated with commercial aspects than with geographical proximity and so all the employment and economic benefits associated.

**Biomass electricity**

Similar to what exposed for hydro, but without the regional tax to electricity production and a considerable higher demand for employment, since not only is it necessary to operate a more complex and less automated plant, but also much labour is required to obtain the biomass

**Geothermal**

Similar to what exposed for solar thermal.

| | |
|---|---|
| **Evolution of RES share** | **Transport**: usage of biofuels from 0,79 % (28.404 tep, 2007) to 4,55% (127.036 tep, 2017, CORES)<br>**Electricity**: share of renewables in power generation from 54,2% (2011, REE) to 65,1% (2017, REE)<br>**Heating and cooling of buildings**: share of renewables in power generation 21,1% (2017, EREN, CORES, IDAE, estimated) |
| **Primary production of energy from renewable sources** | *Electricity*<br>Hydro power: 4.175 GWh<br>Wind power: 10.993 GWh<br>Solar Photovoltaic: 900 GWh |

| | |
|---|---|
| | Bioenergy: 263 GWh<br>*(2017, REE)*<br><br>*Thermal*<br>Solar Thermal: 7.667 tep<br>Wood & other solid biofuels 490.768 tep<br>Geothermal Energy: 1.029 tep<br>*(IDAE, 2015)*<br><br>Liquid biofuels: 152.208 tep<br>*(2017, CNMC, estimated)* |
| **Installed capacity from each renewable energy technology for electricity generation** | Hydro: 4.401 MW<br>Wind: 5.591 MW<br>Solar photovoltaic: 495 MW<br>Biogas & biomass: 47 MW<br>*(2017, REE)* |

## Analysis of the policies and innovation strategies as regards regional RES

**Main energy and environmental strategies/plans at the national and regional level influencing the development of RES**

The strategies and policies to support Spanish renewable energies have varied over time.

For practical purposes, the support models for electric and for thermal generation have differed very significantly, despite the fact that the national or regional administrations (not in the case of Castilla y León) have developed general plans that affected all renewables.

**Support for electric generation**

The electricity support model has mainly focused on setting a fixed purchase price for electricity generated by the renewable facilities, although in the mid-1990s there were direct investment aids to the first Spanish wind farms or mini-hydroelectric plants.

The definition method that fixed purchase price for the electric system (price that was later financed through the electricity purchase rate by all Spanish consumers) has varied over time.

That price has gone from a) being a percentage (to be maintained for 20 years) of an official reference of the electricity price in Spain to b) being the result of auctions in which over a certain value of income the companies make their offers based on an investment cost and exploitation.

The regional policy in this field has been to facilitate the administrative processing of these projects, clarifying, for example, environmentally acceptable areas or mediating with the electric companies to facilitate the joint electrical infrastructure of several renewable facilities.

Occasionally, the regional administration has financed some facilities either by participating in the social capital, or in the form of loans.

**Support for thermal use**

The national policy has been in two different directions.

On the one hand trying to introduce the obligatory nature of installing renewables in new buildings. That attempt that also came demanded by the transposition of the directive was carried out last decade through the new technical building code. Although this obligation was initially established to introduce solar thermal energy, in the end a series of factors such as the existence of several regulatory "back doors" (e.g the picaresque of real estate builders), and the beginning of the crisis of the construction sector, greatly limited the effect of the initiative.

On the other hand, the established support method was the investment subsidy over investment of an average of 30% for solar as well as for geothermal. The measure was a reasonable success with applications exceeding the available funds. The funding and management of these grants has been borne by the regional budget with some co-financing from the EDRF programme. Castilla y León, but also other autonomous communities such as Andalucía, added to these grants some agreements with commercial banks for co-financing the facilities, as well as strict requirements about the technical quality of the facilities with the obligation to comply with certain technical specifications that affected both the installation and the work, operation and maintenance.

**Additional foreseen directives or announced main interests in national/ regional policies as regards RES**

Currently, Spain is awaiting a new government to be formed. Nevertheless, a draft of a new Law on ecological transition is under approval procedure where the National Climate and Energy goals of the National Plan are integrated.

**Status quo and vision regarding regional innovation strategies for smart specialisation in the RES sector**

The Region of Castilla y León is co-leading with the Region of Lapland the Smart Specialisation Thematic Platform on Bioenergy and sees the development of renewable energies as one part of its goal to create jobs and growth from the smart and sustainable use of its natural resources.

At the same time, bioenergy but also wind energy or specially photovoltaic creates new business opportunities and promotes equal growth in our region.

In the future, the structure of our energy demand and production skills will change, since investing in new ways (not only technical, but also commercial or financial) on products with a high added value offers different opportunities to consumers, companies and professionals.

**Processes, know-how, technologies etc. in which the region is especially competitive in the RES sector**

- Wind farms exploitation
- Wind energy potential measurement
- PV installations management and installation
- RES planning
- Management of public authorisation procedures
- Biomass fair management and marketing

**Processes, know-how, technologies etc. in**

- Biogas public opinion management
- Decentralised electricity production management

| | |
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| **which the region is especially interested to enhance capabilities in the RES sector** | - RES in transport fuels<br>- Biofuel logistics and marketing |
| **Innovation projects** | - Provide solar energy to shelters on the Camino de Santiago[11]<br>- Develop a heating network in the presidency of the Junta de Castilla y León (already operative)<br>- Incorporate photovoltaic self-consumption systems into the buildings of the regional administration<br>- Be able to develop measures that generate confidence to consumers of thermal energy, especially in buildings and in the tertiary sector, developing a renewable heating and cooling strategy<br>- Provide renewable energy facilities to all the buildings of the regional administration<br>- Involve commercial banks in the financing of renewable facilities |

## FOCUS ON PUBLIC PARTICIPATION AND STAKEHOLDER ENGAGEMENT

**Barriers to RES, besides technological/ funding**

During the last few years, certain projects have received special resistance by certain pressure groups in some local cases and in others distant hundreds of kilometres away. The reasons have been very varied, having in some cases reached the courts. Depending on the type of project, certain patterns of behaviour can be observed, as follows.

**District heating**

- Resistance of neighbours who fear possible problems caused by fumes from the thermal power plant and the use of toxic waste as fuel (which is legally impossible)
- Resistance from other neighbours as a result of the project being relocated despite the fact that the second one was technically more suitable
- Resistance of the fossil natural gas company, that proposes offers near to losses for the supply of gas
- Resistance of natural gas installers, that underline that the centralized installation would take away installation and maintenance work on the individual gas boilers

**Wind farms**

- Protests by conservation groups against the administrative procedure in their environmental part
- Protests from the managers of public forests when it is considered to locate some wind turbines (or their infrastructures) in their proximity
- Behaviours that can get close to illegitimate actions, such as: protests by conservation groups for possible impacts on the avifauna, arriving to alterate data about birds; funding by real estate developers to conservation groups to avoid wind

11 https://www.tramitacastillayleon.jcyl.es/web/jcyl/AdministracionElectronica/es/Plantilla100DetalleFeed/1251181050732/Ayuda012/1284829708704/Propuesta

farms near their developments; use of bird collisions with certain wind turbines by competing manufacturers

**Large power generation plants with biomass**

- Resistance of conservation groups who fear possible problems caused by the fumes of the thermal power station and the use of toxic waste as fuel (which is legally impossible)
- Resistance of conservationist groups due to the possibility that the biomass demand of the power station could cause the elimination of all vegetation in the area
- Resistance of conservationist groups, that assume a lack of economic viability of a project often without a solid knowledge of it

**Hydraulic power stations**

- Resistance of conservation groups for the possibility of disturbing some endemic species in the area
- Resistance of conservation groups because of the possibility that the ecological flow presented in environmental impact study approved could be lower than the real one
- Resistance of conservation groups for the possibility of visual impact of forced pipes

**Characteristics of the permitting procedures regarding RES planning and projects**

Land-use and urban planning - In general terms, municipalities manage land-use and urban planning and construction permits associated to RES installations.

Environmental impact assessment - The obligation to conduct an environmental impact assessment is prescribed in the Regional law. The requirement is dependent on the capacity and type of the RES facilities to be built; however, it is a common practice to seek a statement of the need of an EIA from the regional state authority also for the projects falling below the EIA thresholds. When a project is located within or nearby an environmental protected area, a specific report has to be made.

**Level of awareness among the general public and policy-makers about RES**

In general, both policy makers and citizens have a good image of renewable energy.

However, the opinions are diversified.

In the eyes of the general public, the misconception that renewable energies are expensive and that they are a whim of left-wing groups and ecologists and certain "obscure business interests" associated with them has somehow influenced.

It does not matter that they mix photovoltaic with biogas or with wind farms, or that they do not know how to differentiate between exploitation or investment costs, the prejudice is firm.

However, that vision changes as soon as we talk about photovoltaic self-consumption, as it is seen as a way out against the "evil" electric companies.

**Level of knowledge/ skills of civil servants**

Due to long history of RES production in Castilla y León and the existence of exclusive competences in the region, the region’s civil servants have the capacity to deal with the permitting procedures.

However, in the Town Halls or in the regional services that tackle directly with the people there is a deficiency in the information and training that the civil servants have when it comes to informing the citizens or managing sanctioning files.

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| **Level of knowledge/ skills of potential proponents** | Varied situation.<br>There are promoters who, inexplicably, are unaware of any type of administrative procedure and who may also have a certain derogatory feeling towards it, which goes against their interests.<br>On the other hand, in other cases, the knowledge of other promoters about the procedure, its deadlines and its management is very high, which results in relatively short processing times. |

## MOST RELEVANT ISSUES

**Regional RES SWOT analysis**

| **Strengths** | **Weaknesses** |
|---|---|
| - High experience of the business sector of renewable energies in many aspects of its value chains<br>- Regional public officials aware of the possibilities of renewable energies<br>- Stability in regional policies for the development of renewable energies<br>- Existence of reasonable regional public funds | - Certain public officials should improve their training<br>- Our companies and professionals present spaces for improvement as regards some skills and capacities in some parts of the value chains<br>- The general population is sometimes not properly informed about the possibilities and limitations of renewable energies |
| **Opportunities** | **Threats** |
| - Replace all individual gas boilers with systems based on heat pumps<br>- Feed with photovoltaic solar energy all the institutional buildings<br>- Value the contributions of bioenergy | - Future of bioenergy rules and regulations about sustainability or particles emission by boilers<br>- Opposition to new RES plants (especially wind, hydro)<br>- Low energy prices make new investments less profitable and competitiveness difficult for RES |

| | **Regional interest** | **Notes** |
|---|---|---|
| **Bioenergy** | High | In Spain, Castilla y León has, possibly, the largest resources of this type. The advantages of this sector are that its power generation is manageable (i.e. you can obtain electricity from a plant as required and not depending on whether it is sunny or windy) and that it produces a great amount of employment also helping the forest with an economic activity that keeps it alive.<br>The problem of emissions of particles is something really minor. |
| **Hydro** | Low | The interest is lower because of the high degree of maturity of this sector in which the only activity during the next few years will be the adequate operation and maintenance of the power plants. |

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| **Wind** | High | The fact of being one of the European regions with the highest installed capacity and that this level is expected to be maintained in the future means that our interest in the sector is very high.<br>Interest that we also have in recovering the industrial capacity that we once had in wind energy. |
| **Solar** | High | In this case the degree of interest varies.<br>Solar thermal energy will occupy a marginal position in the future, so the only interest is to maintain the facilities that are in an adequate state of conservation and little else.<br>However, photovoltaic solar energy is expected to "explode" in the coming years. That this explosion will be based on self-consumption more than on photovoltaic installations of more than 100 MW, as the author believes to be logical, will depend on the good management that is done at the national level and, within the given regulatory limits, at the regional level. |
| **Geothermal** | High | We think that geothermal, aerothermal and the heat pump technology associated with them have a great potential and can become the standard of the future.<br>Our concern will be mainly that the facilities are well executed and exploited and thus generate a high level of satisfaction for their users. |

SWOT analysis for the RES with the highest degree of regional interest within the APPROVE project

**Regional BIOENERGY SWOT analysis**

**Strengths**

- An increasing potential of forest biomass
- A logistic and business infrastructure for the energetic use of: forest biomass increasingly consolidated, and cereal straw fully consolidated
- Moderate competition with other industries that use forest resources, for example, board mills
- Absence of competing land-use claims
- Centralized management by the regional administration of a large part of the forests of Castilla y León

**Weaknesses**

- Forest roads in bad condition
- Lack of capital for building new decentralised plants in remote areas
- Low educated work force with good knowledge of forest management practices
- Almost absolute disinterest in the energetic use of livestock waste
- Scarce development of biofuels marketing network

**Opportunities**

- Growing but moderate demand for district heating systems.
- An important demand for biofuels in bordering regions, especially Madrid.

**Threats**

- Policy decisions that would cut off investments in the sector
- Future of bioenergy in RES accounting (zero-emission status).

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| - First signs of confidence by possible users of biomass boilers and stoves.<br>- Regional forest administration very concerned and motivated to use forest biomass in energy. | - Competition with fossil fuels especially in periods of low prices.<br>- Potential future rules restricting harvesting.<br>- The generalized electrification for the supply of thermal demands.<br>- Very restrictive regulations regarding the emission of particles |

# EPIRUS (GREECE)

## REGIONAL FACTS

**Basic geographical, demographic and administrative characteristics of the region**

A mountainous region, with low density and aged population, Epirus is one of 13 Greek regions and includes 18 municipalities.

It is a single decentralised administrative unit with the power to ensure that the National development policy is implemented on a regional level.

**Current and prospective economic structure of the region**

Epirus is one of the poorest Greek regions in terms of GDP, resulting in significantly lower level compared with the EU average.

Through the process of designing research and innovation strategies and with the help of highly educated human resources, Epirus expects its further development.

Main activities in the region: livestock, agriculture, fishery, tourism.

| | Epirus | Greece[12] |
|---|---|---|
| **Land area**<br>*km2* | 9.223 | 131.957 |
| **Climate typology**<br>*Köppen climate classification[13]* | Csa, Csb | Csa |
| **Population density**<br>*inhabitants/km2* | 36,5<br>*(2017)* | 82,2<br>*(2017)* |
| **GDP per capita in Purchasing Power Standards (PPS)**<br>*Index (EU28 = 100)* | 48<br>*(2017)* | 67<br>*(2017)* |
| **Energy intensity of the economy**<br>*kilogram of oil equivalent per thousand EUR* | NA | 129,4<br>*(2017)* |
| **Share of RES**<br>*% share of renewable energy in gross final energy consumption* | NA | 15,2<br>*(2016)* |
| **Employment rate**<br>*% of the population aged 20 to 64* | 58[12]<br>(2018) | 59,5<br>*(2018)* |
| **Gross domestic Expenditure on Research and Development (GERD)**<br>*%* | 0,78<br>(2016) | 1,13**<br>*(2017)* |

* estimated
** provisional

## RENEWABLE ENERGY SOURCES DEVELOPMENT AND POLICIES

### Analysis of the regional situation as regards RES development

**Short relevant history of RES, status quo of RES production,**

A large proportion of electricity is generated by **hydroelectric** power. **Wind power** (mainly on the coasts and in high altitude areas) is second in produced electricity energy, and **biofuels** have the lowest percentage. Efforts to exploit **geothermal** potentials have been made with promising results.

[12] Eurostat, https://ec.europa.eu/eurostat/data/database
[13] World maps of Köppen-Geiger climate classification, http://koeppen-geiger.vu-wien.ac.at/

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|---|---|
| **different technologies and resources used** | |
| **Any territorial-specific opportunities for the development of certain RES** | - Large **hydrological** potential<br>- Low wind potential<br>- Intermediate (low compared with other Greek regions) **solar** potential (about 4,2 ESH)<br>- Mountainous areas with small agricultural but large **livestock** production |
| **Any territorial-specific environmental issues related with the development of certain RES** | No RES projects are allowed in zones such as areas around settlements, traditional settlements, archaeological sites, coastline, roads, management and archaeological entities, quarry areas.<br>In high productivity agricultural land, solar park projects are banned but biogas projects are not. |
| **Socio-economic added value** | The construction of new plants creates some employment positions. |

## Analysis of the policies and innovation strategies as regards regional RES

**Main energy and environmental strategies/plans at the national and regional level influencing the development of RES**

Actions promoted by **National Energy Strategy**:

- development of renewable energy facilities and incentives
- use and dissemination of clean and efficient technologies that respect the environment
- liberalization of the market, widening of competitiveness, abolition of monopolies in the electricity and gas market
- creating a positive investment climate for individuals and businesses in the production and supply sectors
- energy savings in industry, transport, buildings and housing
- establishing national targets for increasing the penetration of renewable energy, reducing greenhouse gas emissions and saving energy

Legislation:

- Law 3851/2010 “Accelerating the development of Renewable Energy Sources to deal with climate change and other regulations addressing issues under the authority of the Ministry of Environment, Energy and Climate Change”. This law defines National Binding Targets for the participation of RES in energy consumed (namely 20% on final energy consumption, 2% above the mandatory level of 18% set by Directive 2009/28/EC).
- Law 4203/2013 "Renewable Energy Issues and other provisions". This law replacing old laws with respect to large hydropower plants and wind farm projects.
- Law 4513/2018 "Energy Communities and other provisions". This law allows the creation of associations of energy communities in the Greek territory.

- Long term plan for the Greek energy system, Oct 2017[14].

[14] https://www.wwf.gr/images/pdfs/EnergyReportFinal.pdf

| | |
|---|---|
| **Objectives and targets set by the above strategies/ plans as regards RES, CO2 emissions reduction, energy autonomy** | - Evolution of greenhouse gas emissions in the EU with an 80% decrease target by 2050 (100% = 1990 - Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions: A Roadmap for moving to a competitive low carbon economy in 2050)<br>- RES in the final energy consumption (from 15,4% in 2015 to 33,8% in 2050). Source: Long term plan for the Greek energy system |
| **Status quo and vision regarding regional innovation strategies for smart specialisation in the RES sector** | Vision of Region of Epirus:<br>- knowledge-based smart growth and innovation<br>- sustainable development, promoting greener and more resource efficient competitive economy<br>- inclusive growth, promoting a high-employment economy through ensuring economic, social and territorial cohesion<br>- biomass projects due to large livestock, agricultural and fishery farms |
| **EU, national and regional types of measures and funding to support RES development** | EU funded projects in Epirus:<br>- Alterenergy[15]<br>- Galet[16]<br>- Gate[17]<br>- ELENA[18] |
| **Processes, know-how, technologies etc. in which the region is especially interested to enhance capabilities in the RES sector** | In biogas and in geothermal sector |
| **Innovation projects** | University of Ioannina:<br>- Attempts are made to experimentally produce and optimize biodiesel yield based on non-food energy plants through homogeneous and heterogeneous catalysis (Department of Chemistry - Biofuel Production Research Laboratory of the Chemistry Laboratory).<br>- A theoretical and computational study of light-matter interaction in solar energy harvesting devices such as silicon photovoltaics, organic photovoltaics and graphene based devices. Improve these by using nanomaterials of plasmon. |

[15] http://www.php.gov.gr/programs/eu_Programs/alterenergy.html
[16] http://www.e-galet.com
[17] https://www.facebook.com/GATE-Interreg-2014-20-748415918860954/?modal=admin
[18] https://www.eib.org/attachments/documents/epirus_project_factsheet_en.pdf

Atomic and molecular structure of the active material of organic photovoltaics, and electroneous interactions with plasmonic nanoparticles[19].

## FOCUS ON PUBLIC PARTICIPATION AND STAKEHOLDER ENGAGEMENT

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|---|---|
| **Barriers to RES, besides technological/ funding** | Strong **public opposition** especially to **wind farms** projects and **biogas** plants. |
| **Characteristics of the permitting procedures regarding RES planning and projects** | Levels of permitting procedure:<br>- Application for evaluation<br>- Production license<br>- Environmental approval (public participation and consultation)<br>- Installation license<br>- Operating license<br>- Operation of the project |
| **Level of awareness among the general public and policy-makers about RES** | **Policy-makers** have a **high level of awareness** about RES benefits and projects.<br>On the other hand, **general public** is very **sceptical** and most often opposed to RES projects. |
| **Level of knowledge/ skills of civil servants** | Highly educated personnel |
| **Level of knowledge/ skills of potential proponents** | Highly educated proponents |

## MOST RELEVANT ISSUES

**Regional RES SWOT analysis**

| **Strengths** | **Weaknesses** |
|---|---|
| - Large hydrological potential<br>- High educated population | - Low wind/solar potential<br>- Aged population |
| **Opportunities** | **Threats** |
| - Good accessibility to large urban centres<br>- Investing in RES projects contributes to the policies for the protection of the region's environment and rich biodiversity | - Limited availability of adequate sites, since 40% of Region's surface is represented by protected areas<br>- Strong opposition to RES projects (e.g. wind farms) |

[19] Computational Materials Science Lab, http://goo.gl/j2CBSr

| | Regional interest |
|---|---|
| **Bioenergy** | Medium/High |
| **Hydro** | High |
| **Wind** | Medium |
| **Solar** | Medium |
| **Geothermal** | Medium/High |

SWOT analysis for the RES with the highest degree of regional interest within the APPROVE project

**Regional BIOGAS SWOT analysis**

| **Strengths** | **Weaknesses** |
|---|---|
| - Plenty of livestock material<br>- High level university institution | - Existing electricity transmission lines inadequate to accommodate new RES developments, although a modernization of the transmission system is foreseen by the National Power company plans for 2017-2026<br>- Legislation (it should be simplified, too complicated) |
| **Opportunities** | **Threats** |
| - Easy and fast moving to other regional towns<br>- There are lots of producers (breeders, farmers, fish farmers) who would like to participate in a creation effort of biogas projects | - Strong public opposition<br>- Security, safety measures of the facility (people living where such businesses are installed are afraid of accidents that could have an impact on their area)<br>- Greek economic situation (banks do not give loans so easily and the loans they give are at a high interest rate) |

# LAPLAND (FINLAND)

## REGIONAL FACTS

**Basic geographical, demographic and administrative characteristics of the region**

The region of Lapland is located in the middle of Barents Euro-Arctic region by being the threshold in the Arctic, sharing a common border with Russian federation, Norway and Sweden. Lapland is the northernmost region of Finland and the European Union.

Lapland includes 21 municipalities, which form six sub-regions. The area has approximately 178.000 inhabitants which is 3,2 % of the entire population of Finland. The average population density in Lapland is 1,93/km². Lapland's administrative capital Rovaniemi and industrial cities Kemi and Tornio have the most inhabitants.

The Regional Council of Lapland is a joint municipal board formed by its 21 member municipalities. Its basic administrative principles are governed by the Local Government Act (Kuntalaki), no. 365 (1995) and in the basic agreement approved by the member municipalities. The decision-making processes of the regional councils are based on municipal democracy.

Approximately 10.000 Sámi, the only indigenous people in the European Union, live in Finland with approximately 35% living in Lapland in the municipalities of Enontekiö, Inari and Utsjoki and the northern part of Sodankylä. These municipalities form the Sámi Homeland (Sápmi) together with the northern parts of Sweden, Norway and the Kola Peninsula.

**Current and prospective economic structure of the region**

The economic structure of Lapland is strongly service accentuated: nearly three quarters of jobs are in service industry, one-fifth in processing industry and approximately 5% in extractive industry.

The main branches of industry in Lapland are forest and metal industry, tourism, trade and mining industry.

When it comes to business and employment, the prospects of Lapland's development are positive based on the mining and metal industry, energy projects and tourism.

| | Lapland | Finland[20] |
|---|---|---|
| **Land area**<br>*km2* | *100.366* | *338.452* |
| **Climate typology**<br>*Köppen climate classification[21]* | *Dfc* | *Dfc* |
| **Population density**<br>*inhabitants/km2* | 1,91<br>*(2019)* | 18,1<br>*(2017)* |
| **GDP per capita in Purchasing Power Standards (PPS)**<br>*Index (EU28 = 100)* | 101,1<br>*(2016)* | 109<br>*(2017)* |
| **Energy intensity of the economy**<br>*kilogram of oil equivalent per thousand EUR* | NA | 181,5<br>*(2016)* |
| **Share of RES**<br>*% share of renewable energy in gross final energy consumption* | NA | 38,7<br>*(2016)* |
| **Employment rate**<br>*% of the population aged 20 to 64* | 67,7<br>*(2018)* | 76,3<br>*(2018)* |

[20] Eurostat, https://ec.europa.eu/eurostat/data/database

[21] World maps of Köppen-Geiger climate classification, http://koeppen-geiger.vu-wien.ac.at/

| | | |
|---|---|---|
| **Gross domestic Expenditure on Research and Development (GERD)** %<br> | 2,51 (East & North Finland) *(2016)* | 2,76 *(2017)* |

## RENEWABLE ENERGY SOURCES DEVELOPMENT AND POLICIES

### Analysis of the regional situation as regards RES development

**Short relevant history of RES, status quo of RES production, different technologies and resources used**

Lapland became the biggest producer of renewable electricity in the post-war era due to the damming of the River Kemijoki.

**Hydroelectricity** continues as a backbone of Lapland's electricity production (more than 5 TWh per year, around 3/4 of Lapland's electricity production).

**Bioenergy** is mostly used in district heating and as side streams in powering the paper industry. Part of the production is based on co-generation, which also creates electricity. Bioenergy in Lapland is mostly wood-based.

The past decade has seen a big surge of **wind** power in Lapland. The production has grown from nearly zero to 1 TWh per year (around 1/8th of Lapland's electricity production).

**Geothermal** energy and **solar** energy are growing in popularity as a form of heating and electricity-production in single-family houses.

**Any territorial-specific opportunities for the development of certain RES**

Lapland is a sparsely-populated region with a high technical potential for bioenergy, wind and hydro.

Natural Resources Institute Finland (Luke) has shown that the use of **fuelwood** could be sustainably increased five-fold in Lapland. This would be beneficial for increasing the carbon sinks of Lapland's forests. The forestry measures related to cutting fuel wood (< 6 cm diameter) increases the growth of the larger trees in the forests and thus increases the amount of carbon the forests could absorb.[22]

Lapland's **hydropower** production is centered to the River Kemijoki and its tributaries. There is currently one more power plant in the pipeline, however its construction has been delayed due to lengthy administrative procedures.

Lapland's **wind** power potential is high and mostly centered in the coastal areas and the fells.

**Any territorial-specific environmental issues related with the development of certain RES**

**Traditional livelihoods** and **tourism**, together with **the quality of life** of local residents, are considered key values that can be compromised by projects of wind plants, especially larger scale parks.

**Biodiversity** conservation instances and **land-use** conflicts make complicated to plan any new dam for new hydro power development.

**Socio-economic added value**

Lapland has a relatively high share of energy use by its industrial sector due to a small population and the existence of energy-intensive industries such as steel and paper mills. Even though the region uses higher than average amounts of energy, its share

[22] http://www.fao.org/3/i1960e/i1960e00.pdf p.9

of renewables is higher due mostly to the existence of large-scale hydro power and bioenergy.

| | |
|---|---|
| **Evolution of RES share** | **Transport**: usage of bio fuels from 2 % (41,14 GWh, *2008*) to 12% (271,57 GWh, *2017*)<br>**Heating and cooling of buildings**: share of RES in district heating (the main source of heat) from about 20% in 2007 to about 80% today<br>The share of building floor area heated via RES and electricity has increased from 63 % in 2007 to 75% today |
| **Primary production of energy from renewable sources** | Hydro power: 5.180 GWh *(2017)*<br>Wind power: 988 GWh *(2017)*<br>Bioenergy: 8.500 GWh *(2017, estimate)* |
| **Installed capacity from each renewable energy technology for electricity generation** | Hydro: 1.000 MW<br>Wind: 265 MW<br>*(2017)* |

## Analysis of the policies and innovation strategies as regards regional RES

**Main energy and environmental strategies/plans at the national and regional level influencing the development of RES**

**Finland's Energy and Climate Strategy** takes into account and coordinates the Government Programme's energy and climate policies, the long- and medium-term climate change policy plans referred to in the Climate Change Act, and the EU's energy and climate targets for 2030. It sets the national target of RES and Energy Efficiency for the next decade.

Regionally, Lapland has been active in promoting decentralised RES production. The region has its own **Decentralised Renewable Energy plan**.

**Objectives and targets set by the above strategies/ plans as regards RES, CO2 emissions reduction, energy autonomy**

The National Energy and Climate Strategy outlines the actions that will enable Finland to attain the targets specified in the Government Programme and adopted in the EU for 2030, and to systematically set the course for achieving an 80-95 per cent reduction in greenhouse gas emissions by 2050.

With minor exceptions, Finland will phase out the use of **coal** for energy.

The share of **transport** biofuels will be increased to 30 per cent, and an obligation to blend light fuel oil used in machinery and heating with 10 per cent of bioliquids will be introduced. The minimum aim is to have 250, 000 electric and 50, 000 gas-powered vehicles on the roads.

The **electricity market** will be developed at the regional and the European level. The flexibility of electricity demand and supply and, in general, system-level energy efficiency will be improved. Technology neutral tendering processes will be organised in 2018–2020, on the basis of which aid will be granted to cost-effective new electricity production from renewable energy.

By 2030 the share of **renewable energy** in the end consumption will increase to approx. 50 per cent and the **self-sufficiency** in energy to 55 per cent. The share of renewable energy use in transport will clearly exceed the Government Programme target. The domestic use of imported oil will be halved as planned. The greatest non-ETS sector reductions in emissions will be achieved in the transport sector, and this will be the foundation of the medium term climate policy plan of 2017.

| | |
|---|---|
| | The region's plan on **decentralised renewable energy** focuses on improving **local awareness** for renewable energy investments, especially in the **agriculture sector**. Rural areas could face a boost to economies through energy production, for example from agricultural wastes. |
| **Additional foreseen directives or announced main interests in national/ regional policies as regards RES** | To be seen, depending also on the future policies of the new national government (May 2019). The new government programme has set new targets and support mechanisms for biogas production and the reduction of the use of heating oil in the residential sector. In particular, it can be noted that the future increase of the use of wood is highly dependent on new investments that will be decided this year (2019), which depends on the policies the next government will take with regard to forest carbon sinks. |
| **Status quo and vision regarding regional innovation strategies for smart specialisation in the RES sector** | The Regional Council of Lapland is co-leading the **Smart Specialisation Thematic Platform on Bioenergy** and sees the development of renewable energies as one part of its goal to create jobs and growth from the smart and sustainable use of its natural resources.<br>At the same time, bioenergy creates new business opportunities and promotes equal growth in the whole of Lapland. Lapland aims at increasing refining-related small and medium-sized entrepreneurship in the bioeconomy sector.<br>In the future, the structure of forestry income will change, and investing in new products with a high added value offers opportunities also in Lapland. The biorefineries currently under development create a foundation for the development of the SME industry. |
| **EU, national and regional types of measures and funding to support RES development** | Relatively strict national rules for state aid are limiting project funding opportunities for local stakeholders. Multiple projects developing networks and partnerhsips are ongoing.<br>Three biggest projects funded through the **ERDF** during this programming period have been i) the re-use of biomass-ash residues for fertilizer in the forestry sector, ii) a study on the impacts of drying wood chips to the profitability of the supply chains, iii) smart energy demo investments at the Lapland University of Applied Sciences. |
| **Processes, know-how, technologies etc. in which the region is especially competitive in the RES sector** | **Circularity of bio-streams in the paper industry** and district heating. Stora Enso and Metsä Group paper mills in Kemi producing their own energy, further investments are in the pipeline to make the circularity even more advanced.<br>**District heating and cooling**. NEVE district heating plant in Rovaniemi produces forest fertilizer from biomass ash. |
| **Processes, know-how, technologies etc. in which the region is especially interested to enhance capabilities in the RES sector** | - Biogas<br>- Decentralised energy production<br>- RES in transport fuels |
| **Innovation projects** | - Several projects on increasing RES share in transport (Clean Snowmobile Challenge for electrifying snowmobiles, use of woodgas in cars)<br>- Major bioplant investments incoming[23] |

[23] http://www.borealbioref.fi/en/

## FOCUS ON PUBLIC PARTICIPATION AND STAKEHOLDER ENGAGEMENT

| | |
|---|---|
| **Barriers to RES, besides technological/ funding** | Public opposition to the development **wind and hydro** power. This is especially the case for **major projects** with high visibility in the public sphere. Projects are either stuck in courts or do not receive permits from municipalities, due to **local opposition**.<br>Regarding **bioenergy**, there is a **lack of demand** for fuelwood especially in sparsely populated areas where the supply would be the best. Many single family houses are still using oil boilers, due to low price for heating oil and costs of new investments. |
| **Characteristics of the permitting procedures regarding RES planning and projects** | **Land-use planning**<br>Regional land use plan provides a general indication of areas suitable for the purpose of RES development. Detailed land use planning may not conflict with the regional plan. The municipal land use plans include permits for RES installations.<br>**Environmental impact assessment**<br>The obligation to conduct an environmental impact assessment is prescribed in the Act on Environmental Impact Assessment Procedure (468/1994). The requirement is dependent on the capacity of the power plants to be build, however it is common practice to seek a statement of the need of an EIA from the regional state authority also for the projects falling below the EIA limit.<br>When a project is located within or near a Natura 2000 area, a specific "Natura assessment" has to be made. If the assessment concludes that the project has significant negative impacts on the protected values, a permit to derogate from the prohibition to alter the natural habitat has to be applied for.<br>Other permits might include environmental and water permits, approval from the Defense Forces, aviation permits. Building a grid connection to the main grids also requires a permit. |
| **Level of awareness among the general public and policy-makers about RES** | Level of awareness of policy-makers and general public is high due to long history of RES projects in the region. Decision makers have experience from often difficult debates on land-use with competing interests. |
| **Level of knowledge/ skills of civil servants** | Due to long history of RES production and the existence of national authorities in the region, the region's civil servants have the capacity to deal with the permitting procedures. |
| **Level of knowledge/ skills of potential proponents** | Permitting authorities are experienced in procedures regarding RES plants, and know how to guide investors to energy aid for investments. Applications to ERDF funds related to RES and energy efficiency is still small. Rounds have been organised where the intermediary body has concentrated to low-carbon projects, to increase their share to the targeted 25% (higher than the EU requirement of 20%). |

https://www.metsaboard.com/Media/Stock-Exchange-and-Press-Releases/Pages/Release.aspx?EncryptedId=A6706BE83849EABC&Title=MetsaBoardanditsassociatedcompanyMetsaFibretolaunchpre-engineeringphasesforthreemajorinvestments

## MOST RELEVANT ISSUES

**Regional RES SWOT analysis**

| Strengths | Weaknesses |
|---|---|
| - RES production higher than own consumption in electricity<br>- Natural resources (especially wood and hydro) | - Small internal market<br>- Many areas have low property values and people are not willing to invest in changing their heating systems towards RES based sources |
| **Opportunities** | **Threats** |
| - Increasing demand for decarbonised energy that Lapland can produce<br>- The globally growing bioeconomy sector can produce local energy as side streams | - Future of bioenergy rules and regulation's (how are emissions counted, what type of biomasses can be utilised in the production of energy)<br>- Opposition to new RES plants (especially wind, hydro)<br>- Low energy prices make new investments less profitable and competitiveness difficult for RES |

| | Regional interest | Notes |
|---|---|---|
| **Bioenergy** | High | Continues to be the biggest source of energy in Lapland. It is highly likely that new major investments are upcoming. |
| **Hydro** | High | The region has a high interest in hydro production although there has been relatively little activity in new instalments. |
| **Wind** | High | Wind is becoming profitable even without feed-in tariffs and many national organisations are seeing Lapland as the main driver of future growth in Finland's wind capacity. |
| **Solar** | Medium | Demand is growing, there are new projects on joint purchasing. |
| **Geothermal** | Medium | Increasing interest among home-owners. |

SWOT analysis for the RES with the highest degree of regional interest within the APPROVE project

**Regional BIOENERGY SWOT analysis**

| Strengths | Weaknesses |
|---|---|
| - Large remaining sustainable felling potential for forests<br>- Utilisation of otherwise not marketable wood and side streams<br>- Strong networks of local SME's in the harvesting, transportation of wood | - Forest management of private-owners is sporadic and lacking<br>- Relatively low prices for energy wood<br>- Long transportation times and forest roads in bad condition<br>- Competing land-use claims (tourism, agriculture including reindeer herding, mining, etc.) |

| | |
|---|---|
| - Highly-educated work force with good knowledge of forest management practices | - Lack of capital for building new decentralised plants in remote areas<br>- Relatively lower value of forest land (forest-owners do not manage their forests leading to lower amount of forest side streams to be used in bioenergy production) |
| **Opportunities** | **Threats** |
| - Growing demand for district heating<br>- Constantly increasing forest stock<br>- Governmental/EU support to forest management<br>- Strong global development of bioeconomy that produces energy side streams | - Policy decisions that would cut off investments in sector<br>- Future of bioenergy in RES accounting (zero-emission status in EU's climate rules)<br>- Competition with fossil fuels<br>- Potential future rules restricting harvesting |

# NORMANDY (FRANCE)

## REGIONAL FACTS

**Basic geographical, demographic and administrative characteristics of the region**

Normandy, in the North of France, has been created in 2016 after the merge of Upper and Lower Normandy Regions. It is composed of six administrative departments for a total of 3,4 million inhabitants representing 5,1% of the French population. Normandy is the 9th region in France in terms of inhabitants. Population density is 111, 8 inhabitants/km2.

The Regional prefecture is Rouen but the Regional Council is located in Caen (considered as the political city of the region). The city with the most inhabitants is Le Havre, although Rouen has a larger urban area, with more than 500.000 inhabitants.

The Regional Council of Normandy is responsible for the general development of the territory, including environment, culture, transport, tourism, education (high schools, apprenticeship) as well as the management of European funds.

**Current and prospective economic structure of the region**

The Normandy Region was previously divided into two different Regions: Upper and Lower Normandy; both territories have a common history but their own specificities and areas of speciality with a strong heterogeneity between the two territories. However, both territories are mainly employing in the tertiary sector.

**Upper Normandy**

*Primary sector (2,4%)*, low development - Agriculture (diversified: bovine, cereals, polyculture).

*Secondary sector (46,1%)* - Upper Normandy has a secondary sector highly developed, especially in the power field, with two nuclear power plants, and is the first French Region for oil refining. The main industrial specialisations are the following: petroleum, chemistry, pharmaceutical industry, parachemistry, automobile, electric and electronic.

*Tertiary sector (51,6%)*

**Lower Normandy**

*Primary sector (6,5%)* - 73% of Lower Normandy territory is devoted to agriculture with 7% of the population specialised in agriculture (highest rate in France).

*Secondary sector* (35%) - Agro-food industry is strongly developed and is the first employer (in the industry field) of the territory; Electric and electronic construction is the second industry field that hires the most; Automobile; Metalworking industry; Energy (nuclear power plant based in the city of Flamanville and generating a high specialisation in the sector), wood transformation.

*Tertiary sector (58,5%)* - Tourism and leisure activities; Trade; Transports (geographical situation encouraging maritime transports).

Normandy in general is the region that hires the most in the energy field in France (36.000 jobs).

| | Normandy | France[24] |
|---|---|---|
| **Land area**<br>*km2* | 29.906 | 547.030[25] |
| **Climate typology**<br>*Köppen climate classification[26]* | *Cfc* | *Cfc* |
| **Population density**<br>*inhabitants/km2* | 111,8<br>*(2016)* | 105,5<br>*(2017)* |
| **GDP per capita in Purchasing Power Standards (PPS)**<br>*Index (EU28 = 100)* | 85<br>*(2017)* | 104<br>*(2017)* |
| **Energy intensity of the economy**<br>*kilogram of oil equivalent per thousand EUR* | NA | 117,1<br>*(2016)* |
| **Share of RES**<br>*% share of renewable energy in gross final energy consumption* | 6,1<br>*(2016)* | 16,0<br>*(2016)* |
| **Employment rate**<br>*% of the population aged 20 to 64* | 70,7<br>*(2018)*[23] | 71,3<br>*(2018)* |
| **Gross domestic Expenditure on Research and Development (GERD)**<br>% | 1,3<br>*(2015)* | 2,19*<br>*(2017)* |

* estimated

## RENEWABLE ENERGY SOURCES DEVELOPMENT AND POLICIES

### Analysis of the regional situation as regards RES development

**Short relevant history of RES, status quo of RES production, different technologies and resources used**

Normandy is characterized by the presence of three nuclear power plants providing more electricity than the territorial consumption.

But RES history started in the 90's with the **first regional wood energy program**. Its objectives were first to organize and involve the stakeholders of this activity to create a real cluster around wood energy in Normandy. The objectives were also to develop the use of wood to produce renewable heat or electricity. A few years later, Normandy has become an example in France for the organization of the wood energy sector from forestry or wood exploitation to management of heat plants.

Even if Normandy is not among the first French forestry regions, the use of wood is very developed now and Normandy is for example at first place in France for use of wood energy per inhabitants in social collective houses. There is a total of 310 wood-fired heating plants, including 262 collective boiler installations, for a total of 664 MW of installed capacity, and a total consumption of 867.000 tons of wood per year.

Based on the success of wood energy organization, the Normandy Region and ADEME (the French Environment & Energy Management Agency) have decided to start a similar action dealing with **biogas** production in Normandy. A three-year program 2018-2020 is now engaged with objectives to organize the stakeholders and make projects possible. Normandy has now 76 biogas factories for 33 MW of installed capacity.

[24] Eurostat, https://ec.europa.eu/eurostat/data/database

[25] Metropolitan France. Metropolitan France + DOM: 643.427 km2

[26] World maps of Köppen-Geiger climate classification, http://koeppen-geiger.vu-wien.ac.at/

Normandy is also concerned with **wind energy**. The political support for offshore wind energy is strong. Three offshore wind farms of 1,5 GW of installed power are set-up and will start to produce electricity from 2022.

There are 79 onshore wind energy farms in Normandy for around 700 MW of installed power (365 wind turbines over 500 KW). The first wind farm was implemented in 2004. This energy is mostly settled in the north of Normandy. After years of very strong growth, until 2011, the wind energy sector shows an admittedly more modest but nevertheless regular increase over the years 2012 to 2017 (about +10% installed capacity every year since 2015).

Regarding **solar energy**, Normandy is not among the first regions in France. At the end of 2017, the area of photovoltaic solar panels is estimated at around 995.600 m², for an installed capacity of 131 MWp. Photovoltaic installations are mainly located in the Manche and Seine-Maritime, representing respectively 31% and 28% of the installed capacity. Installed powers continue to grow at a steady pace, even though evolution rates are lower than between 2009 and 2012. Between 2016 and 2017, installed capacity is up 6,5%, the biggest increase since 2013. In 2017, photovoltaic installations produced 129,5 GWh of renewable electricity.

Hydroelectricity and geothermal energy are very less developed in Normandy.

**Any territorial-specific opportunities for the development of certain RES**

Even if Normandy is near the Paris area, the region is mostly a rural territory with its assets of strong agricultural activities.

The territory has a large share of agricultural lands and an agricultural sector highly developed allowing the production of biomass for the development of biogas projects.

Normandy has about 14% of forestry surface, allowing a dynamic wood energy production. Normandy is the first territory in France in the wood energy sector and considered as exemplary in the management of its forests. Currently the Regional Council and its partners are developing strategies to improve the production of **hedge wood** (sustainable management certification, increase of the hedge wood use…).

Finally, the geographical situation of the region implies the presence of a steady wind (onshore and offshore) permitting a stable development of wind farms. The Normandy Region is the 8th one in France in terms of connected load.

**Any territorial-specific environmental issues related with the development of certain RES**

Normandy does not have the required resources to develop some geothermal technologies (lack of hot water field).

The Region has also no capacity to increase its hydroelectricity production due to the necessity to improve ecological conditions of rivers.

**Socio-economic added value**

The implementation of renewable energy systems allows the territory to avoid the use of fossil energy coming from abroad and costing a lot. In addition to avoid CO2 emissions, the development of renewable energy clusters and projects creates local employment by exploitation and management of local resources.

| | |
|---|---|
| **Evolution of RES share** | **Gross final energy consumption**: from 5,6% in 2008 to 8,1% in 2014<br>**Electricity**: from 4% in 2008 to 9% in 2014, to 10% (estimated) in 2017 |
| **Primary production of energy from renewable sources** | Hydro power: 129,6 GWh<br>Wind power: 1.292,9 GWh<br>Solar energy: 129,5 GWh |

| | |
|---|---|
| | Biogas: 162,6 GWh<br>Wood & other solid biofuels: 6.608,5 GWh<br>Renewable wastes: 215,8 GWh<br>Geothermal energy: data not available<br>*(2018)* |
| **Installed capacity from each renewable energy technology for electricity generation** | Hydro: 50 MW<br>Wind: 670 MW<br>Solar photovoltaic: 130 MW<br>Biogas: 23 MW (co-management only)<br>*(2017)*<br>Solid biofuels (wood): 250 MW - hybrid heat and electricity<br>*(2018)* |

## Analysis of the policies and innovation strategies as regards regional RES

**Main energy and environmental strategies/plans at the national and regional level influencing the development of RES**

At the national level, the energetic transition is acknowledged by law and described in the **Pluriannual Energy Programme** (PPE). This document sets particular objectives for each renewable energy for a specified period.

At the regional level, the Normandy Region has to prepare and pilot a **regional scheme for energetic and ecologic transition, transports, planning** (*Schéma Régional d'Aménagement, de Développement Durable et d'Égalité des Territoires* - **SRADDET**) which fixes also regional objectives dealing with renewable energy. Most of these objectives focus on improving the performance of Normandy with the aim to contribute to the national objectives.

In addition of this regional scheme, the Normandy Region supports a specific **regional wood energy programme** and a **regional biogas production programme**.

Moreover, the objective is to make Normandy the most competitive region in France in the field of **marine** renewable energy. Three offshore wind farms are currently being developed in Dieppe Le Tréport; Courseulles-sur-Mer; Fécamp. The objective for 2030 is the commissioning of those projects, allowing the production of 4.500 GWh. Regarding the renewable electricity production of an offshore windfarm and its contribution to the regional objectives for our energetic mix, Normandy Region is also supporting the launch of a fourth project of windfarm to reach an installed capacity of 2,5 GW in 2030.

Finally, Normandy is rich of natural assets for tidal energy production with the Raz Blanchard. The regional objective is the development of a specific industrial sector thanks to the exploiting of such resources. To do so, the Region has developed partnerships with SIMEC ATLANTIS and EFINOR inside NORMANDIE HYDROLIENNES.

**Objectives and targets set by the above strategies/ plans as regards RES, CO2 emissions reduction, energy autonomy**

CO2 emissions reduction objectives and energy production choices at the regional level are based on international as well as national commitment.

At the national level the **PPE** defines several objectives:

- Multiplication by 1,7% of renewable electric generation between 2014 and 2023 and by 1,5% of heat production
- Support to heat networks
- Reach the objective of 20% of bio-based fuel in the Natural Gas for Vehicles (NGV) total consumption in 2023

Those objectives are supposed to lead to a 75% decrease of gas emissions from now until 2050.

Decrease of total energy consumption by 27% in 2030 and 50% in 2050 compared to 2010. Increase of the share of renewable energy in the total energy consumption (23% in 2020, 32% in 2030).

At the **regional level**, the objective set by SRADDET is declined in the following targets.

**Electricity**

- Wind:
  - Offshore →production of 4.500 GWh by 2030
  - Onshore → 450 to 675 MW more installed capacity by 2030 producing between 1.185 and 1.775 GWh per year.
- Solar: 181 to 238 GWh production by 2021; 270 to 415 GWh production by 2030
- Biogas: Implementation of 6 to 10 cogeneration units per year

**Heat**

- Wood-energy: reach the objective of 7500 to 7800 GWh production per year in 2021 and 8600 to 9400 in 2030 (meaning an increase of 3000 GWh from now to 2030).
- Biogas: objective of 5000 GWh in 2030 to reach the objective of 10% biogas injected in distribution networks.
- Solar: doubling of the production between 2014 and 2023

**Additional foreseen directives or announced main interests in national/ regional policies as regards RES**

The current PPE is under revision and could fix new national objectives to be achieved in 2028. This can also change the condition of national support for a particular energy (for example: rate of funding or financial conditions of energy purchase).

**Status quo and vision regarding regional innovation strategies for smart specialisation in the RES sector**

The main ambition for Upper-Normandy is to become an Eco-Region, innovative and successful in the field of energy and ecology transition towards a low carbon economy, to the benefice of employment and territorial development. Specialization Areas include energy transition and in particular effective energy systems. In addition, our RIS3 aims at delivering renewed tools for a governance more open to stakeholders, steering tools and communication, which is in line with the APPROVE approach.

In Lower-Normandy, as regards the RES sector, the RIS3 focuses on marine renewable energy.

**EU, national and regional types of measures and funding to support RES development**

At the national level, RES development can benefit from several programs and organisations. In particular, ADEME supports, accompanies and finances renewable energy projects. This agency works both at the national and local level.

At the regional level, Normandy Region implements ERDF and also its own funds to subsidize some RES projects or operators for energy programs. In particular, specific objective 2.1 “Increase the production and distribution of high-potential renewable energy in Haute-Normandie” (under TO 4) of the Regional Operational Programme

2014-2020 funds projects dealing with biogas production, wood energy heat factories, heat networks and heat recovery.

At the local level, the Normandy Development Agency is also supporting renewable projects holders by proposing zero-interest-loans (for non-agricultural-projects). Moreover, the State-Region Plan Contract is supporting renewable energy projects by including a specific axis about renewable energies. These projects are mostly solar, wood energy small projects and biogas production opportunities studies.

**Processes, know-how, technologies etc. in which the region is especially competitive in the RES sector**

The Region is especially competitive in the production of **bioenergy** sources and in the production and management of **wood**. It is the first French region in terms of wood energy production (it represents 65,8% of the total production of renewable energy sources in the Region).

Normandy is competitive in the **district heat** network sector too.

Normandy is also competitive in **marine** renewable energy sector, especially for offshore wind energy with three farms to be realised within the next years, a lot of SMEs and research teams involved. Normandy appears to be the first French region for marine renewable energies.

**Processes, know-how, technologies etc. in which the region is especially interested to enhance capabilities in the RES sector**

The Region is especially interested in improving its processes as well as know-how in the **biogas** energy source since it is currently developing several projects in such area and willing to increase the share of energy produced by biogas. A particular aspect to be improved is the **management of the deposits for biogas**. In fact, many projects are getting developed causing high competition on biogas deposits resources between projects developers in a same area. The knowledge of the deposits amount available in the area is also something we need to improve.

There is also an interest in improving the management and development of the **hedge wood** sector in a sustainable perspective, so that it can have an impact on the wood-energy sector.

The Region is also interested in improving its know-how in the **tidal** energy area.

**Innovation projects**

The Normandy Region is currently working on several innovation areas: projects linked with transport management (optimisation of energetic and propulsion systems), with marine renewable energies as well as with hydrogen sources.

Several innovative projects are getting implemented on the territory:

- BIOGNV project: project focusing on the development of the biomethane sector in Normandy, from production by methanisation of organic materials to distribution in the form of compressed natural gas for road transport vehicles.
- INWIT: R&D project focusing on offshore wind technology[27]

[27] Article talking about the project: https://www.rouennormandyinvest.com/actualites/projet-inwit-filiere-eolien-en-mer/

## FOCUS ON PUBLIC PARTICIPATION AND STAKEHOLDER ENGAGEMENT

**Barriers to RES, besides technological/ funding**

### Wind energy

**Public opposition** in the implementation of onshore and offshore wind farms, due to visual as well as environmental impacts despite the involvement and the support of local elected officials. Those oppositions cause consequent delays in the implementation of the projects, which remain stuck in courts. E.g. the implementation of a five-wind turbine farm in the Seine-Maritime department (Flamets-Frétils & Auvilliers villages) facing important public opposition. The implementation of the project has taken ten years after a total of six appeals.

Moreover, **elected officials protest** against the way wind farm developers are proceeding to ensure themselves the ground possession which is necessary for their project, contracting directly with land owners before consulting local public authorities.

Regarding funding, some projects owners are sometimes opposed to other investors taking parts in the project (will to control all the governance).

Legal and administrative procedures are strong regarding the implementation of wind farms, including the military aspect that could impact the project: the implementation of wind turbines should not impact the functioning of military radars. The DEMPERE tool has been launched in 2015 to measure the impact of wind turbines in such equipments (masking, decrease of the reach). Results are still awaited.

Bioenergy:

As regards bioenergy, public opposition is also a concern. Despite the respect of law imposing a minimum distance between the installation and the habitations, public opposition remains strong.

E.g. the creation of a local association in Bréauté (village located in the Seine-Maritime department) to fight the implementation of a biogas project due to the fear of disturbing smell propagation. Other oppositions are raising against biogas production plants (e.g. at Bieville-Beuville or at Saint Pierre/Dives) which create delay for projects (legal complains, need of localisation change …).

In general:

Projects are **not perceived as contributing enough to the local life** from an economic point of view. The benefits deriving from the projects are evident to local councils in terms of taxes more than directly to the population of the villages welcoming the new plants (causing imbalance between the different territorial stages).

Finally, elected officials invited for the first APPROVE stakeholder meeting expressed the **lack of information** they were experiencing from the very beginning of the project (by owners as well as developers).

Renewable **energy price** in France is still high and competited by nucelar energy which is ”underestimated” for a lot of people.

There is also a resistance vis-a-vis the evolution of the energetic model implemented in France, since renewable energy involves a decentralised system (versus a centralized system).

**Characteristics of the permitting procedures regarding**

The general procedure for the implementation of a **wind farm** consists in a 10 step procedure:

**RES planning and projects**

- Identification of areas allowing the implementation of wind farms (implementation of a mast for a period of 6 to 12 months for wind measures)
- First contacts with local elected officials for the presentation of the project as well as land owners for the implementation of the project. Public information meetings can be organised at this step of the project, in fact this step is rarely including local inhabitants.
- Signature of a sale agreement between the project holder and the farm owners.
- Impact assessment including several aspects: environment, local population, biodiversity, landscape, heritage
- Impact assessment submission and inquiry
- Consultation including several actors:

  Public survey lasts for a period of one to two months and is organised through the authority of an investigating commissioner.

  Consultation of the departmental commission for nature, landscape and sites (including environmental associations, associations for landscape, heritage).

  Consultation of the environmental authority
- Administrative decision
- Financing
- Building
- Commissioning

Public consultation comes up at the 6th step of the project.

For Marine Renewable Energy, a law has been promulgated in 2018 (LOI n°2017-727 10th August 2018), creating the "*permis envelope*" and modifying the public consultation process. For projects implied in a competitive procedure, local inhabitants are consulted beforehand. In such situation, the government has to refer to the CNDP (French national public debate commission); the project owner doesn't have to do so afterwards.

**Biogas** projects permitting procedures:

After the formulation of the project and the choice of the builder, the project owner has to start the ICPE (Installation Classified for the Protection of the Environment) procedure:

- Declaration: trade declaration and demand for building permit. 2 to 6 months
- Registration: administrative procedure, proof that the project respects the general prescriptions. During this step the project owner has to start communicating about his project. 6 to 8 months
- Authorisation ICPE: implementation of the impact assessments (health, fauna, natural environment, water, air, waste, noise) and risk assessment. 10-12 months
- Public survey. 1 month

Public consultation remains low since the consultation of locals comes up at the end of the project, once it has been decided and the project launched. Moreover, the flexibility of the project remains low at this stage of the project and the public opinion has a weak impact.

| | |
|---|---|
| | The lateness of public consultation during the permitting process was unanimously recognized by regional stakeholders during the APPROVE regional meetings and is a negative point. |
| **Level of awareness among the general public and policy-makers about RES** | The level of awareness among the general public and policy-makers depends on several criteria:<br>- Type of energy<br>- Size of the community or local authority (how staffed it is)<br>- Method and tools employed to promote or inform about projects and renewable energies.<br>Then it can be from low to good. |
| **Level of knowledge/ skills of civil servants** | Currently correct but has been lower and can still be improved. Civil servants dealing with RES funding procedures are environment and energy national agency employees or Normandy region employees. |
| **Level of knowledge/ skills of potential proponents** | It is getting improved due to the implementation of **committees** gathering different types of actors and an **active communication** between stakeholders involved in funding of RES projects. |

## MOST RELEVANT ISSUES

Self-assessment of Strengths, Weaknesses, Opportunities and Threats concerning the regional RES development and innovation strategies for smart specialisation in the sector

**Regional RES SWOT analysis**

| Strengths | Weaknesses |
|---|---|
| - Territorial specificities such as wind, forests, agriculture allow the implementation of RES<br>- Good cooperation with project holders who are well trained and informed on available funds and procedures<br>- A lot of stakeholders involved<br>- Regional plans for wood and biogas energies<br>- Wood energy sector well structured<br>- Awareness of general public about main issues of renewable energies and energetic transition (sometimes)<br>- Hedge wood: only 1% of the resource is currently exploited | - Heterogeneity of the territory in the development of RES<br>- Permitting procedures do not allow a correct exchange with the locals<br>- Some difficulties in managing the complexity of the involvement of many stakeholders and their contributions<br>- Public opposition to RES projects, especially to wind and biogas projects<br>- “Low” share of renewable energies in total energy production<br>- Insufficient public funding capacity<br>- Lack of awareness of general public about main issues of renewable energies and energetic transition (sometimes) |

| | |
|---|---|
| | - High competition between biogas projects and other biomass valorization sectors (example of the composting practices). |
| **Opportunities** | **Threats** |
| - Climate and energetic transition objectives<br>- Increasing interest in implementing biogas projects<br>- Support from local elected officials (sometimes)<br>- Concern of citizens about the environment and the future | - Structuring of the citizen opposition at regional level, especially on wind and biogas projects<br>- Non-support from local elected officials (sometimes)<br>- Competition with fossil fuels<br>- Climate change causing important impacts on local environment (for example disappearance of beeches[28] used for wood-energy over the long term)<br>- Decrease of the hedge wood resource (long-term) |

| | Regional interest | Notes |
|---|---|---|
| **Bioenergy** | High | High interest in the bioenergy sources, increasing demand and development of new projects. The Region is particularly interested in wood and biogas energy sources.<br>In 2017 65,8 % of the total renewable energy was produced by wood energy. |
| **Hydro** | Low | In Normandy there are 90 micro hydroelectric power plant covering 0,5% of the total energy consumption of the Region. Low evolution since 2008 in the absence of new projects (stability). |
| **Wind** | Medium | Normandy has 79 wind farms, representing a total of 365 wind turbines, covering 4,6% of the total energy consumption in the Region. Normandy Region does not have any policy instrument to support this energy. |
| **Solar** | Medium | In Normandy there are about 995.000 km2 of solar panels covering 0,4% of the total energy consumption of the Region. The Region is showing interest and support toward solar energy but as regard the territory specificities, solar power remains less productive than wind power, explaining the medium interest expressed toward this energy source. However, the installed capacity has increased by 6,5% between 2016 and 2017. |
| **Geothermal** | Low | Low investments |

[28] French and Belgian surveys have proved the impact of global warming on beeches, showing that the increase of temperature by 2°C would have an impact on their development that would be moved in higher altitude (or places with more humidity). Since this tree is used for wood energy in Normandy, its disappearance would have an impact over the long term on the field.
http://documents.irevues.inist.fr/bitstream/handle/2042/65336/RFF_2017_69_3_205_218_latte.pdf?sequence=1

SWOT analysis for the RES with the highest degree of regional interest within the APPROVE project

**Regional BIOGAS SWOT analysis**

| Strengths | Weaknesses |
|---|---|
| - Numerous resources on the territory<br>- Biogas expertise and several partners (Nov&atech, Biomasse Normandie, Regional Agricultural Chamber)<br>- Diversity of projects and projects proponents (farmers, industrial companies)<br>- Good public support (national / regional)<br>- Regional biogas program 2018-2020 | - Funds available (may be insufficient)<br>- Immature structure of the biogas sector (lack of organisation of the supply chain, lack of stakeholders – e.g. equipment traders)<br>- Dimension of projects related to economic rentability (current economic conditions encourage project developers to size them bigger to achieve acceptable profitability; thus, they also need more funds to invest)<br>- Passiveness in public authorities (generally there is no strong support)<br>- Slowness in project engineering (implementation of the projects, from the idea to the final realization, takes a long time due to several factors: farm inputs availability, authorizations for the spreading zone, solidity of the project and its financing; then the administrative procedures are quite heavy for project holders - ICPE authorization for example)<br>- Public acceptability of the projects |
| **Opportunities** | **Threats** |
| - Expected decrease of projects cost due to a strong development reducing production costs<br>- Actors of the energy sector (e.g. GRDF – Gaz Réseau Distribution France) defining higher objectives than those defined at the national level allowing a strong dynamic in the sector (a 30% share objective of biogas in global energy consumption against a 10% national objective)<br>- Development of the biogas mobility (bioNGV: use of the organic waste to produce biogas for transport) | - Change of national support framework (funding and energy buyback rate)<br>- Competitiveness of natural gas compared with biogas regarding the production costs<br>- Possible raw material competition when there are many projects in the same area |

# APPENDIX - TEMPLATE OF THE "REGIONAL REPORT ON GAPS, NEEDS AND CHALLENGES"

## REGIONAL FACTS

Introduction to the main characteristics of your region (Lapland / Epirus / Normandy / Castilla y León) (2 pages max)

| | | | |
|---|---|---|---|
| **Basic geographical, demographic and administrative characteristics of the region** | … | | |
| indicators | | nation | region |
| **Land area**<br>*km2* | | | |
| **Climate typology**<br>*Köppen climate classification*<br>(http://koeppen-geiger.vu-wien.ac.at/) | | | |

| | | | |
|---|---|---|---|
| **Current and prospective economic structure of the region** | … | | |
| indicators | | nation[29] | region |
| **Population density**<br>*inhabitants/km2* | | | |
| **GDP per capita in Purchasing Power Standards (PPS)**<br>*Index (EU28 = 100)* | | | |
| **Energy intensity of the economy**<br>*kilogram of oil equivalent per thousand EUR* | | | |
| **Share of RES**<br>*% share of renewable energy in gross final energy consumption* | | | |
| **Employment rate**<br>*% of the population aged 20 to 64* | | | |
| **Gross domestic Expenditure on Research and Development (GERD)**<br>% | | | |

[29] Source: https://ec.europa.eu/eurostat/data/database (up to 2016)

## RENEWABLE ENERGY SOURCES DEVELOPMENT AND POLICIES

Analysis of the regional situation as regards RES development. Please refer to the following sources (when applicable): hydro, solar, wind, geothermal, bioenergy. (3 pages max)

| | |
|---|---|
| **Short relevant history of RES, status quo of RES production, different technologies and resources used** *(please include information on decentralised production if available)* | … |
| **Any territorial-specific opportunities for the development of certain RES** *(eg. presence of wind, agriculture, …)* | |
| **Any territorial-specific environmental issues related with the development of certain RES** *(eg. use of wood is subject to strict regulation due to the impact on air pollution)* | |
| **Socio-economic added value** *benefits to the population from the RES sector, employment in the RES sector* | |

| indicators | nation[30] | region |
|---|---|---|
| ***Evolution of RES share*** *share of renewable energy in:* - *gross final energy consumption* - *transport* - *electricity* - *heating and cooling* *(last 10 years)* | | |
| ***Primary production of energy from renewable sources*** - *hydro power* | | |

[30] Source: https://ec.europa.eu/eurostat/data/database (up to 2016)

| | | |
|---|---|---|
| - *solar energy*<br>- *wind power*<br>- *geothermal energy*<br>- *liquid biofuels*<br>- *biogas*<br>- *wood & other solid biofuels*<br>- *renewable wastes* | | |
| ***Installed capacity from each renewable energy technology for electricity generation***<br>- *hydro (non pumped)*<br>*<1MW*<br>*1MW–10 MW*<br>*>10MW*<br>- *hydro pumped (pure)*<br>- *hydro mixed*<br>- *solar photovoltaic*<br>- *solar thermal*<br>- *wind*<br>- *geothermal*<br>- *solid biofuels*<br>- *biogases*<br>- *biodiesels*<br>- *other liquid biofuels*<br>- *tide, wave, ocean* | | |

Analysis of the policies and innovation strategies as regards regional RES. (2 pages max)

| | |
|---|---|
| **Main energy and environmental strategies/plans at the national and regional level influencing the development of RES** | |
| **Objectives and targets set by the above strategies/ plans as regards RES, CO2 emissions reduction, energy autonomy** | |
| **Additional foreseen directives or announced main interests in national/ regional policies as regards RES** | |
| **Status quo and vision regarding regional innovation strategies for** | |

| | |
|---|---|
| **smart specialisation in the RES sector** | |
| **EU, national and regional types of measures and funding to support RES development** | |
| **Processes, know-how, technologies etc. in which the region is especially competitive in the RES sector** | |
| **Processes, know-how, technologies etc. in which the region is especially interested to enhance capabilities in the RES sector** | |
| **Innovation projects** *main R&D projects ongoing in the RES sector* | |

## FOCUS ON PUBLIC PARTICIPATION AND STAKEHOLDER ENGAGEMENT

Investigation about the present regional situation as regards the core topic of APPROVE (3 pages max)

| | |
|---|---|
| **Barriers to RES, besides technological/funding** *Please provide some examples, e.g. projects that have been stopped because of public opposition, call for projects funded by ERDF that have not been exploited by potential proponents, …* | |
| **Characteristics of the permitting procedures regarding RES planning and projects - in particular as regards the public participation and consultation required within environmental assessment processes (eg. Environmental Impact Assessment, Strategic Environmental Assessment)** | |
| **Level of awareness among the general public and policy-makers about RES, and about their benefits and environmental impacts** | |
| **Level of knowledge/skills of civil servants (eg. for managing appropriate RES funding procedures)** | |
| **Level of knowledge/skills of potential proponents as regards funding instruments, permitting procedures, RES features** *(eg. for successfully participating in ERDF or CF calls)* | |

## MOST RELEVANT ISSUES

A. Self-assessment of Strengths, Weaknesses, Opportunities and Threats concerning the regional RES development and innovation strategies for smart specialisation in the sector, based on the information collected in the previous chapters.

**Regional RES SWOT analysis**

| **Strengths** | **Weaknesses** |
|---|---|
| - …<br>- … | - …<br>- … |
| **Opportunities** | **Threats** |
| - …<br>- … | - …<br>- … |

B. Please indicate the most appropriate **degree of regional interest (High, Medium, Low)** in each RES type, according to the territorial characteristics and to policies analysed in the previous chapters.

| | **Regional interest H/M/L** | **Notes** |
|---|---|---|
| **Bioenergy** | | |
| **Hydro** | | |
| **Wind** | | |
| **Solar** | | |
| **Geothermal** | | |

C. For the RES with the highest degree of regional interest or for the RES you would like to focus on within the APPROVE project, please compile a specific SWOT table. Please feel free to provide more than one SWOT table also for additional RES, if this is of interest for you.

**Regional *type of RES* SWOT analysis**

| **Strengths** | **Weaknesses** |
|---|---|
| - …<br>- … | - …<br>- … |
| **Opportunities** | **Threats** |
| - …<br>- … | - …<br>- … |

*As a reference, you may want to consider the following scheme and example (on a specific topic).*

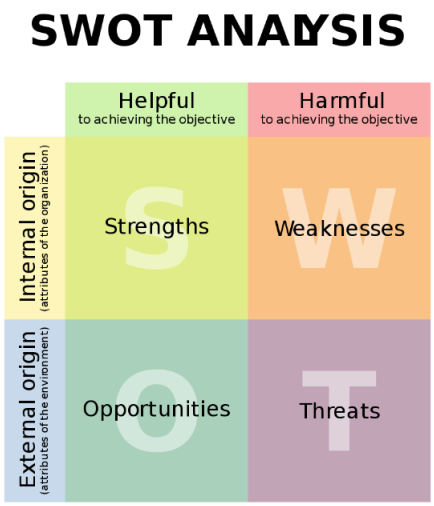


**Table 5**
Regional SWOT for PFF supply chains in SEE representing the result of the iterative regional SWOT formulation process involving various SEE experts from different professional categories. The main strategic issues are shown in a ranked order for the four SWOT categories: strengths, weaknesses, opportunities and threats.

| Internal strengths | Internal weaknesses |
|---|---|
| S1. Sufficient wood quantity | W1. Low profitability due to high procurement resp. investment costs |
| S2. Utilisation of otherwise not marketable timber qualities | W2. Lack of all year round available forest roads and low forest road accessibility |
| S3. Short distribution distances | W3. Weather dependency of harvesting & logging operations |
| S4. European Biofuel Standards | W4. Information deficits and lack of coordination resp. transparency in the supply chain |
| S5. Short procurement distances | W5. Excessive bureaucracy |
| | W6. High variation in quality and moisture of PFF |
| | W7. Lack of qualified work force |
| **External opportunities** | **External threats** |
| O1. Fast growing PFF demand | T1. Raw material competition with forest based/wood processing industry (leading to increasing feedstock price) |
| O2. Increasing wood land area resp. growing stock and high regional biomass resource potential | T2. Unpredictable periodical undersupply |
| O3. Innovation due to R&D in advanced processes for biomass procurement (including ICT), pre-processing and conversion | T3. Natural conservation (e.g. Natura 2000) restricting harvesting |
| O4. Governmental/EU support: $CO_2$-taxes, subsidies, feed in tariffs, research projects | T4. Competition with fossil fuels |
| O5. Instability of fossil fuel supply and volatile fossil fuel prices | T5. Restrictive capital market |

Rauch P. et al., *SWOT analysis and strategy development for forest fuel supply chains in South East Europe,* Forest Policy and Economics (2015), , http://dx.doi.org/10.1016/j.forpol.2015.09.003