Climate Related Energy Developments in Spain

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Report for COMPLEX
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1: Introduction

1.1: General introduction
The following document comprises the first deliverable (3.1) for WP3, "Realizing Climate Policy Options" and presents the results of the project scoping work undertaken for the Spain case study in this WP. Scoping work was undertaken in three discrete consecutive phases, from general (national level) through to region-specific (autonomous community level or NUTS 2) down to case study-specific (province (NUTS 3) or sub-regional level) to allow identification of appropriate case study areas and an appropriate stakeholder community. Following desk-based appraisal work and preparation of preliminary sociograms, information was solicited from stakeholders through telephone survey. Results are presented for the initial appraisal, stakeholder survey and final case study area choice, finishing with a concluding section in which the following steps to be undertaken are defined.

1.2: Background to the scoping statement
It was recognised at the outset that it was neither possible nor desirable to study 17 autonomous regions within the scope of the project (see Description of Work, p.23). Successful application of participatory approaches together with development of a geographical model of land use change in response to climate mitigation options required a more detailed focus. However the exact scale of the model (whether incorporating a series of regions or only a single geographical area such as a province or watershed) could not be determined in advance without risking over generalisation (too large a study area) or excessive precision (too small a study area). In addition, the research team could not reliably define a precise study area of appropriate size without consultation with key stakeholders in land use and energy policy. Finding the appropriate level of study thus required a transparent and structured approach in which stakeholders could be engaged early on to assist in the process.

At the outset, it was clear, for reasons of project scope, that the country scale was too large a study area and that the municipality was too small, being both unsuitable for consideration of landscape scale impacts and of insufficient importance in terms of energy policy implementation (though the municipality does have a great deal of responsibility for land planning). Thus, a compromise solution was required that allowed the least suitable potential study areas to be gradually filtered out as information became available, leaving a manageable study area from the point of view of land use dynamics (would depend on the region, but somewhere between a small province, e.g. The Rioja and a large autonomous community, e.g. Castille-la Mancha is probably about right). The possibility of eventually undertaking participatory modelling work in two contrasting, but smaller, study areas was also not ruled out.

1.3: Project scoping structure
A structured stepwise process was therefore developed to select the most appropriate case study region on the basis of the information obtained from desk-based and participatory information-gathering exercises. This process is described as follows:

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1 According to the EU Nomenclature of territorial units for statistics (NUTS)
3.1A Bibliographic research at national level: Rapid appraisal of Renewable Energy (RE) in Spain from existing available publications and internet sources.

3.1B Case study selection from multiple autonomous regions: Initial stakeholder engagement, data collection and preliminary analysis of land use dynamics and climate mitigation technologies.

3.1C Detail model case study area: A summary of the final detail model case study area chosen.

We considered that the stepwise procedure outlined above offered the following advantages:

- The selection of the final detailed case study was transparent and evidence-based rather than arbitrary.
- Knowledge about RE policy in Spain can be accumulated incrementally from less to more detailed.
- The final detailed case study area can be firmly anchored in its national context.
- The aims and objectives of the COMPLEX project can be disseminated to a wider range of stakeholders as the scoping work flows downwards.
- Region-specific issues can be distinguished from general issues and vice-versa.
- Insulates against failure (if the final case study region proves unsuccessful after the final selection has been made), it is possible to return to the intermediate level (3.1B) where data and stakeholder engagement has already been made.

2: Stage 3.1a - Bibliographic research at national level

2.1: Methods for stage 3.1a

To begin the process a detailed search of available information from internet sources, grey literature and academic publications was undertaken. A rapid appraisal document was prepared detailing the principal RE sources for each of 17 autonomous communities in Spain, the overall energy balance, and the state of the art in terms of policy directives and drivers, as far as was possible to discern from these sources. Likely availability or accessibility of data was also considered.

As a result of this first stage a large amount of information was obtained for each Spanish Autonomous Community, which is available in Annex 1.

A filtering process was initiated on the basis of the information obtained in the rapid appraisal. This involved development of a series of indicators in relation with three different concepts that are key issues for Complex Project as follows:

1. Land use resources/Territory

I1. Mapping availability: indicator takes value 1 if there is cartographic information on RE infrastructures available by internet, even if it is not available for download, and value 0 if there is not.

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2 In this report, the term “Renewable Energy” (RE) has been used. This term is widely used in the scientific and policy literature and is the closest translation of the term “Energías Renovables” used by Spanish stakeholders. For the purposes of this document RE is considered to be broadly equivalent to the term Climate Related Energies (CRE) used in WP2.
I2. Administrative structure: indicator takes value I if it is an insular autonomous community, value M if it is a peninsular monoprovincial autonomous community and value P if it is a peninsular pluriprovincial autonomous community.

2. Renewable energy production:

I3. Energy mix: number of different RE sources for electricity production.

3. Governance and stakeholders:

I4. Energy Planning: indicator takes value EP when a regional energy plan is currently in force, G when a regional energy plan focused on a specific RE is currently in force and O when there is no operative regional energy plan.

I5. Organizations: existence of organizations with publications or research activities related to RE at the studied region.

As this is the first stage of the project, it was considered very important to include as much diversity between regions analysed as possible. By casting the net wide in this way, it was hoped to obtain as broad a spectrum of representative RE implementation scenarios as possible. For this reason, regions were selected to provide maximum variability in the indicators (see figure 1 below), rather than on the basis of optimum responses to the indicators.

Figure 1. Conceptual application of indicators to first phase Complex case study selection.
2.2 Results for stage 3.1a

<table>
<thead>
<tr>
<th>I1. MAPPING AVAILABILITY</th>
<th>I2. ADM. STRUCTURE</th>
<th>I3. ENERGY MIX</th>
<th>I4. ENERGY PLANNING</th>
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Table 1 (above): Responses to indicators I1-I5.

As lack of cartographic information relating to renewable energy might pose a problem for model development, the first decision to be taken was the selection of the three autonomous regions where cartographic information relating to RE was available: Andalusia, Aragon and Castille-and-Leon. Furthermore, by selecting these regions it was also possible to satisfy the variability criteria for indicator 3 Energy mix, as these three regions contained a wide range of RE types. In order to obtain the full range of variability for indicator 2 Administrative structure, The Canary Islands, Navarre and The Rioja were selected, which also provides the full range of variability for indicators 4 and 5.

Even though there are of course other possible combinations of regions that would also ensure variability of the indicators, the selection that has been made is considered to be representative of the range of different situations likely to be encountered in Spain.

Application of these indicators allowed 11 regions to be discarded. Six study regions remained that could be considered suitable for further investigation. These were the autonomous communities of Aragon, Andalusia, Castille-and-Leon, The Canary Islands, Navarre and the Rioja. Even though it was clear that these 6 areas still constituted too large and diverse a geographical scope for full model
development and participatory approaches to be undertaken, the knowledge base was not yet sufficiently developed to allow further refinement.

Although Climate Mitigation policy (CMP) options are quite diverse (including, for example, energy conservation), measuring the implications of these at the scale of the landscape is more difficult. It was therefore necessary to define more precisely the kind of Climate Mitigation Policy options that were likely to have direct impacts in terms of land use change. For this reason, it was decided to focus primarily on renewable energy landscape-related features (RELF) (wind turbines, biofuels, solar installations etc.). Though the expansion of RELF were felt by researchers to be the most likely to produce land use impacts, stakeholders were also consulted on this point to ensure that important, less obvious land use impacts were not excluded. To give one example, changes to building regulations implemented through CM policy might have landscape impacts through reduced demand for building materials (increased or decreased mining or quarrying activity, deforestation or afforestation). A second example might be the way in which stricter controls on vehicle emissions might reduce traffic, with knock on effects on road building and quarrying activity (less demand for roadstone).

3: Stage 3.1b - Case study selection from multiple autonomous regions

3.1: introduction to stage 3.1b
At this stage of the work, the OCT COMPLEX team has carried out more detailed research and engaged key stakeholders both at national level and in the six regions selected in the previous stage (see 3.1A). This second analytical phase of the project was carried out in these six areas in order to arrive at one final detailed study region for development of the PLUS4-CMP simulation model, which is known as PLUS4-CMP (Participatory Land Use Scenarios for Climate Mitigation Policy).

PLUS4-CMP (still currently at design stage) will combine Participatory Action Research (PAR), the Contextual Interaction Theory (CIT) approach as applied by De Boer and Bressers (2011) and a land use model. This approach had implications for the regions selected. Prior to the intermediate analytical stage discussed here, all members of WP3 met in order to define the most relevant requirements to be used as a basis for the selection of the final detailed study area:

With respect to CIT and PAR it was agreed that the selected territory should have

- Potential implementation problems
- Ambition to move forward in Renewable Energy (RE) implementation
- Bottom-up actions/Local initiatives on RE and Climate Change (CC)
- Interest and involvement of stakeholders

With respect to the Land Use Model, the selected territory should have:

- Good data availability and data quality (land use and land cover (LUC)\(^3\) and RE cartography)

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\(^3\) No distinction is made here between land cover (e.g. vegetation classes) and land use (e.g. agriculture). The principal dataset used (Corine Land Cover) combines land use and land cover. Though clearly these are
• Good evidence for LUC change associated with RE technologies
• Interest and involvement of stakeholders

3.2: Methods for stage 3.1b
In order to collect the necessary information to come to a decision, two different approaches were used: a) an LUC analysis to measure the importance of LUC change associated with RE implementation and the establishment of what we have termed Renewable Energy related Landscape Features (RELF), especially focused on wind energy and solar energy; and b) initiation of a participatory process using techniques based on those employed in Participatory Action Research (following Chambers 1994, Pretty 1995, Villasante et al. 2000, Castellanet and Jordan 2002, Villasante 2006, McIntyre 2008, Hernandez-Jimenez and Winder 2010, Guzman et al 2013) specifically, sociograms and semi-structured interviews with selected national and regional stakeholders involved in the implementation of the RE policies.

On the basis of the requirements described above, six indicators were defined to allow selection of the final detail case study area.

3.2.1: GIS analysis of LUC occupation
The main objective of this analysis was to measure the effect, in terms of LUC occupation, both in absolute terms (hectares) and relative to the total area (%), of RELF in the six phase 2 study regions. This allows the potential for LUC change associated with RELF to be tested.

First, the location of the RELF was plotted in order to evaluate the spatial variability of RELF within each Autonomous Community so as to allow smaller focus regions to be selected where necessary.

With respect to land occupation by RELF, the proportion of the LUC category occupied (agriculture, forest, urban) was obtained by means of cross tabulation of two datasets: Corine Land Cover (CLC) level 3 (year 2000) for the LUC categories and the Land Cover Information System for Spain (SIOSE) for the year 2005 for the RE occupation. Cross-tabulation analysis is a well-known geographical information analysis technique frequently employed in investigation of land use and land cover change (e.g. Pontius et al 2004, Shalaby and Tateshi 2007, Hewitt and Escobar 2010). The spatial coincidence of two GIS layers or ‘coverages’ is explored by plotting the categories of the first layer against each category of the second layer, and expressing the results in the form of a contingency table. CLC is part of the CORINE (Coordination of Information on the Environment) programme, an integrated land resource management system for the whole European community, initiated in 1985, with the aim of guiding international land resource policy across national boundaries. It is a large scale (1:100,000) high resolution dataset obtainable free of charge through the European Environment
Agency (EEA 2007). SIOSE, by contrast, is a national database that covers the whole of the Spanish territory, providing detailed land cover information at a very large scale (1:25,000).

Wind energy and solar energy provided the focus because they are the most extensive in terms of land occupation in Spain (OSE 2009,2012). However, since most solar infrastructures were implemented between 2006 and 2009 they will therefore not be detected by our analysis. SIOSE 2009 will be available to the COMPLEX project in the near future however. This will permit a more exhaustive analysis of the effect of solar energy infrastructures on LUC to be carried out.

A full description of CLC2000 LUC categories used in this analysis can be consulted in appendix 2.

Three main results of this analysis are presented in deliverable 3.1:

1. Location of RELF.
2. Land occupied by RELF.
3. Proportion of land occupied by RELF by LUC type.

3.2.2: Stakeholder sociograms and interviews
The methodological framework employed for the participatory process was based on participatory approaches typically used under PAR. In particular, three tools taken from PAR were used: sociograms, semi-structured interviews and discourse analysis. These techniques are explained below.

With the first phase of the participatory process three objectives were defined:

1: Engage main stakeholders with COMPLEX project
2: Develop an understanding of the regional aspects of the implementation of RE policies.
3: Request digital cartographic data for regional RELF and LUC for GIS analysis and subsequent model development.

Sociograms
The objective of a sociogram, a well-known sociological and anthropological research technique, is to establish the social relations that exist between groups, institutions, or individuals through graphical representations, to illuminate the trusts, misgivings or connections that could be of interest at a given time in a specific sectoral or territorial community (Villasante, 2006).

These sociograms have two general objectives:

a. To identify sets of action present in the study area using the definition coined by Villasante (2000). We understand joint action to mean "a series of small social networks", which set out different types of
relationships "in very varied processes" framed within specific socio-economic and cultural constraints Villasante (2000).

b. To establish the social relations existing among these small social networks. The knowledge of existing power relationships can be the basis for the construction or re-construction of relationships that articulate various shared proposals.

**Semi-structured interviews**

The interview is a qualitative technique that uses data obtained from recording conversations with an informant or informants. The interview is not considered a normal conversation, but a formal conversation, intended to focus on some of the perceived objectives of an investigation. For this kind of interview it is necessary to determine the relevant required information in advance.

The technique used is 'open questions', giving the opportunity to perceive more nuances in the response; this allows for interconnected issues to be explored, but requires a great deal of researcher attention to be able to appropriately channel and develop the discussion topics.

According to Ruiz Olabuenaga (1999) this process is effective for the following reasons:

- It is a conversation, not an interrogation.
- Given that the conversation does not have a fixed structure it is necessary to direct or channel the issues, or to use words that encourage and motivate the interviewee.
- The attitude of the interviewer has to be friendly but professional.

**Discourse Analysis** is central to this early phase of the research. The key relevant topics used in the analysis were based on the literature review undertaken previously and the transcription of the interviews.

This analysis allowed the OCT COMPLEX team:

- To define positions and strategies of stakeholders through their discourse.
- To identify stakeholders as well as relationships.
- To establish milestones (key development points for RE technologies and their implementation) in the region.

This analysis was carried out after the semi-structured interviews had been held. This process serves as a check on information previously obtained through other sources (e.g. literature, internet).

The first task undertaken to initiate the participatory process was to identify and map the main national and regional stakeholders. The team carried out several preliminary sociograms based on the literature review: one sociogram was developed at national level and 6 at regional level, one for each Autonomous Community selected for more detailed study. To do this we used the 'Venn diagram' technique in which stakeholders were represented using circles. At this point the team still doesn't know what social relations exist between groups, institutions, or individuals identified so this doesn't
yet appear in the sociograms. It will be necessary to develop the sociograms further when the
preliminary participatory phase is completed to include the new information arising from newly
identified stakeholders.

At a national level, two stakeholders were selected and for each region, two stakeholders were
selected. Both national and regional level stakeholders were contacted to carry out an open but
structured telephone interview. (see Appendix 3 to see the interview pro-forma). Some stakeholders
did not wish to participate; these individuals were substituted by other, related, stakeholders where
possible.

Interviews lasted about 50 minutes each and covered four main issues: RE current situation and
tendencies, regional policies, stakeholders involved in the process and cartography availability. 9
interviews were carried out in total, at least one per region.

The most important results of these analysis are summarized below in the form of a preliminary
sociogram and detailed text description:

3.2.3: Indicators for selection of case studies:
The 6 requirements specified above (introduction) for development of the PLUS4-CMP simulation
model were used as indicators for selection of the case studies. These were as follows.

1. Identification of potential implementation problems: social conflicts in relation with RE
infrastructures, lack of legislation.

2. Ambition to move forward: For the case study, the presence of ambitious regional policies to
combat CC was considered highly desirable. It was considered important to determine what
kind of objectives had been fixed by the regional governments for RE implementation and to
which point they had complied with these objectives.

3. Bottom-up actions/Local initiatives on RE or CC. As a key determinant in the success of
failure of policy actions at implementation stage, it was important to evaluate the presence or
absence of social involvement with energy issues. Of particular interest were initiatives arising
from within the population itself, especially those that have been carried out over a long or
medium time period. If no such initiatives were known to exist, other actions directed towards
local environmental sustainability were taken into account.

4. Interest and involvement of stakeholders: Clearly, the level of interest and involvement of
stakeholders would be key to the successful completion of participatory activities as part of
model development. This first contact with stakeholders was therefore used to assess the
level of interest and likely level of future involvement of key stakeholders in future participatory
activities. The telephone interviews were therefore also used to establish whether
stakeholders responsible for or involved in the implementation of RE were interested in
collaborating with the COMPLEX project.

5. Availability and quality of cartographic data for both LUC and RELF. With respect to LUC
cartography, CLC is available for all regions. In addition, an LUC cartographic dataset (known
as SIOSE) was found to exist. Unlike CLC, SIOSE incorporated RELF directly as LUC
categories. SIOSE covers only the year 2005 at present, though a 2009 dataset is likely to be available soon.

In addition, some regions have developed a regional LUC dataset over a series of dates (e.g. 1990, 2000, 2006). This is likely to be useful in future stages of the project.

6. **Association of RE technologies with LUC:** In order to measure the quantity of land in each of the six intermediate study regions associated with RELF (wholly or partially occupied by it), a GIS analysis was carried out in which RELF drawn from SIOSE 2005 were cross-tabulated against CLC2000. For the land use model development it is necessary to associate RE uses with LUC categories and to observe (explicit or implicit) LUC change. A region where no change of this kind can be detected has no observable LUC change dynamic associated with RELF and will not be chosen for further research.

Results obtained for these above listed indicators are specified below in the individual sections for each of the six Autonomous Communities selected for study at this level, with the exception of indicator 3: *Bottom-up actions/Local initiatives on RE or CC.* Although a question related to this issue was included in the interviews (see interview proforma in Appendix 3), stakeholders only knew about top-down local initiatives (e.g. municipal planning on energy saving). As a result, it was decided to eliminate this indicator in this phase. Once a detailed case study region has been selected and the second phase of the participatory process has been initiated, it will be possible to return to this issue with stakeholders equipped with the appropriate knowledge of these kinds of local initiatives.

### 3.3: Results for stage 3.1b - National level

#### 3.3.1: Stakeholders and interviews

The preliminary sociogram for the whole Spanish territory shows a range of organizations working on Renewable Energies and Climate Change. The Ministry of Industry, Energy and Tourism is a national government department. The IDAE (Institute for Diversification and Energy Savings) is an agency under the Ministry of Industry, Energy and Tourism, linked through the office of the Secretary of State for Energy. IDAE contributes to the achievement of national objectives in terms of the improvement of energy efficiency, renewables and other low-carbon technologies.

Other institutions linked with the government are:

The OECC (Spanish Office of Climate Change). One of the main objectives of the OECC (created in 2001), is to enhance awareness of the causes and effects of climate change in government and in wider society.

FB (Biodiversity Foundation) is a public foundation established by the Spanish Government, under the Ministry of Agriculture, Food and Environment. FB works to preserve natural heritage and biodiversity, through the generation of employment, wealth and welfare of the society as a whole. One of the strategic objectives of FB is the fight against climate change.

The business sector is organized under APPA (Association of Renewable Energy Producers). Two other big lobby platforms, dedicated to wind and solar energy were also found.
AGRESTA and COALICIÓN CLIMA are businesses that have some actions related to RE and are also linked to the environmental sector generally.

There is an important scientific organization, BC3 (the Basque Center for Climate Change), which specializes in long-term research about the causes and consequences of climate change.

Four environmental organizations, some of them with regional representation, are also working on RE and CC.

In the Media sector we find the Renewable Energy Magazine (http://www.energias-renovables.com/). The COMPLEX project contacted and interviewed the IDAE. A summary of the interview is presented as follows:
Interview summaries

• **Past tendencies and current RE**: According to our interviewee, RE in Spain was given strong impetus by the Law 54/1997. This law provided the basis from which all regulations have been developed. Each RE type has its own particular evolution.
  
The interviewee thinks that wind energy has had a very gradual evolution but was strongly developed from the year 2000 (the interviewee does not comment on the reasons).
  
According to the interviewee, the year 2007 was a turning point for photovoltaic solar energy as 2007 saw the establishment of a regulatory framework. This represented a decisive push for RE development through the use of temporary economic incentives. The interviewee considered that the years 2000 and 2007 were what he referred to as *key dates* for the development of wind power and photovoltaic solar energy respectively.
  
On the other hand, the interviewee did not think it possible to speak about a particular key date for biomass energy because it still hasn't seen strong development. In relation to offshore energy, the interviewee observed that the technology was so incipient that it isn't possible to speak about key dates for development of this type of energy either.
  
From the interviewee's outlook, RE development has entailed both a regulatory framework combined with technological breakthroughs. The interviewee considered that “poor legislation” was implemented by the previous government that had to be corrected.
  
On January 2012, the Popular Party government approved the Royal Decree 1/2012 that resulted in the indefinite suspension of all economic incentives via the special energy mechanism (Spanish legal term that includes all those electric energy generation technologies that use renewable energies, waste and co-generation).

• **LUC changes/Conflicts**: IDAE does not have this kind of information. Although IDAE has a general idea about these topics, this information is held by the autonomous communities who are responsible for establishing their own land development regulations.

• **Future**: The interviewee sees a question mark over the future of RE due to both the economic crisis and the fall in the consumption of energy. He thinks that all actors involved in RE are now waiting to see what will happen in the near future. The subsidy regime for RE was halted in 2012 following the economic crisis and since then new RE systems are not being implemented, because they cannot compete on price with the conventional energy production systems.
  
In relation to the fulfillment of the 20-20-20 objectives (objectives approved by the European Council for the year 2020) he tells us that Spain has already achieved its target of 20% of the energy consumption coming from RE sources.

- **Social sectors involved with RE**: According to our interviewee, the main actors involved in RE implementation in Spain are institutions and companies (investors).

- **Cartography availability**: IDAE does not hold or manage cartographic data.
3.4: Results for stage 3.1b - Region-specific

3.4.1 Andalusia

And1: Overview of location of RELF by LUC category.

According to SIOSE (2005), 594ha (0.08%) of the Andalusian territory were dedicated to wind energy infrastructures and 183ha to solar infrastructures. Wind energy energy has been developed particularly in Cadiz province and, to a lesser extent, in Granada, Almería and Sevilla. Solar infrastructures have been developed particularly in Almería and the provinces of the north of the region: Córdoba and Huelva (see figure A1).

With respect to the LUC categories that have been occupied by these RELF, wind energy installations have mainly been developed on natural land: Sclerophyllous Vegetation (29.4%) and Natural Grasslands (25.9%), and on Construction Sites (18.1%), (see figure A2 for a more detailed description). On the other hand, solar energy infrastructures seem mainly to have occupied agricultural areas: Non-irrigated Arable Land (43.1%), Complex Cultivation Patterns (14.4%). Solar installations have also occupied natural land, especially Sparsely Vegetated Areas (20.4%), though to a lesser extent than agricultural land (See figure A3).
Figure A1. Andalusia – Location of Renewable Energy related Landscape Features (RELF) according to SIOSE (2005)
Wind energy in Andalusia - Land uses

Solar energy in Andalusia - Land uses
And2: Stakeholders and interviews

The preliminary sociogram for Andalusia shows a range of organizations working on Renewable Energies and Climate Change. In the regional government there are some departments involved. The business sector is organized under APREAN (Andalusian Renewable Energy Producers and Developers association). We also found a scientific organization, CTAER (Renewable Energies Advanced Technology Centre), specialized in RE. These three sectors are linked in the Andalusian Cluster of Renewable Energy. Two environmental organizations, with regional representation, are also working on RE and CC, but they are not involved in the cluster.

COMPLEX project has contacted and interviewed the AAE (Andalusian Energy Agency) and APREAN.

Interview summaries

- **Past tendencies and current RE situation**: RE began to be implemented in Andalusia in the 1980s, when the first wind farm was established at Tariza (Cádiz). Wind energy started to be profitable in the 1990s and much more profitable around 2004-2005. Solar
Photovoltaic energy was rapidly developed between 2007 and 2010 due to the increase in subsidies available under national legislation. With the elimination of subsidies in national legislation in 2012 development ceased.

Both stakeholders agree on the fact that regional administration is supporting RE development in the region, but under the current national legislation further development would be quite difficult.

- **LUC changes:** In general, photovoltaic has been installed in less productive agricultural areas and wind energy infrastructures in natural areas, and it is compatible with other agrarian or livestock uses. However, in the days of economic prosperity, photovoltaic projects had to compete with tourism-related developments such as golf courses.

- **Conflicts:** Both stakeholders felt that conflicts related to the location of RE infrastructures had been overcome. They highlighted some conflicts in the past related to landscape impacts of wind farms, with environmentalists’ groups (due to impacts on birds) and with other groups such as hunters. Currently, off-shore wind energy developments have encountered some conflicts with fishing.

- **Future:** The Administration considers that RE in Andalusia has a future due to its natural resources, social support and regional authority support. However the future is conditioned by the legislation at the national level. In APREAN they are optimistic about the future due to the ongoing policy activity at a national and international level (agreements, summits, legislation) around CC and RE.

- **Policies:** Andalusian Plan of Energetic Sustainability (PASENER), in which RE plays a fundamental role. PASENER came to an end in 2013 and its objectives have been achieved. Work is presently being undertaken on the new plan which will succeed PASENER.

  There is regional economic support for some RE projects.

- **Social sectors involved with RE:** From the beginning, the RE sector was developed by big companies, however there are also some smaller companies involved with 100% Andalusian capital, especially in the photovoltaic energy sector.

- **Cartography availability:** AAE has cartographic information of RE location, some of which would be extremely useful for the COMPLEX project. Unfortunately, AAE have refused access to some data.

And3: Regional indicators

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>I1 Potential implementation</td>
<td>Conflicts with national legislation. Initially, there were some conflicts with environmentalists and hunters’ groups, but stakeholders interviewed find them overcome. Currently, off-shore developments have conflicts with fishing.</td>
</tr>
<tr>
<td>problems</td>
<td></td>
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<tr>
<td></td>
<td>Ambition to move forward</td>
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<td>----------------------------------------------------------------------------------------</td>
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<tr>
<td></td>
<td>Interest/implication of stakeholders</td>
</tr>
<tr>
<td></td>
<td>Data availability/quality</td>
</tr>
<tr>
<td></td>
<td>Possibilities for LUC change</td>
</tr>
</tbody>
</table>
3.4.2: Aragon

Ara1: Overview of location of RELF by LUC category.

According to SIOSE (2005) no land was dedicated to solar energy uses at that time. However, stakeholders drew attention to a boom in solar photovoltaic power in Aragon that took place in 2007, subsequent to the development of this cartographic dataset. More up-to-date information with respect to solar photovoltaic power is likely to be available when SIOSE 2009 is released in the near future. Wind energy installations occupy 693.3ha, which represents 0.14% of the total territory of Aragon. These infrastructures are mainly located in Zaragoza (Saragossa) province, with some of them in the south of Huesca (see figure Ar1).

In relation to LUC, these wind energy infrastructures have been located particularly in agricultural areas: Non-irrigated Arable Land (66.56%), Complex Cultivation Patterns (5.45%) and Land Principally Occupied by Agriculture With Significant Areas Of Natural Vegetation (4.72%). A significant proportion of wind energy infrastructures are located in natural areas, particularly Sclerophyllous Vegetation (14.61%). See figure Ar2 for a more detailed information.
Figure Ar1. Aragon – Location of Renewable Energy related Landscape Features (RELF) according to SIOSE (2005)
Figure Ar2.

Wind energy in Aragon - Land uses

- Continuous urban fabric
- Discontinuous urban fabric
- Road and rail networks and associated land
- Non-irrigated arable land
- Permanently irrigated land
- Olive groves
- Complex cultivation patterns
- Land principally occupied by agriculture
- Broad-leaved forest
- Coniferous forest
- Mixed forest
- Natural grasslands
- Sclerophyllous vegetation
- Transitional woodland-shrub
- Sparsely vegetated areas
**Ara 2 Stakeholders and interviews**

Our preliminary sociogram for Aragon shows some regional stakeholders currently working on CC and RE in Aragon. Responsibility for RE in the regional government falls within the department for energy planning. The business sector has no organization specifically focused on RE, but RE development is included in more general business organizations. However, there is an organization called Fundación Hidrógeno focused on RE, mainly Hydrogen, where the business sector collaborates with the regional government. In addition, some environmental organizations with representation in Aragon are now working on RE and CC. There is a scientific organization supported by the regional government, CIRCE (Research Centre for Energy Consumption and Resources).

The COMPLEX project has contacted and interviewed the Energy Planning Department and CIRCE.

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**Interview summaries**

- **Past tendencies and current RE situation:** Renewable energy production in Aragon started in the 1990s. It produces wind energy, solar, biomass and biogas and geothermal energy as a residual production source, however wind and solar energy are the main RE production
sources. Wind energy infrastructures were the first to be implemented and the implementation process was slower than in the case for solar energy. Photovoltaic energy took off in 2004-2005, and especially after 2007 until 2011, as in the rest of the country. In the opinion of the stakeholders interviewed, when the national legislation framework was modified, Aragon was less well prepared for the changes than other autonomous communities (the interviewee did not specify which). Stakeholders considered the capacity of the electricity network, controlled by the big electricity companies, to be the key element impeding the development of RE in Aragon.

- **LUC impacts:** RE infrastructures mainly occupy uncultivated areas or less productive agricultural land. At the moment, there are 70 windfarms located in pseudostepparic land. Photovoltaic infrastructures are distributed in small solar orchards. In the opinion of stakeholders, the area occupied by RE infrastructures is low in relation to the total area of the region, and is quite compatible with agricultural production. However, agricultural land use is combined with energy uses only where agricultural land is productive.

- **Conflicts:** There were some conflicts in the beginning, 10 or 12 years ago. Nowadays, the main conflicts are with the neighbouring regions that have decided to protect landscape instead of developing RE but suffer nonetheless from the visual impacts of RE infrastructures implemented in Aragon.

- **Future:** Both stakeholders are optimistic about the future of RE sector, not only in Aragon, but also in Spain and Europe as a whole. CIRCE says that if RE development is currently stalled, it is simply a result of the prevailing economic circumstances, and that the only risk for RE development in the future could be the emergence of a new more competitive energy source (for instance shale gas extraction (fracking) if this were shown not to have negative environmental impacts).

- **Policies:** CIRCE has no in-depth knowledge of the regional legislation and was unable to answer this question. All of the following responses are therefore those given by the stakeholder from the energy planning department of the regional government.

There is a regional energy plan which includes RE objectives. One objective of this plan is to double the energy produced from renewable sources (particularly wind energy and hydropower from irrigation reservoirs) by 2020 and not to increase the energy coming from conventional sources. The stakeholders consulted considered that whether or not these objectives can be attained will depend on the national legislation. Surprisingly, this stakeholder also considered it necessary to increase overall energy demand.

The regional government have an agreement with Red Eléctrica (the main electricity distributor) which determines the amount of energy permitted by the network.

The regional government have some regional subsidies to RE supporting mini-hydropower installations for irrigation and biomass coming from forest exploitation.

- **Social sectors involved with RE:** The regional administration is now working on the next energy plan and it is the first time that they have developed a participatory process involving,
among others, research centres, environmentalists’ groups, trade unions and consumer groups.

From CIRCE’s perspective, RE development is in the hands of RE infrastructure investors and developers, business associations, regional and national governments and Red Eléctrica. As this market has a turnover of approximately one million euros per installed megawatt (MW), research and social groups find it difficult to become involved in the decision process.

- **Cartography availability:** There is no regional cartography either for LUC or RE infrastructures.

### Ara 3: Regional indicators

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>I1 Potential implementation problems</td>
<td>Conflicts with national legislation. Electricity network capacity. Conflicts with neighbouring regions because of landscape impacts.</td>
</tr>
<tr>
<td>I2 Ambition to move forward</td>
<td>By 2020: duplicate RE production, maintain energy production from conventional sources, even when they produce more energy than they need.</td>
</tr>
<tr>
<td>I4 Interest/implication of stakeholders</td>
<td>Both stakeholders interviewed seem to be interested in Complex project.</td>
</tr>
<tr>
<td>I5 Data availability/quality</td>
<td>There is no regional cartography either for LUC or for RE location.</td>
</tr>
<tr>
<td>I6 Possibilities for LUC change</td>
<td>Currently, 0.14% of the territory (693ha) Wind energy mainly located in agricultural areas (particularly Non-irrigated Arable Land)</td>
</tr>
</tbody>
</table>
3.4.3: Canary Islands

Can 1: Overview of location of RELF by LUC category.

According to SIOSE (2005) 110,32ha of land is dedicated to wind energy production and 0.05ha to solar energy production, which represents in total 0.15% of the total regional territory. There are more wind energy production projects located in Gran Canaria, but projects located in Tenerife occupy a larger area. (see figure Can 1).

In relation with LUC changes, wind energy infrastructures have been implemented in both natural (52,47%) and agricultural areas (43,3%). Natural land comprises mainly Sparsely Vegetated Areas (33,18%) and Beaches, Dunes and Sands (14,82%) with Sclerophyllous Vegetation less well represented (4,47%). Agricultural land comprises non-irrigated arable land (26,12%), permanently irrigated land (15,76%) and pastures (1,41%)

Solar energy infrastructures are less dispersed than wind energy installations and all of them (100%) occupy Permanently Irrigated Land.
Figure Can 1. Location of Renewable Energy related Landscape Features (RELF) according to SIOSE (2005)
Our preliminary sociogram shows some regional organizations currently working on RE in Canary Islands. Responsibility for RE in the regional government belongs to the Employment, Industry and Trade Department, but island authorities (e.g. Cabildo of Tenerife) also play a role. Scientific organizations working on RE and CC in the Islands are partly owned by the regional government, for example ITC (Canary Island Technical Institute). ITER (Technical Institute of RE, working especially in Tenerife) is also linked to the island authority (Cabildo de Tenerife) and has both research and business activities. In the Canary Islands we also find some environmental organizations working on CC and RE.

The COMPLEX project has made contact with the Cabildo de Tenerife, the Regional Government, ITC and ITER, but only ITER wished to be interviewed.
Interview summaries

- **Past tendencies and current RE situation:** Mainly wind and solar energies have been developed up to now. 145MW of wind energy and 156MW of photovoltaic energy have been installed. Hydroelectric power has still not been developed, there is only one mini-hydropower station (1MW) constructed. Finally, geothermal production is still at the prospection phase.

The first wind farm was constructed 25 years ago. Initially, wind energy developed fairly rapidly, but has been limited by the size of the territory and the nature of electricity supply and distribution (the Canary islands have six small independent electricity networks). In addition, the trade winds cross the islands throughout the year. The interviewee considered that much more advantage could be taken of this important and renewable resource.

Land planning for energy infrastructures is now being prepared. As this document does not yet exist, each energy project has to be sent to the municipal planning authority which slows the process down. This was a key factor in delaying the development of solar energy in the Canary Islands in recent years (2006-2008) when legislation was more favourable than at present.
Since 1997, the Industry Department has been responsible for announcing tendering processes for RE power installation (in accordance with both land capacity and electricity network capacity). These announcements have been very conflictive. The first was made in 1997, the process was later annulled due to corruption issues. A subsequent invitation to tender was made in 2009, when the installation of 440MW was announced, however contracts have not been awarded due to the Environmental Assessment Process. In addition, Red Eléctrica has recently modified its energy distribution network planning due to the economic crisis.

Photovoltaic energy development has been different in the different islands as the island governments (Cabildos) are responsible for land planning. About 70% of the photovoltaic energy production infrastructures are located in Tenerife.

According to the interviewee, under the new national regulations in force since January 2012, the situation has become uncertain and development has stopped. Furthermore, prices payed for the electricity produced by renewable sources have gone down from 3 euros per Watt-Peak (Wp) to 0.6 euros per Wp, mainly due, in the opinion of the interviewee, to market expansion and the entry of China in the market.

In summary, the interviewee considered that photovoltaic energy development was more in line with the rest of the country, but wind energy development has completely stopped and technologies are outdated.

As difference between energy costs between conventional and renewable sources are much greater in Canary Islands than in other Autonomous Communities, a Working Group has been created which includes the Industry Ministry and the Canary Islands' regional government to analyse the Canary Islands' specific situation in relation to energy prices and to give special consideration to the case for wind energy.

In order to stimulate RE production in the Canary Islands it would be necessary to work on costs, net balance legislation for private individuals and bringing the national moratorium to an end.

- **LUC changes:** Photovoltaic energy has been installed mainly on agricultural land and wind energy on agricultural and industrial land.

- **Conflicts:** As Canary Islands are a small territory and have fragile environmental values, environmentalists’ groups have big impact. There are some conflicts with these groups in relation to the environmental impacts of RE infrastructures.

- **Future:** In the short term, the future of RE seems to be quite dark due to the economic crisis. In the case of photovoltaic energy, the number of RE production hours that are payed at a subsidised price have been already reduced and a further reduction is rumoured. This situation could drive small businesses to bankruptcy.

In the case of RE infrastructures installed on buildings, development is presently stalled, though the interviewee felt that they will probably be developed in the medium term.
• **Policies**: In Canary Islands, there is a regional plan (PECAN), which establishes specific objectives. These objectives have recently been reviewed and reduced. However, even these reduced objectives still seem to be unachievable. Photovoltaic energy is closest to achieving its objectives, but there is a long way to go with other RE sources.

• **Social sectors involved with RE**: Environmentalists’ groups, the Industry Department of Canary Islands regional Government, island governments (Cabildos) with responsibilities for land planning, ITER, ITC. There is also a developers cluster (ACE), and an installation cluster (RICAM)

• **Cartography availability**: There is no cartography available for use by the COMPLEX project.

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>I1 Potential implementation problems</td>
<td>Conflicts with national legislation.</td>
</tr>
<tr>
<td></td>
<td>Lack of land planning for RE installations.</td>
</tr>
<tr>
<td></td>
<td>Electricity network capacity.</td>
</tr>
<tr>
<td></td>
<td>Conflicts with environmentalists’ groups.</td>
</tr>
<tr>
<td>I2 Ambition to move forward</td>
<td>There is a regional plan (PECAN), which establishes specific objectives.</td>
</tr>
<tr>
<td></td>
<td>These objectives have recently been reviewed and reduced.</td>
</tr>
<tr>
<td>I4 Interest/implication of stakeholders</td>
<td>OCT has contacted 4 different stakeholders and only one wished be interviewed.</td>
</tr>
<tr>
<td></td>
<td>RE development is especially interesting in Canary Islands due to the higher cost of conventional energy than on the mainland.</td>
</tr>
<tr>
<td>I5 Data availability/quality</td>
<td>There is no regional cartography either for LUC or for RE location.</td>
</tr>
<tr>
<td>I6 Possibilities for LUC change</td>
<td>Currently, 0.15% of the territory (110.37ha)</td>
</tr>
<tr>
<td></td>
<td>Wind energy is located in both agricultural and natural areas.</td>
</tr>
</tbody>
</table>
3.4.4: Castille-and-Leon
CyL 1. Overview of location of RELF by LUC category.

According to SIOSE (2005), there are 1057ha dedicated to wind energy production and 62ha to solar energy, representing 0.12% of the regional territory.

Wind energy is mainly located in the east of the region, particularly in the provinces of Soria and Burgos, but also in Zamora, León, Ávila, Salamanca and Segovia. Solar energy infrastructures are located in Zamora, Valladolid and Palencia. (see figure CyL1)

In relation to land occupation, wind energy infrastructures have been located particularly in natural areas (95.2%): Sclerophyllous Vegetation (32.5%), Natural Grasslands (26%) and Moors and Heathland (13.3%). Solar energy has been installed in both natural (56.6%) and agricultural (43.4%) areas. RE infrastructures installed in agricultural areas have occupied mainly Non-irrigated Arable Land (30.6%), although some are also found on Permanently Irrigated Land (9.7%) (see figure CyL2 for more detailed information).
Figure CyL1. Location of Renewable Energy related Landscape Features (RELF) according to SIOSE (2005)
Wind energy in Castille and Leon - Land uses

Solar energy in Castille and Leon - Land uses
Cyl2 Stakeholders and interviews

As shown in the first sociogram for Castille-and-Leon, there are some institutional departments with responsibilities in RE both at the regional and provincial levels. The business sector is also organized into some associations. There is one environmental organization working on RE and CC and both Valladolid University and one regional RE specialized training centre are also working on RE research. However, as far as researchers were aware, there is no common space for the different groups to work together.

The COMPLEX project has contacted EREN (Regional Government Department in charge of Energy Issues) and Valladolid University. A researcher specialized in RE in Castille-and-Leon from Valladolid University has been interviewed.

Interview summaries

- **Past tendencies and current RE situation:** Wind energy has been implemented everywhere in the region since 2000. In 1999 a regional plan was drawn up for wind energy development that fixed as an objective the generation of 7000MW of power from this RE source. Currently, Castille-and-Leon is producing 5200MW. However, at present, wind energy development is
slower than previously as, when national legislation was last modified, energy produced from renewable sources was no longer subsidised.

The photovoltaic energy development boom began in 2008, but ended in 2010. Previously some small solar gardens were installed and later some small local investors had been involved. However, during the boom years, big businesses invested in solar energy and even some areas that were also highly productive for agriculture were used for energy production, principally as a result of speculation.

In relation to biomass, the regional government is trying to incentivise this type of production, but success has been limited.

- **LUC changes:** Solar energy has been installed in agricultural areas (medium quality), and the agricultural land use was mostly eliminated by the concrete raft foundations for the solar installations. Wind energy developments have mainly taken place in natural areas and is compatible with other uses. Recently, wind energy developments have also been located in less productive agricultural areas.

- **Conflicts:** There are no major conflicts. In the case of wind energy, there are some conflicts with the neighbouring Autonomous Communities. For instance, Cantabria has chosen a land planning model in which natural and landscape values are highly protected. Meanwhile, Castille-and-Leon has opted for a land planning model more strongly oriented towards use of their productive resources. In these circumstances areas of the Cantabrian border are affected by the landscape impacts of RELF implemented in Castille-and-Leon.

Another conflicts source is the distribution of the economic benefits which usually accrue to municipal authorities. There is a debate about where exactly this money should be spent, on services for the whole municipality or on services for those areas located next to RELF.

- **Future:** The interviewee was optimistic about the future because Castille-and-Leon is a big and depopulated territory, in his opinion much of this large surface area could be dedicated to energy production.

- **Policies:** A wind energy regional plan from 1999 fixed some standards but it didn’t include information related to location of RELF. In addition, a biomass plan has also been drafted with much more detailed information. There is no plan for solar energy.

The wind energy plan includes objectives (7600MW is as much as the electricity network can support), and in the interviewee’s opinion this is achievable. At this moment, many turbines are about 15-18 years old and their life expectancy is 20 years. Newer turbines are more efficient, so energy production can be substantially increased in the near future without more land occupation, just by replacing the turbines.

- **Social sectors involved with RE:** Investors, regional government who stimulates RE development, local governments who have the responsibility of giving construction licenses, local environmentalists’ groups (urban dwellers coming to the villages at weekends looking for an attractive landscape), national environmentalists’ groups, and the local population, who have been forgotten in the RE development process.
- **Cartography availability**: EREN has some RE maps in kml format (GIS file format used by Google earth) directly downloadable from their webpage. The COMPLEX team asked them for these maps in a different format (shapefile), but EREN was not able to provide them.

The Valladolid University researcher who has been interviewed has developed a very detailed cartography of wind energy infrastructures and he would be happy to collaborate with the COMPLEX project in further phases of work.

There is no regional LUC cartography.

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Results</th>
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<tbody>
<tr>
<td>I1 Potential implementation problems</td>
<td>Conflicts with national legislation.</td>
</tr>
<tr>
<td></td>
<td>Conflicts with neighbouring CA.</td>
</tr>
<tr>
<td></td>
<td>Conflicts over distribution of economic benefits.</td>
</tr>
<tr>
<td>I2 Ambition to move forward</td>
<td>There is regional wind energy planning, which establishes objectives that the interviewee considers achievable.</td>
</tr>
<tr>
<td>I4 Interest/implication of stakeholders</td>
<td>Interest from the research sector, but not from the institutions.</td>
</tr>
<tr>
<td>I5 Data availability/quality</td>
<td>EREN has RE location cartography in kml format directly downloadable from the internet.</td>
</tr>
<tr>
<td></td>
<td>The Valladolid University researcher contacted by COMPLEX has developed a map of wind energy installations that he would be happy to make available to the Complex project.</td>
</tr>
<tr>
<td></td>
<td>There is no regional LUC cartography.</td>
</tr>
<tr>
<td>I6 Possibilities for LUC change</td>
<td>Currently, 0.12% of the territory (1119ha)</td>
</tr>
<tr>
<td></td>
<td>Wind energy is located particularly in natural areas. Solar energy is located in both agricultural and natural areas.</td>
</tr>
</tbody>
</table>
3.4.5: Navarre

**NAV1: Overview of location of RELF by LUC category.**

According to SIOSE (2005), 502ha are occupied by wind energy infrastructures in Navarre, and 355ha by solar energy infrastructures, which constitutes 0.82% of the total regional territory. These infrastructures are mainly located in the south of the province (see figure Nav1).

With respect to LUC, wind energy infrastructures occupy both natural (54.9%) and agricultural (45.1%) areas. The natural areas occupied by RELF are mainly Sclerophyllous Vegetation (34.7%) and Coniferous Forest (13.1%). Agricultural areas occupied by RELF are mainly Non-irrigated Arable Land (26.7%) and Land Principally Occupied by Agriculture (13.5%). Solar energy infrastructures have been implemented particularly on agricultural areas (85.6%), specifically: Non irrigated Arable Land (28.7%) and Permanently Irrigated Land (28.5%). See figure Nav2 for more detailed information.
Figure Nav 1. Location of Renewable Energy related Landscape Features (RELF) according to SIOSE (2005)
Wind energy in Navarre - Land uses

Solar energy in Navarre - Land uses
NAV2 Stakeholders and interviews

As our preliminary sociogram shows, RE institutional responsibilities belong to the Economy, Property, Industry and Employment Department. In addition, regional institutions are part of other organizations included in the scientific, business and environmental groups. In addition, two other regional environmental groups are working on RE and CC (EeA and Gurelur) and there is a wind energy business association.

The COMPLEX project has contacted and interviewed the Regional Government Economy Department and the Territorial Observatory of Navarre (OTN).

Interview summaries

- Past tendencies and current RE situation: In the early 80s subsidies to RE started in Navarre, mainly focused on minihydraulic energy and solar power. In 1984 the first analysis of
regional energy production and consumption was carried out. In 1989 EHN was created. In the early 90s the first RE action plan was developed and some meteorological stations were created. In the 90s the most important development of RE was carried out, particularly in minihydraulic energy and wind power. In 1994 the first wind farm was constructed, very close to Pamplona and visible from many locations. It had a high level of public acceptance however. In 1995 the first RE plan was developed for the period up to the year 2000 and later extended to 2005. During this time period, RE production went from 0MW to 850MW.

Since 2000 the RE sector has been reinforced with the creation of CENER (the National Renewable Energy Centre) in 2000 and CENIFER (The integrated Centre for Renewable Energy Education) in 2003.

Photovoltaic energy was developed between 2007 and 2009 in the form of solar farms located in agricultural areas.

Biomass was slightly developed with the construction of the Sangüesa power station by Acciona.

• **LUC changes:** Solar energy has been installed in less productive agricultural areas and the energy related use is not compatible with the previous agricultural use. Wind energy has been installed on wild land (monte) and in scrub areas and its compatible with other agricultural and livestock uses.

Main land occupation by RE implementation is related to the construction of infrastructures to access the RELF.

• **Conflicts:** In the opinion of OTN, nowadays there are no conflicts associated with RE in Navarre. There were some conflicts in the first years of RE development related with landscape impacts, impacts on birds and path construction, but they were solved by information and social participation.

In the opinion of the Regional Government, there are some conflicts with environmentalist groups due to the excessive wind energy development and in relation with impacts on birds. However, the Regional Government thinks bird mortality is reasonable. There are also other conflicts in relation to the Itoitz reservoir and a proposed biomass plant that is presently under consideration.

• **Future:** The regional Government is optimistic about the future because of the regional policies and plans that consider RE as a strategic sector for the regional economy.

In the opinion of OTN, the near future is complicated because of the economic circumstances and because current national legislation is no longer promoting RE development. They believe that RE will continue to develop, but business activity in this sector is likely to be less than in recent decades.

• **Policies:** Between 1995 and 2004 wind energy was developed in the region, but its development subsequently slowed, mainly due the capacity of the electricity network.
Between 2007 and 2010 a new regional plan was in force, the first to include incentive schemes for RE. In 2010 the last RE regional plan was approved with a horizon of 2020.

- **Social sectors involved with RE:** Civil society, local population and businesses.

  CENER, CENIFER, universities and technological centres are working on Research and Development, CENIFER and universities are working on training. There are at least 80 businesses, both big and small, working with RE in Navarre, such as Acciona, Gamesa, Ingeteam and MTorres. The most active environmentalists’ groups are EeA (Ecologists in Action) and SEO/Birdlife.

  There was a solar cluster but it is no longer active.

- **Cartography availability:** There is a regional LUC cartography that COMPLEX project already has. It is likely that a cartographic dataset for wind energy also exists.

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>I1 Potential implementation problems</td>
<td>Capacity of the electricity network. Conflicts with environmentalists’ groups. Conflicts related to a biomass plant presently under consideration.</td>
</tr>
<tr>
<td>I2 Ambition to move forward</td>
<td>There is a regional RE planning currently in force.</td>
</tr>
<tr>
<td>I4 Interest/implication of stakeholders</td>
<td>Both interviewees have been very collaborative.</td>
</tr>
<tr>
<td>I5 Data availability/quality</td>
<td>Regional LUC cartography with energy LUCs. Possibly wind energy cartography.</td>
</tr>
<tr>
<td>I6 Possibilities for LUC change</td>
<td>Currently, 0.82% of the territory (857ha) Wind energy is located in both natural and agricultural areas. Solar energy is located particularly in agricultural areas.</td>
</tr>
</tbody>
</table>
3.4.6: *The Rioja*

*Rio 1. Overview of location of RELF by LUC category.*

According to SIOSE (2005) 198ha of land is occupied by wind energy infrastructures and 1ha is dedicated to solar energy infrastructures in The Rioja, which represents 0.39% of the total regional territory. These infrastructures are located in the southeast of the region as shown in figure Rio1.

In relation to LUC occupation, wind energy infrastructures are located mainly in natural areas (85.9%): Broad-leaved Forest (28.2%), Coniferous Forest (18.2%), Natural Grasslands (14.6%) and Sclerophyllous Vegetation (12.6%). See figure Rio2 for a more detailed information.

Solar energy infrastructures are located on land Principally Occupied by Agriculture.
Figure Rio1. Location of Renewable Energy related Landscape Features (RELF) according to SIOSE (2005)
As our preliminary sociogram for Navarre shows, institutional responsibilities in relation with RE in The Rioja belong to the Innovation, Industry and Commerce Department, and the Economic Development Department also plays a role. In the business group, there are some firms working in The Rioja, mainly Iberdrola and ARESOL. There are also some environmentalist groups, but there is no common working space between the different groups.
The COMPLEX project has contacted the Innovation, Industry and Commerce Department and the Spanish Branch (Amigos de la Tierra) of the international environmentalist group Friends of the Earth. Only Friends of the Earth expressed an interest in the project and agreed to be interviewed.

Interview summary

- **Past tendencies and current RE situation:** According to a study undertaken by the university of Vigo, The Rioja has the third highest Kwh per inhabitant respect to other CA generated by RE sources. However, the interviewee claimed that ecological values in half of the autonomous community have been destroyed by RE infrastructures. He also considered that there had been no planning of RE development, with hydroelectric and wind power projects being approved indiscriminately. The interviewee noted that this had led to the river drying out in some stretches.

Currently, 500 wind turbines are installed in The Rioja, distributed in 15 wind farms and located in the southeast of the region and, in the opinion of the interviewee, without respecting any environmental criteria. There have been also some small experiments with biomass.

The interviewee observed that some mini-hydropower plants owned by big businesses have also been installed without respecting ecological flows. In the opinion of Friends of the Earth, a better option for regional energy development would be the exploitation for power generation of two existing reservoirs.

Factors influencing RE development are mainly subsidies and electricity network capacity.

- **LUC changes:** For wind power developments, natural land belonging to local authorities has been used. Solar energy has been implemented in private estates in stepparic areas, even where they are protected by Natura2000 network.

- **Conflicts:** There have been some conflicts with hunters associations, but not many. With environmentalists' groups, there are conflicts with Friends of the Earth due to the environmental impacts of the infrastructures and to the lack of regional planning for energy development.

- **Future:** In the opinion of the interviewee, RE development is likely to be blocked for the next five years, with only some small projects with private investment implemented.

- **Policies:** There is no regional energy plan. The Economic Development Agency (ADE) has a subsidy stream for RE.

- **Social sectors involved with RE:**
  - Regional government and municipalities, all in favor of RE development because of the economic benefits.
  - Businesses
  - There are some groups opposed to RE development in vineyard areas. Wine production for national and international markets is a key economic activity in The Rioja.
• **Cartography availability:** As far as the COMPLEX project was able to ascertain, there is no available cartography on RE nor LUC.

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>I1 Potential implementation</td>
<td>Conflicts with environmentalists’ organisations.</td>
</tr>
<tr>
<td>problems</td>
<td>Also some conflicts with hunters and vineyard owners.</td>
</tr>
<tr>
<td>I2 Ambition to move forward</td>
<td>As far as COMPLEX is aware, the Government of The Rioja has not fixed an objective for RE development.</td>
</tr>
<tr>
<td>I4 Interest/implication of</td>
<td>Up to now, only an environmentalists’ group has expressed its interest in Complex project.</td>
</tr>
<tr>
<td>stakeholders</td>
<td></td>
</tr>
<tr>
<td>I5 Data availability/quality</td>
<td>There is neither a regional land uses cartography nor a RE location cartography.</td>
</tr>
<tr>
<td>I6 Possibilities for LUC change</td>
<td>Currently, 0.39% of the territory (857ha)</td>
</tr>
<tr>
<td></td>
<td>Wind energy is located in both natural and agricultural areas.</td>
</tr>
<tr>
<td></td>
<td>Solar energy is located particularly in agricultural areas.</td>
</tr>
</tbody>
</table>
3.5: Conclusions

National legislative framework has driven RE development in all of the regions analysed here. At present, RE production is no longer subsidized in Spain and its development has slowed. Furthermore, electricity network capacity (Red Eléctrica Española is the sole energy transmission operator in Spain) emerged as a key element affecting RE development in all regions. Nevertheless, neither the overall RE development nor the current situation with respect to RE is the same in the different Autonomous Communities.

In order to select the most convenient case study for the COMPLEX project, the analyses have focused on these regional differences. From the regional institutions, different strategies for RE have been applied in recent decades. In some Autonomous Communities, for example Navarre, the regional government has been involved in RE development since the beginning, and has taken part in business and research, and has promoted the development of regional RE plans. At the other extreme, some Autonomous Communities such as The Rioja have never published any regional plan focused on RE.

In relation to RE potential implementation problems, two main groups of conflicts can be discerned: a) those related to ecosystem modification and landscape impacts due to RE installations and b) those related to the distribution of economic benefits of RE implementation. The former is particularly associated with environmentalists’ groups, but also with hunters and other land ownership groups (e.g. vineyard owners in The Rioja). Owing to the multi-level distribution of political competence in Spain, RE landscape effects are also suffered by autonomous communities that have not decided to implement RE from their neighbours who have. In this latter group only Castille-and-Leon (on the border with Cantabria) has been specifically named, but there are likely to be other cases that have not been detected in this study so far.

In relation to land occupied by RELF, Navarre stands out with 0.82% of its territory occupied by wind and solar energy developments. It is not always straightforward to distinguish between these two types of RELF included in the analysis; although it seems to be generally agreed that solar energy has been implemented mainly in agricultural areas and wind energy in natural areas, this may be an oversimplification. There are some exceptions, for example in the case of Aragon, where wind energy has generally been developed on non-irrigated arable land perhaps because of the low agricultural yields in these areas. At this point, there is a general agreement between the stakeholders interviewed about productive combinations of land uses (e.g energy production plus agricultural production), which seems to be possible in the case of wind energy but not solar power.

For the PLUS4-CMP model, cartography for land uses and RE location is likely to be a key element conditioning model development. Therefore, a search of the regional cartographic sources has been one of the elements of this first phase. These vary widely across regions: Autonomous Communities such as The Rioja, Canary Islands and Aragon have not developed either land use cartography or RE.
location maps. Of the other three Autonomous Communities analysed here that do have some cartographic resources, Navarre seemed to be outstanding, with its own land use cartography, which includes energy uses as a LUC category, for a series of dates. This cartography has already been supplied to the COMPLEX project.

4: Stage 3.1c - Selection of the detail model case study area

On the basis of the ideas discussed in the preceding sections, Navarre has been selected by the project team to provide the main case study, in which PLUS4-CMP will be completely developed. However, some other Autonomous Communities also showed many interesting characteristics. For this reason the following interesting themes were identified as worthy of consideration for satellite analyses or projects linked to COMPLEX in the future:

- During this first phase of the team’s research, conflict between neighbouring Autonomous Communities was detected (see interview summaries for Castille-and-Leon and Aragon). This conflict is based on the landscape impacts of RELF. Multi level governance in Spain and its effects related to RE implementation and landscape might therefore make for a worthwhile satellite study.

- In the Canary Islands, a range of circumstances coincide which are directly linked to the inherent characteristics and limitations of the territory. These might make for an interesting case study of the socio-economic factors related to RE development and supply. The question we would like to answer here is: What obstructions need to be removed to allow development of the RE sector in the Canary Islands in the light of its importance due to the high cost of conventional energy?

- In the case study of Aragon, most RE installations were located in pseudo-stepparic arid areas, with low agricultural yields. Might the development of RE offer a means to fight against the serious depopulation and rural land abandonment that this large and arid region is currently suffering?

- Lack of information and conflicts with environmentalists’ organisations in The Rioja. The analysis encountered a lack of regional RE planning, a paucity of general information about RE in the region and found the regional government’s representatives unwilling to cooperate with the project. The negative views of RE development (specifically with respect to its environmental impacts) held by the representative from Friends of the Earth indicate that, at the very least, the Rioja government seems to be suffering from a serious public image problem with respect to its RE implementation policy.
5: Scoping statement final remarks

It was not possible to obtain cartographic information about biofuels in any of the autonomous communities studied. As far as the project is aware, there is none available. With the exception of Navarre, the only available dataset for other land based RE types was SIOSE, a LUC database presently available for the year 2005 only. This meant that the final period of the economic boom (2005-8) during which time much RE capacity was installed could not be detected in the GIS analysis of LUC and RELF. This problem may be remedied in the near future when SIOSE 2009 is released. However, given that RE have been developing in Spain for a long time (since the 1980s) it is slightly surprising that more information is not in the public domain. Making detailed data available about all types of RE is a key for dissemination and transparency in policies or activities which may have an impact on the environment; this is recognised under the INSPIRE directive of the European Union (EU 2007). In some cases, such as Andalusia, cartographic visors and Web Map Services (WMS) allow users to view, but not download or manipulate RE data. Clearly, for any GIS-based analysis or modelling work, this is insufficient.

By proceeding through a series of scales, beginning with a rapid appraisal of RE in all of the Spanish territory and finishing by selecting a single NUTS2 region (Navarre), it has been possible to broadly scope the work of the OCT team in the COMPLEX project as set down in the project DOW under task 3.1, leading to deliverable 3.1, this document.

In the next phase of the project the team will concentrate on publishing the scoping work outlined in this document and developing both the participatory process and the full model design for PLUS4-CMP.
6: References


7. Appendices

APPENDIX 1. RAPID APPRAISAL

National level

- Action Plans 2008-2012 (PAE4 +) and 2011-2020 (E4) Strategy and Efficiency Savings
- Activation Plan 2008-2011, reinforces the previous two
- Planning of gas transport infrastructure and electricity 2008-2016
- Planning of gas transport infrastructure and electricity 2012-2020 (pending approval)

1. Andalusia

Reports and documents

Energy cartography: http://www.agenciaandaluzadelaenergia.es/administracion/cartografia-energetica

info-ENERGÍA application: consumption and production data; historical series, grouped by sources and sectors. Furthermore, infrastructures, socio-economic and environmental indicators are provided.

Energy data from Andalusia (2010)

Legislation


Andalusian Plan on Energy Sustainability 2007-2013 (PASENER)

Andalusian Strategy facing Climate Change

Andalusian Action Plan for Climate 2007-2012

Organizations

Agencia Andaluza de la Energía (depende de la Consejería de Economía, Innovación, Ciencia y Empleo) http://www.agenciaandaluzadelaenergia.es/administracion/renovables

Centro Tecnológico Avanzado de Energías Renovables (CTAER) http://www.ctaer.com/

Asociación de Promotores y Productores de Energías Renovables en Andalucía http://www.aprean.com/

2. Aragon

Reports and documents

Renewable energy in Aragon 2008

Maps in pdf format are also available; therefore obtaining raw data to generate maps might be possible.

Organizations

Caja Inmaculada, la Confederación de Empresarios de Aragón y el Consejo de Cámaras de Aragón


CIRCE Centro de Investigación de Recursos y Consumos Energéticos http://fcirce.es/
Observatorio de la Biomasa en Aragón (no publication available, founded in 2012)

Legislation
Strategic Plan of Aragon 2005-2012 (PLEAR)
Aragon Government Action Plan against Climate Change and for Clean Energies 2008-2012
Aragonese Strategy of Climate Change and Clean energies (EACCEL) 2009

3. Canary Islands.
Legislation
Special Territorial Plans of Energy Infrastructures (PTEOIE), each island has its own.
Currently, there is available documentation about El Hierro, La Gomera, La Palma, Lanzarote and Fuerteventura islands.

Organisations
Instituto Tecnológico y de Energías Renovables http://www.iter.es/
Asociación Canaria de Energías Renovables
GERCA Gabinete de Energías Renovables de Canarias http://gerca.es/?lang=en
RICAM Cluster Empresarial de las Energías Renovables, el Medio Ambiente y los Recursos Hídricos de Canarias http://www.clusterricam.org/
GIS Viewer with wind farms cartography: http://meteodata.itccanarias.org/

4. Cantabria
Legislation
Energy Plan of Cantabria 2006-2011
Summary of energy sustainability plan draft 2011-2020 (April 2012)
Organisations –not found

5. Castille and Leon
Reports and documents
Wind Farms Map and Producing Companies (2010)
Wind Farms under construction (February 2011)
Wind Farms currently working (February 2011)
Wind Energy Production (2008)
Hydropower Stations (>10MW) (2006)
Mini-stations in Special Regime (<10MW) (2005)
Mini-stations in Regular Regime (2006)
Energy maps of Castille-and-Leon in KMZ format (Google Earth): electricity distribution networks, gas distribution network, no renewable energies, hydroelectric energy, wind energy,
solar energy and bioenergy.

Legislation

Regional Plan of Bioenergy of Castille-and-Leon 2011-2020
Regional Strategy on Climate Change 2009-2012-2020
Regional Strategy on Sustainable Development 2009-2014
Solar Energy Plan of Castille-and-Leon (no information nor documentation is available)
Wind Energy Plan of Castille-and-Leon, including 9 different provincial documents

Organisations – not found

6. Castille-La Mancha

Reports and documents

2010 – Table 4

Organisations
Instituto de Investigación en Energías Renovables http://www.ier.uclm.es/

Legislation

Decree 138/2009, of 15th September, passing the Strategy for Energy Development of Castille-La Mancha (EDECAM)
Wind Energy Plan of Castille-La Mancha, horizon 2014 (PERCAM)
Plan of Renewable Energy in Castille-La Mancha
Order of 18/11/2011, that establishes regulatory basis for subsidies to promote renewable energy self-consumption in Castille-La Mancha. DOCM: 07-DEC-11
Resolution of 28/06/2012, announcing subsidies for the exploitation of renewable energies in Castille-La Mancha 2011-2012, in the following areas: thermo solar, thermal biomass, hybrid biomass and thermo solar, isolated photovoltaic, treatment equipment for biomass and geothermic. DOCM: 29-JUN-12
Correction of Resolution 28/06/2012. DOCM: 09-JUL-12
Energetic Saving and Efficiency Plan in Castille-La Mancha

7. Catalonia

Reports and documents
Energy balance 2009
Electric energy balance 2009
Electric power production:
Organisations

Instituto Catalán de Energía
(https://www20.gencat.cat/portal/site/icaen/menuitem.0e77dd7d73736725fc644968bb0c0e1a0/?vgnextoid=7dd08a206017c110VgnVCM1000000b0c1e0aRCRD&vgnextchannel=7dd08a206017c110VgnVCM1000000b0c1e0aRCRD&vgnextfmt=default)

Institut de Reserca en Energia de Catalunya (http://www.irec.cat/)

Legislation

Plan of definition of Priority Development Areas (Zonas de Desarrollo Prioritario, ZDP) for wind farm installation in Catalonia.
Framework Plan of Climate Change Mitigation in Catalonia 2008-2012
Plan of Energy and Climate Change in Catalonia 2012-2020
Plan of energy saving and efficiency in buildings and equipment of regional government (Generalitat de Catalunya) 2011-2014

8. Madrid

Reports and documents
Energy balance of Madrid region (Comunidad de Madrid) 2010 (2012)
Energy balance of Madrid municipality 2010
Energy balance of Madrid City 2010 - Summary

Organisations - not found

Legislation
Energy plan of Madrid region (Comunidad de Madrid) 2004-2012

9. Navarre

Reports and documents
Energy balances–horizon 2010 Plan monitoring reports:
PEN0510 Monitoring report (2006)
PEN0510 Monitoring report (2007)
PEN0510 Monitoring report (2008)
Renewable energy in Navarre. Horizon 2010 (April 2010)

Associations: not found

Legislation
Energy Plan of Navarre 2005-2010
Energy Plan of Navarre 2011-2020
Strategy against Climate Change in Navarre 2010-2020
Action Plan for a sustainable use of biomass in Navarre

10. Valencia

Reports and documents
Energy data 2010
Plan for Wind energy development and execution 2003
Wind energy Plan - Rules 2001
Wind energy plan - Areas 2001
Organisations: not found

Legislation
Plan of energy saving and efficiency in the region (Valencia) 2001-2010
Wind energy plan of Valencia 2003-2008

11. Extremadura
Reports and documents
Area of environmental protection – Climate change
In AGENEX Web there is some info on renewable energy
http://www.agenex.net/es/dptos/departamento-de-energias-renovables/21-areas.html
Organisations:
Agencia Extremeña de la Energía (http://www.agenex.net/es/agenex/entidades-participantes.html)

Legislation
Energy Plan 2009-2012, according to sustainable energy development in Extremadura

12. Galicia
Reports and documents
Renewable energies 2000
Energy balance 2010
Transport fuel consumption 2010
Electricity consumption - Sectors 2010
Hydraulic electricity – Reservoirs situation 2010
Consumption Evolution of Gross Electricity coming from renewable energies 2010
Consumption Evolution of raw energy 2010
Evolution of electricity production 2010
Evolution of electric power 2011
Evolution of fuel use 2010
Installed electric power - October 2012
Organisations:
Instituto Enerxético de Galicia (http://www.inega.es/descargas/publicaciones/78-d-Energias_Renovables_en_Galicia.pdf)

Legislation
Energy strategic plan of Galicia 2010-2015
Wind energy plan of Galicia (PSEGA) passed in 1997 and modified in 2002
http://www.inega.es/enerxiasrenovables/eolica/plansectorialeolico.html

13. Balearic Islands
Reports and documents
Energy statistics 2009
Organisations - not found
Legislation
Electricity and gas sectors planning 2002-2011
Energy Plan of Illes Balears 2005 (PDSE)
Summary – Complete document:
http://dgener.caib.es/www/user/portalenergia/pdse/docs/memoria_es.html
Plan of renewable energy promotion: de sol a sol (PIER) Related to PDSE, with horizon 2012

14. The Rioja
Legislation
Organizations – not found

15. Basque Country
Reports and documents
Annual energy data and balances
Observatory of energy situation - Information on electricity evolution and consumption of electricity, gas and fuels of the region (Comunidad Autónoma del País Vasco). External situation. Consumption in Spain and petroleum consumption in the world. Price information of electricity, gas, fuels, coal and CO2.
Organisations
EVE Ente Vasco de la Energía (http://eve.es/web/Energias-Renovables.aspx)
Legislation
Energy Strategy of Euskadi 3E2020
Plan of science, technology and innovation 2010
Competitiveness Plan 2010-2013
Plan “Euskadi in the society of information” 2010
Sectoral territorial plan of wind energy

16. Asturias
Reports and documents
Energy in 2010 – energy data of the region (Principado de Asturias)
Organisations – not found
Legislation
There is no own legislation. National legislation applies.

17. Murcia.
Legislation
Renewable energy Plan 2012
Law 10/2006, of 21st December, on renewable energies and energy saving and efficiency of the region (Región de Murcia)


Municipal Ordinance of solar catchment of Murcia municipality.


Order of 29th April 2011, announcing subsidies for execution and exploitation of renewable energy projects and energy saving and efficiency measures included in the Action Plan 2008-2012 (PAE+4) for different sectors such as industry, transport, public services, agriculture and energy transformation (BORM nº 106, 11/05/2001)

Organisations – not found
## APPENDIX 2. CLC2000 LEVEL 3

### 1. ARIFICIAL SURFACES

<table>
<thead>
<tr>
<th></th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1.1 Urban fabric</strong></td>
<td></td>
</tr>
<tr>
<td>Continuous urban fabric</td>
<td>Most of the land is covered by structures. Buildings, roads and other types</td>
</tr>
<tr>
<td></td>
<td>of artificial surface cover almost all of the ground. Non-linear areas of</td>
</tr>
<tr>
<td></td>
<td>vegetation and bare soil are exceptional.</td>
</tr>
<tr>
<td>Discontinuous urban fabric</td>
<td>Most of the land is covered by structures. Buildings, roads and other types</td>
</tr>
<tr>
<td></td>
<td>of artificial surface are associated with vegetated areas and bare soil,</td>
</tr>
<tr>
<td></td>
<td>which occupy discontinuous but significant areas.</td>
</tr>
<tr>
<td><strong>1.2 Industrial, commercial and transport</strong></td>
<td></td>
</tr>
<tr>
<td>Industrial or commercial units</td>
<td>Areas of artificial surfaces (with concrete, asphalt, tarmacadam, or stabilised,</td>
</tr>
<tr>
<td></td>
<td>e.g. beaten earth) devoid of vegetation, occupy most of the area in question,</td>
</tr>
<tr>
<td></td>
<td>which also contains buildings and/or vegetated areas.</td>
</tr>
<tr>
<td>Road and rail networks and associated land</td>
<td>Motorways, railways, including associated installations (stations, platforms, embankments). Minimum width to include: 100 m.</td>
</tr>
<tr>
<td>Port areas</td>
<td>Infrastructure of port areas, including quays, dockyards and marinas.</td>
</tr>
<tr>
<td>Airports</td>
<td>Airport installations: runways, buildings and associated land.</td>
</tr>
<tr>
<td><strong>1.3. Mine, dump and construction sites</strong></td>
<td></td>
</tr>
<tr>
<td>Mineral extraction sites</td>
<td>Areas with open-pit extraction of industrial minerals (sandpits, quarries) or other minerals (opencast mines). Includes flooded gravel pits, except for river-bed extraction.</td>
</tr>
<tr>
<td>Dump sites</td>
<td>Landfill or mine dump sites, industrial or public.</td>
</tr>
<tr>
<td>Construction sites</td>
<td>Spaces under construction development, soil or bedrock excavations, earthworks.</td>
</tr>
<tr>
<td><strong>1.4 Artificial, non-agricultural vegetated areas</strong></td>
<td></td>
</tr>
<tr>
<td>Green urban areas</td>
<td>Areas with vegetation within urban fabric. Includes parks and cemeteries with vegetation.</td>
</tr>
<tr>
<td>Sport and leisure facilities</td>
<td>Camping grounds, sports grounds, leisure parks, golf courses, racecourses, etc. Includes formal parks not surrounded by urban zones.</td>
</tr>
</tbody>
</table>

### 2. AGRICULTURAL AREAS

<table>
<thead>
<tr>
<th></th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>2.1 Arable land: Cultivated areas regularly ploughed and generally under a rotation system.</strong></td>
<td></td>
</tr>
<tr>
<td>Non-irrigated arable land</td>
<td>Cereals, legumes, fodder crops, root crops and fallow land. Includes flower and tree (nurseries) cultivation and vegetables, whether open field, under plastic or glass (includes market gardening). Includes aromatic, medicinal and culinary plants. Excludes permanent pastures.</td>
</tr>
<tr>
<td>Permanently irrigated land</td>
<td>Crops irrigated permanently and periodically, using a permanent infrastructure (irrigation channels, drainage network). Most of these crops could not be cultivated without an artificial water supply. Does not include sporadically irrigated land.</td>
</tr>
<tr>
<td>Rice fields</td>
<td>Land developed for rice cultivation. Flat surfaces with irrigation channels. Surfaces regularly flooded.</td>
</tr>
<tr>
<td><strong>2.2. Permanent crops:</strong> Crops not under a rotation system which provide repeated harvests and occupy the land for a long period before it is ploughed and replanted: mainly plantations of woody crops. Excludes pastures,</td>
<td></td>
</tr>
</tbody>
</table>
grazing lands and forests.

<table>
<thead>
<tr>
<th>Vineyards</th>
<th>Areas planted with vines.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fruit trees and berry plantations</td>
<td>Parcels planted with fruit trees or shrubs: single or mixed fruit species, fruit trees associated with permanently grassed surfaces. Includes chestnut and walnut groves.</td>
</tr>
<tr>
<td>Olive groves</td>
<td>Areas planted with olive trees, including mixed occurrence of olive trees and vines on the same parcel.</td>
</tr>
</tbody>
</table>

2.3. Pastures

| Pastures                | Dense, predominantly graminoid grass cover, of floral composition, not under a rotation system. Mainly used for grazing, but the fodder may be harvested mechanically. Includes areas with hedges (bocage). |

2.4. Heterogeneous agricultural areas

| Annual crops associated with permanent crops | Non-permanent crops (arable lands or pasture) associated with permanent crops on the same parcel. |
| Complex cultivation                        | Juxtaposition of small parcels of diverse annual crops, pasture and/or permanent crops. |
| Land principally occupied by agriculture, with significant areas of natural vegetation | Areas principally occupied by agriculture, interspersed with significant natural areas. |
| Agro-forestry areas                        | Annual crops or grazing land under the wooded cover of forestry species. |

3. FOREST AND SEMI-NATURAL AREAS

3.1. Forests

| Broad-leaved forest             | Vegetation formation composed principally of trees, including shrub and bush understories, where broadleaved species predominate. |
| Coniferous forest               | Vegetation formation composed principally of trees, including shrub and bush understories, where coniferous species predominate. |
| Mixed forest                    | Vegetation formation composed principally of trees, including shrub and bush understories, where broadleaved and coniferous species co-dominant. |

3.2. Shrub and/or herbaceous vegetation associations

| Natural grassland                  | Low productivity grassland. Often situated in areas of rough uneven ground. Frequently includes rocky areas, briars, and heathland. |
| Moors and heathland                | Vegetation with low and closed cover, dominated by bushes, shrubs and herbaceous plants (heath, briars, broom, gorse, laburnum, etc.). |
| Transitional woodland/shrub        | Bushy or herbaceous vegetation with scattered trees. Can represent either woodland degradation or forest regeneration/colonisation. |

3.3. Open spaces with little or no vegetation
| **Beaches, dunes, and sand plains** | Beaches, dunes and expanses of sand or pebbles in coastal or continental, including beds of stream channels with torrential regime. |
| **Bare rock** | Scree, cliffs, rocks and outcrops. |
| **Sparsely vegetated areas** | Includes steppes, tundra and badlands. Scattered high-altitude vegetation. |
| **Burnt areas** | Areas affected by recent fires, still mainly black. |
| **Glaciers and perpetual snow** | Land covered by glaciers or permanent snowfields. |

4. **WETLANDS**

4.1. Inland wetlands: Non-forested areas either partially, seasonally or permanently waterlogged. The water may be stagnant or circulating.

| **Inland marshes** | Low-lying land usually flooded in winter, and more or less saturated by water all year round. |
| **Peatbogs** | Peatland consisting mainly of decomposed moss and vegetable matter. May or may not be exploited. |

4.2. Coastal wetlands: Non-wooded areas either tidally, seasonally or permanently waterlogged with brackish or saline water.

| **Salt marshes** | Vegetated low-lying areas, above the high-tide line, susceptible to flooding by sea water. Often in the process of filling in, gradually being colonised by halophilic plants. |
| **Salines** | Salt-pans, active or in process of development. Sections of salt marsh exploited for the production of salt by evaporation. They are clearly distinguishable from the rest of the marsh by their segmentation and embankment systems. |
| **Intertidal flats** | Generally unvegetated expanses of mud, sand or rock lying between high and low water-marks. |

5. **WATER BODIES**

5.1. Inland waters

| **Water courses** | Natural or artificial water-courses serving as water drainage channels. Includes canals. Minimum width to include: 100 m. |
| **Water bodies** | Natural or artificial stretches of water. |

5.2. Marine waters

<p>| <strong>Coastal lagoons</strong> | Unvegetated stretches of salt or brackish waters separated from the sea by a tongue of land or other similar topography. These water bodies can be connected with the sea at limited points, either permanently or for parts of the year only. |</p>
<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
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<tbody>
<tr>
<td>Estuaries</td>
<td>The mouth of a river within which the tide ebbs and flows.</td>
</tr>
<tr>
<td>Sea and ocean</td>
<td>Zone seaward of the lowest tide limit.</td>
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</tbody>
</table>
APPENDIX 3. INTERVIEWS PRO-FORMA

3.1 PROFORMA INTERVIEW TO REGIONAL STAKEHOLDERS

1. RE tendencies and current situation.
What type of renewable energies is the region producing?
What was the RE evolution like in the region during the last decade?
Which factors are stimulating or inhibiting the use and implementation of RE in the region?
Is there any land use change driven by the implementation of climate mitigation policies?
Are there any conflicts about the use or implementation of renewable energies? If affirmative, do these conflicts have any clear territorial implications? With which renewable energy is the conflict related?
What are the reasons of the conflict?
Which is your opinion about RE development in the future?

2. Regional policy framework.
Is there any regional energy plan in force? Has this plan defined any horizon or objective for renewable energies? Have these objective been achieved? Were these objectives achievable?
Is there any economic incentive linked to the RE promotion policies?
Is there any area where RE installations development is forbidden or limited?

3. Involved stakeholders.
Which social groups are affected by the RE development in your region?
Are there any organisations, centres, institutions, associations or NGOs with relevance (with partial or total dedication) in tracing, support, research or implementation of renewable energies? Which?
Is there any local initiative about sustainability or climate change mitigation? (E.g. sustainable villages)
From your point of view, what role might your organisation play in relation to RE development?

4. Cartography availability
Is there spatial information about location of RE infrastructures?
Are there regional spatial land use datasets? If affirmative, how many time periods are there?
3.2 PRO-FORMA INTERVIEW TO NATIONAL STAKEHOLDERS

1. RE tendencies.
Key Dates in the evolution of renewable energy in Spain.
Have these changes been related to changes in the legislation?
Which others factors have stimulated or inhibited the use and implementation of RE in Spain?
Impacts of these changes.

2. Current situation
Legislation current situation
Is there any land use change driven by the implementation of climate mitigation policies?
Are there any conflicts about the use or implementation of renewable energies? If affirmative, do these conflicts have any clear territorial implications? With which renewable energy is the conflict related?
What are the reasons for the conflict?

Has Spain achieved its marked objectives? Are these goals achievable?
Is there any economic incentive linked to the RE promotion policies?

4. Future
Which is your opinion on RE development in the future?

5. Involved stakeholders
Which actors/sectors/major interest groups are involved in the implementation of renewable energy in Spain?

6. Cartography availability
Do you have spatial information on location of RE infrastructures?