Technical University of Denmark

Management of uncertainty and ambiguity in complex polytechnic projects: the case of Wind Power in Spain

Master Thesis Engineering Management

Jaime Sánchez Saralegui
18-7-2014

Information about this document

Title
Management of uncertainty and ambiguity in complex polytechnic projects: the case of Wind Power in Spain

Author
Jaime Sánchez Saralegui

Supervisor
Kristian Borch

Co-supervisor
Christian Thuesen

Collaboration company
Part of the information included in this document has been obtained from the experience of a developer of wind farms. In order to maintain the secrecy, this text will refer from now on to "*Developer Alfa*". The projects and other information obtained from Developer Alfa will also receive generic names like "*Wind Farm A*" or "*Village 1*".

Academic institution
Technical University of Denmark

Program
Master of Science in Engineering Management

Study line
Design and management of complex systems, structures and projects

Length
5 months, 30 ECTS

Submission date
18th July 2014

Abstract

Wind power has traditionally had a high level of support from the public opinion across different European countries. However, when the development of a wind farm is announced, some local opposition may be experienced. The complexity of these projects leads to an increase on uncertainty and ambiguity levels, with respect to their successful completion, which needs to be identified and managed so the negative effects on the project are reduced.

This Master thesis analyzes the case of wind power in Spain, focusing on project development practices currently used and their effect over the acceptance in local communities. A Technology Innovation System of Analysis has been designed to structure the study, using Actor Network Theory to analyze the dynamics between the different actors, as well as the power distribution and the procedural justice.

The evolution of the wind power industry is presented, followed by the description of the experience of a developer of wind farms in Spain. The case concerning a number of installations with controversial episodes is analyzed in detail with the use of a socio-technical approach. This is followed by a discussion, where the lack of public participation is identified as an important problem and two approaches to addressing it are proposed.

The first approach suggests to open the development processes to all the stakeholders of the project, thus making it more transparent and at the same time increasing procedural justice and the level of trust towards the developer. The second approach suggests to establish active partnerships with local communities, by offering a substantial number of shares of the projects or by promoting the establishment of cooperatives of neighbors to invest in wind farms. This would increase distributional justice and by extension the attachment of more people to wind power.

Acknowledgements

I would like to acknowledge:

My supervisor, Kristian Borch, for his helpful guidance along the entire process, making it possible to participate in interesting discussions and giving me the opportunity to analyze technical projects from a different perspective

My co-supervisor, Christian Thuesen, for enriching the discussions around project management and collaborating with his experience to the proposal of solutions

My colleagues for this project, Jaime Palomo and Tinna Sigmundsdóttir, for their valuable suggestions and active collaboration to find alternatives to the problems we faced

Javier and Álvaro, for their participation in the interviews and their supply of information that made it possible to conduct the analysis of the projects

Jorge Corrales and Heikki Willstedt, for their contribution with valuable information about the wind power industry in Spain

The participants in the project Wind2050, for their collaboration in highly productive discussions and their feedback during the meetings we had along the semester

Claudia, Patricia, Dimitrios and Olav, for their help to review the thesis and their useful suggestions to improve the text

And finally to my parents, for supporting me during my education and making it possible to have attended this Master Degree at the Technical University of Denmark.

I would like to sincerely thank all the acknowledged for your time and collaboration which made the completion of this Master thesis possible.

Table of contents

1. List of key-words: definitions

It is considered relevant to start this study by providing a list of key-words, so the author and the reader share a conceptual reference so that the next chapters can be understood more clearly.

Actor
Actors are someone or something which make a difference and have an importance for a process (Latour 2005)

Network
A network is a set of actors, human and non-human, with relevant relations between them (Latour 2005)

Stakeholder
The stakeholders of a project are individuals and organizations that are actively involved in the project, or whose interests may be positively or negatively affected as a result of project execution or project completion; they may also exert influence over the project and its results (PMBOK Guide 2000)

Local acceptance
Acceptance of siting decisions and renewable energy projects by local stakeholders, particularly residents and local authorities (Wüstenhagen et al. 2007)

NIMBY
"Not in my back yard" describes the phenomenon of people who are in favor of wind power but are opposed to wind turbines in their own area (Wolsink 2000)

Technological innovation system (TIS)
Socio-technical systems focused on the development, diffusion and use of a particular technology in terms of knowledge, product or both (Bergek et al. 2008)

Complexity
Inability to evaluate the effects of actions because too many variables interact, causing inadequacy of the available information (Pich et al. 2002)

Uncertainty
Uncertainty is defined, in the field of management of construction projects, as absence of information required for the decision that needs to be taken at a point in time (Winch 2002)

Ambiguity
Ambiguity refers to the different considerations that various people can make from the same fact, and that can lead to unexpected situations. Previous authors define it as absence of knowledge about functional variables (Schrader et al. 1993) or different interpretations of the same piece of information (Brun et al. 2009).

Framing

Framing is the process through which a common world is established between different actors of a project, which allows them to achieve a collective scenario of a desired outcome (Jolivet & Heiskanen 2010)

Overflowing

Overflowing represents the instability and uncertainty inherent to complex projects, which might break up at any moment (Jolivet & Heiskanen 2010)

This list of definitions is meant to enhance the understanding of the following chapters for the reader, avoiding misunderstandings and the use of different meanings for the same concept. The concepts defined above are used along the study. Further discussion about their relation to wind power can be found in the chapters below.

2. Introduction

Wind Power has experienced a fast growth in Spain since the first wind turbine was installed in the 1980s, until becoming the main source of energy in 2013. However, the functional characteristics of this technology system may not be moving in the right direction, attending to the experience in other European countries, where society demanded a more active role and not being mere observers.

Including local communities in the planning and development phases of wind farm projects is very often not done due to the inherent complexity and the initial demand of time and resources. End-users, authorities, and public and private organizations have traditionally been identified as the main stakeholders and it has been assumed that only they form the network of stakeholders.

In addition, the current economic situation in Spain has led to major cuts in the subsidies and investments in renewable energies in general, and wind power in particular. Public opinion has accepted these changes and the few reactions that have been observed come mainly from energy companies and developers who saw their business opportunities being limited.

This study explores the role of local communities and their importance to these projects, specially focusing in the existence of uncertainties and ambiguities and the project management tactics to deal with them. The case of a wind farm development project in Spain will be studied, including the experience of a developer and a number of interviews with project managers involved in these projects.

2.1. Background: the Wind2050 Project

This Master Thesis was designed together with the Director of the Wind2050 Project, which consists in a multidisciplinary study on local acceptance and the development of wind power projects. The target of the Danish Government to obtain all energy from renewable sources by 2050 makes necessary the installation of more wind farms across the country. However, many wind farms currently being developed have experienced the opposition of local communities.

This study aims to identify different reasons than the simplistic “Not in my back yard” or “NIMBY”, which explains the resistance of local communities towards the installation of wind farms as mere selfish attitudes. This is done to better understand their motives for opposition and to align the strategy for developing new wind farms with their expectations. The analysis of the situation in Spain was considered relevant, due to the size and importance of its Wind Power industry.

2.2. Project development practices in Wind Power

The Work Package 3 is the part of the Project Wind2050 that focuses on the relation between local acceptance and private project development practices. This study is strongly connected to it, identifying and analyzing wind farm project development practices in Spain and their influence on acceptance of the projects by local communities.

This study will explore the reasons for the increase of uncertainty and ambiguity on wind farm projects, including the lack of information existing around some of the locals' reasons for resistance and the different interpretations that they and the developers make of the same events. The collection of data is based on interviews with Project Managers, at a company with a large experience developing Wind Farms, and other important actors in the industry, and the review of previous scientific articles about local acceptance of wind farms in Spain and other countries.

2.3. Socio-technical approach

This study uses a socio-technical approach, taking into account the nature of the technology used as well as socioeconomic characteristics of the local communities and its organizational components. The analytical framework is formed by the Actor Network Theory (ANT), applied to the case by the use of a technological innovation system (TIS) that makes the analysis more systematic and less abstract. The use of other concepts such as the value framework and uncertainty and ambiguity reduction models makes it possible to analyze the TIS and the dynamics around it.

The desired outcome of the analysis is the identification of reasons for opposition. The development of strategies that understand better the effects local resistance has over wind power projects will be proposed in the discussion. The following chapter presents the research question for this study and the process that led to its formulation.

3. Problem Statement

The current situation of renewable energies in Europe, and specifically Wind Power, can be seen in two ways: on the one hand, there is a general support to this technology due to its evident environmental benefits and the creation of economic activity around its research and development. On the other hand, there are many cases of resistance to the installation of wind farms by local communities and environmental NGOs across different countries, but no solid reasons have been found to this opposition.

There is an extended belief that NIMBY is the main explanation, which means that people support wind farms as long as they are not installed near their properties. Several studies oppose this reason (Wolsink 2000 and 2006; Wüstenhagen et al. 2007) and propose other explanations such as the fear of impact on their health, the noise or the specific attachment to the existing landscape (Borch personal communication).

Some studies elaborate on the reasons for community acceptance (Wüstenhagen et al. 2007), identifying distributional and process justice, and trust in the developer as key factors for acceptance of renewable energy installations.

Some authors have studied the acceptance of wind power in Spain with a sociologic approach (González & Estévez 2005; González 2008). This study includes a socio-technical analysis of this topic, by using Actor Network Theory (ANT) to analyze both technology and society, and how they are interrelated.

The introduction of the terms uncertainty and ambiguity in this study is motivated by the identification in previous studies, of other complex projects, that the management of this phenomenon is related to acceptance and success of projects (Schrader 1993; Atkinson et al. 2006; Pitch et al. 2002)

The ambiguity regarding local acceptance of wind farms led to the formulation of the following research question (RQ):

RQ: *"How to account for ambiguity as a blocking mechanism when planning and managing complex projects: the case of Wind Power in Spain"*

The answer to this question is given in the discussion, as a result of the analysis of the case study in Spain. The following three sub-questions were formulated to define the expected results from the analysis, thus making more systematic the process to answer the main research question:

Sub RQ 1: *"Which are the blocking mechanisms used by local communities when there is no acceptance of these projects?"*

The first sub-question is answered after the description of a controversial case in Spain (chapter 7). Other blocking mechanisms were identified during the interviews with experienced developers, but could not be analyzed due to the time limitation. Future studies of those cases are proposed in the perspectivation of this paper (chapter 12).

Sub RQ 2: *"Which are the problems project managers face when these episodes happen?"*

The risks associated to controversies around the development of a wind farm are analyzed in chapter 9 and discussed in chapter 10. The comparison of the projects studied in Spain with a number of cases in other countries makes it possible to answer the second sub-question.

Sub RQ 3: *"How can project developers plan better by understanding the dynamics of the blocking mechanisms?"*

The answer to the third sub-question is given in the discussion of this study, where specific suggestions to improve the current strategies are made.

The following learning objectives are expected to be acquired after the completion of this master thesis. They are now presented, in order to introduce the structure followed in this study:

- Identification and description of wind farm project development practices
- Analysis of the influence these practices have on local acceptance
- Investigation of the reasons for ambiguity on local acceptance of wind farm projects
- Contrasting the results obtained from satisfactory and less satisfactory projects
- Integration of conclusions from the previous points in a list of recommendations.

These learning objectives influence the structure of the analysis, presented in chapter 4.

4. Structure of the analysis

The structure of the analysis is presented in figure 2. A technology innovation system (TIS) is used to organize the analysis in four blocks, each of them corresponding to one chapter in the thesis.

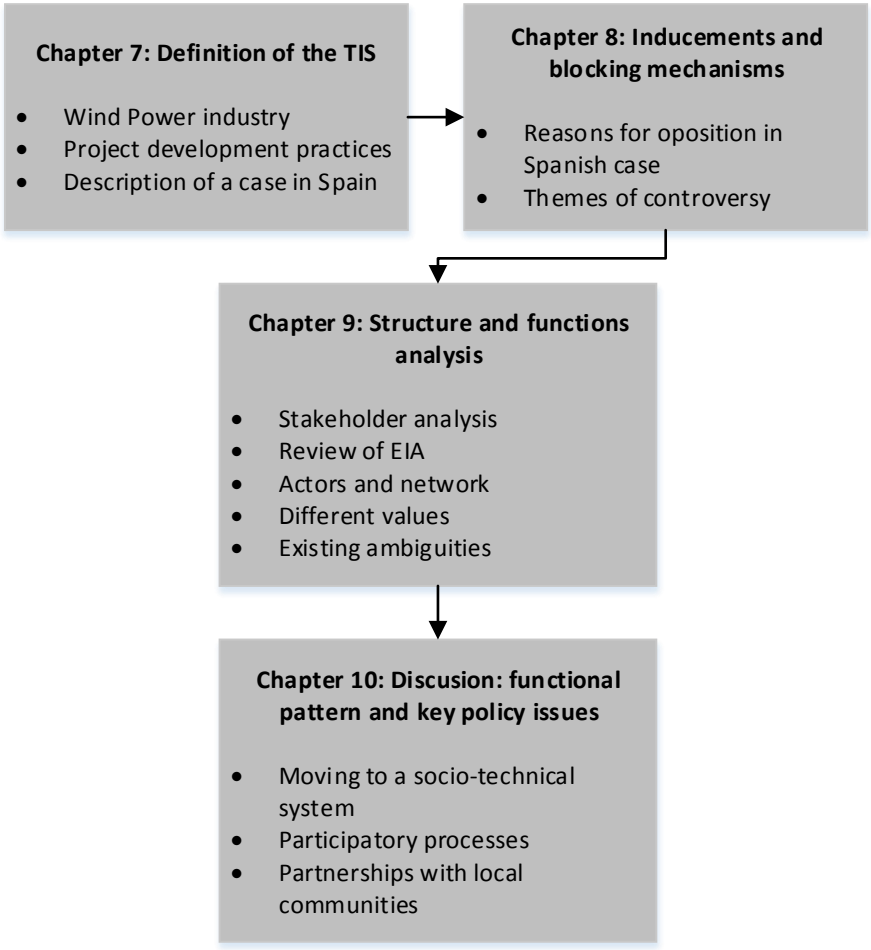


Figure 2: Technology innovation system analysis

The theories and concepts used during the analysis of the TIS (chapter 9) are now presented:

ANT is used to identify the dynamics around the actors involved in the development of a wind farm. The risks of excluding certain stakeholders and the need of understanding the importance of key-documents like the Environmental Impact Assessment (EIA) is analyzed.

The value framework concept is used to argue the different expectations that the actors involved in a project may have. If these different values are not taken into account during the planning phase, an increase of uncertainty and ambiguity levels may occur.

The existence of uncertainty and ambiguity in the project will be analyzed afterwards. This will be followed by the discussion of the most appropriate strategy to reduce them, which may be applied to other projects in the future.

Figure 3: Moving from the specific case studied to general solutions

The structure moves from a general definition of the innovation system to a specific case in Spain and the controversies which occurred there. Afterwards, a detailed analysis and discussion of the project is performed, concluding the study with a conclusion which future project in the wind industry may follow.

Chapter 5 elaborates on the reasons to include the theories presented above. The description of the theories is followed by the methodology (chapter 6). The method used to apply the theory in order to answer the research question is then explained.

5. State-of-the-art

This chapter presents the theoretical approach that is used in the analysis, by describing each theory and explaining how it is applied to the case studied.

5.1. Actor Network Theory

Actor Network Theory (ANT) is the core theoretical approach to this study. It is a relevant approach for studying the relations between technology and society and it has been previously used to the study of controversies around wind power (Jolivet & Heiskanen 2010). Its focus is on actors and networks involved in a technological system, providing a useful understanding on how they interact (Fujimura & Latour 1989; Callon 1998; Law 1999; Latour 2005).

It has been considered relevant the definition of its two main concepts:

Actors are someone or something which make a difference and have an importance for a process; while a network is a set of actors, human and non-human, with relevant relations between them (Latour 2005).

These concepts are applied in the analysis of the case study. The actors that form the network around the development of a wind farm are identified and the relation between them is analyzed and discussed (chapter 9).

ANT assumes networks are never completely stable, since actors and their relations are constantly changing. These changes are defined as translations. The result of these translations is “a situation in which certain entities control others” (Callon 1986). It is interesting to underline this idea, since power distribution is one of the key factors affecting acceptance. ANT will help to identify how it is distributed in the case study performed in this thesis.

The following table includes the four moments of translation or change in a network.

Table 1: The four moments of translation (Own elaboration, inspired in Callon 1986)

Problematisation *Finding the weak points*	**Interessment** *Attracting new actors*	**Enrollment** *Aligning expectations*	**Mobilization** *Innovation occurs*

Problematisation is the stage when certain actors envision a new network and try to problematize the current network and its actors; interessment occurs when new actors are attracted to participate in the new system; enrollment takes place when the different expectations, roles and interests are aligned; and mobilization is when new actors act as spokespersons for the network translation, meaning innovation. The current moment of translation is identified in chapter 10, followed by a discussion about the expected next movements.

Wind Power in Spain will be studied using ANT, in order to better understand the innovation system functioning. The existence of power relationships and different associations between actors is analyzed in chapter 9. The use of a Technological Innovation System (TIS) of analysis makes it possible to understand the connection between actors, networks and institutions in Wind Power in a more systematic way. The following sub-chapter explains what a TIS consists of.

5.2. Technological Innovation System (TIS)

As mentioned before, a TIS is a socio-technical system focused on the development, diffusion and use of a particular technology in terms of knowledge, product or both (Bergek et al. 2008). Therefore, Wind Power in Spain constitutes a TIS and it can be analyzed by studying its functional dynamics. The components of a TIS are the actors, networks and institutions contributing to the development and diffusion of new products and processes. The scheme of analysis proposed by Bergerk et al. consists in six steps, each of them containing multiple variables to be analyzed (figure 4):

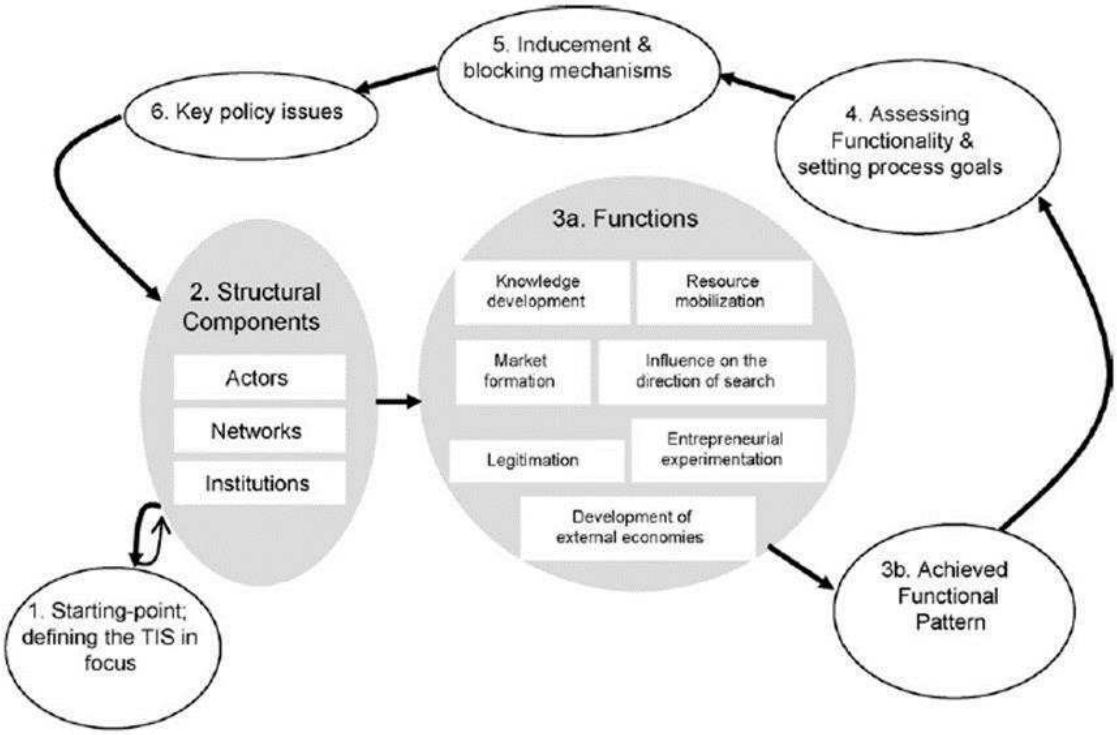


Figure 4: Technological Innovation System analysis (Bergek 2007)

An adaptation of this TIS to the case of Wind Power was made (figure 2), in an attempt to simplify the process and to focus only in those functions which affect the local acceptance. It starts by describing the TIS and identifying the blocking mechanisms that motivate the study. Afterwards, an analysis of the structural components of the system, in terms of actors, networks and institutions is done. This is followed by a description of the functional pattern of the industry in terms of legitimization, resource mobilization, knowledge development and experimentation. The key policy issues are part of the discussion of the paper.

The following lines summarize the content of each chapter to analyze the TIS, which has been presents in chapter 4 (figure 2):

Chapter 7: Definition of the TIS
It includes the definition of the knowledge field, the extension of the analysis, the spatial frame in which it operates, the current situation of the industry it belongs to and the analysis of the normative frame that may provide difficulties for the growth of the TIS. Finally, a case in Spain is described.

Chapter 8: Inducements and blocking mechanisms
It includes description of specific blocking mechanisms used in the project studied and the identification of controversies around the innovation system.

Chapter 9: Structure and function analysis
Analysis of the structural components of the TIS, including main actors, institutions and their networks; analysis of the different values and expectations around the system, power distribution, legitimacy and resources available.

Chapter 10: Discussion of key policy issues
Identification of functional patterns and key issues. Discussion of the results from the analysis of the innovation system, including proposals for specific solutions.

The following sections present the additional theories and concepts used to complete the analysis of the TIS. The value framework (Ouden 2012) is now presented. It is a concept used to analyze the reasons behind the existence of opposition and resistance to the project from part of the local community.

5.3. Innovation design: the value framework

The design of innovation systems, attending to the different values for each actor, has been studied by Ouden (2012). The creation of 'shared value' for people, organizations and society becomes difficult if there is not an understanding of what "value" means for each of them. Understanding the importance of these different values for Wind Power developments is crucial for the design and planning of successful projects. He suggests that people, organizations and society form a framework structured by four levels of value.

The value framework is a useful tool for understanding the different expectations and benefits that wind power projects create for different people. The four levels of value are: user, organization, ecosystem and society (figure 5).

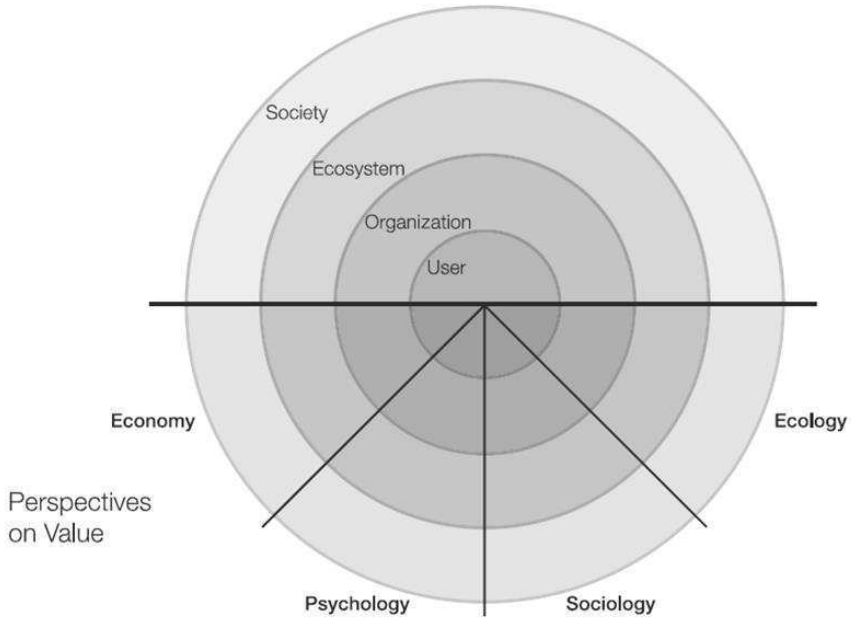


Figure 5: Levels and perspectives of value (Ouden 2012)

Each of them is carefully analyzed, in regards to Wind Power, in chapter 9, including the four different perspectives for each of those levels of value. The analysis explains the origins for the episodes of resistance related to local acceptance. The following sub-chapter describes the concepts of local acceptance and social acceptance.

5.4. Social acceptance and local acceptance

Social acceptance has three main components: socio-political, market and community acceptance. Although it would be interesting to study the three of them, the focus of this study is in project development practices and the influence of local acceptance. Therefore, community acceptance of wind farm projects will be the aspect analyzed in detail.

The concept of local acceptance refers to the acceptability that the part of a community directly affected by the project professes towards it. It is, therefore, directly connected to the concept of community acceptance, meaning "the acceptance of siting decisions and renewable energy projects by local stakeholders, particularly residents and local authorities" (Wüstenhagen et al. 2007).

The main factors influencing this type of acceptance are (figure 6):

Procedural justice, which means the fairness of the decision making process. This refers to the use of participatory processes, the openness and transparency of the documents shared with the public, etc.;

Distributional justice, which means the share of costs and benefits from the project with the local community;

And trust perception by local communities, which means the existence of available information about the intentions of foreign investors and developers. These factors are analyzed in detail in chapter 9.

Figure 6: Social acceptance (Wüstenhagen et al. 2007)

Local acceptance is usually described by a U-shape along the progress of a project, starting with a high level of acceptance in the planning or pre-project phase, falling down to the lowest levels during the project execution, and rising up again after the project has been concluded. This evolution on the level of acceptance will also be analyzed in the following chapters.

The existence of resistance of local communities to the installation of wind farms is very often related to the limited information about the project, as well as the misunderstandings during the communication with the developer. Uncertainty and ambiguity are a consequence of lack of justice and trust during the different phases of the project development. These concepts are described in the following section.

5.5. Stakeholder management: uncertainty and ambiguity

High levels of uncertainty and ambiguity have been identified in previous studies as initiators of episodes of resistance. This section explains these concepts and refers to previous studies relating stakeholder management and the reduction of uncertainty and ambiguity.

Uncertainty
Uncertainty is defined, in the field of construction project management, as absence of information required for the decision that needs to be taken at a point in time (Winch 2002). Uncertainty is usually present in complex projects, where a number of different actors, processes and requirements need to be managed and included in the planning. Uncertainty can be reduced by provisioning more information (Brun & Saetre 2009)

Uncertainty is one of the key words of this study. How to manage and reduce uncertainty in projects, in order to avoid unexpected results, is crucial for project developers. The design, preparation and implementation of specific tactics to prevent uncertainty, will be discussed in chapter 10.

Uncertainty is related to the concept of ambiguity, both are characteristics of projects with high level of complexity (Pich et al. 2002). Schrader et al. described uncertainty and ambiguity as different phenomenon which need different reduction strategies. Michael Thiry (2002) confirmed this difference and designed a model that relate those concepts in changing situations.

Before describing how these two models can be applied to wind farms development, a definition of ambiguity is given:

Ambiguity
Ambiguity is another key word in this study and it is directly related to uncertainty in complex projects. There are different definitions, such as “absence of knowledge about functional variables” (Schrader et al. 1993) or the different interpretations of the same piece of information (Brun & Saetre 2009). The importance of finding an accurate definition for this term is crucial for this study, since the identification of factors increasing ambiguity in complex projects is one of the main objectives.

The definition used in this study is the different considerations that various people can make from the same fact, and that can therefore lead to unexpected situations. Ambiguities cannot be predicted by provisioning more information, since the understanding of the fact itself differs as much as not even considering it a risk for the project. The reduction of ambiguity passes by sense-making processes and understanding the existing relations between different variables. These processes will be analyzed and discussed in chapters 9 and 10.

There are two concepts directly associated to ambiguity, which refer to the previous and posterior phases. A definition is given in the lines below:

Framing
Framing is the process through which a common world is established between different actors of a project, which allows them to achieve a collective scenario of a desired outcome. This concept sheds light on the ways in which such a scenario is gradually transformed into a reality (Jolivet & Heiskanen 2010).

The framing process is therefore previous to the appearance of ambiguities around the project. If the process is completed with active communication between actors, participatory processes and a fair distribution of power, a low level of ambiguity is expected.

Overflowing
Overflowing represents the instability and uncertainty inherent to complex projects, which might break up at any moment. Overflows might arise when other actors do not conform to what was expected from them, for instance when parties that were not invited to the table invite themselves in or start to carry out their own alternative scenario (Jolivet & Heiskanen 2010).

Overflows are a result of high levels of ambiguity around a project and may lead to controversies and resistance episodes, like those described in chapter 8. In order to reduce the level of uncertainty and ambiguity, Michel Thiry proposes an integrated programme management cycle:

The integrated programme management cycle
It is formed by a performance and a learning cycle (Thiry 2002). The learning cycle is based on different principles than the performance cycle; time, focus, decision and leadership take different dimensions. Once a decision has been made, implementation time should be as short as possible, since it becomes a success factor, and more time is required for the interaction leading to the decision.

In addition, while planning and execution must be rational, analytical and efficient, the process leading to decision making relies more on sense-making and intuition, requiring innovation and creativity.

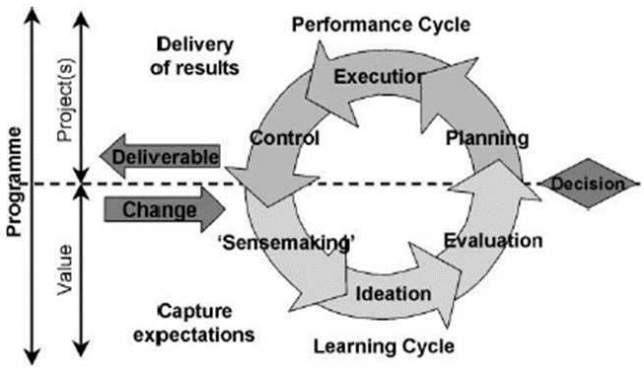


Figure 7: The integrated programme management cycle model (Thiry 2002)

In the performance cycle, the project needs to be broken down into work packages, and roles and responsibilities clearly allocated so that resources can be focused on simple specific tasks without questioning. In the learning cycle, the same resources will need a holistic approach of the project in order to be able to identify a wide range of opportunities; the project has to be viewed as a system of complex interactions to which everybody can contribute. The programme management cycle is applied by using the uncertainty-ambiguity model, described in chapter 6.

In the next chapter the methodology used in this thesis is described, explaining the structure of the paper, the collection of data, and how the different theories are applied in the analysis. The uncertainty-ambiguity matrix (Schrader et al 1993) and the uncertainty-ambiguity model (Thiry 2002) are presented as well, explaining how they will be used to reduce these two characteristics of complex projects.

6. Methodology

The methodology used to apply the theory presented above in the analysis of the wind power in Spain is now presented. Afterwards, the use of a case study is justified. And finally, the data collection process is explained.

6.1. Use of theory to analyze the TIS

The Actor Network Theory
ANT is the core theoretical approach in this study. As mentioned in chapter 5, ANT is applied in our study by using the technology innovation system concept to structure it, dividing the study into four blocks that aim to describe in detail how it functions, which the main actors are, the existing networks, and the relations between them.

In addition, ANT concepts such as “the moments of translation” will be used to argue the change process that this innovation system is experiencing. Finally, a detailed description of the actors in the development of a wind farm and their network is included in chapter 9.

The value framework
This concept is used in the analysis (chapter 9) to argument the reasons behind the different understandings that the actors have about the same episodes during the project. It makes it possible to find the origin of the resistance and to find the connection with the increase of uncertainty and ambiguity levels.

The uncertainty-ambiguity matrix
Schrader suggests that the problem solver decides in the problem-framing process on both the levels of ambiguity and uncertainty involved. The following matrix (table 2) includes the five possible cases.

Table 2: Uncertainty-ambiguity matrix (Schrader et al 1993)

	Low uncertainty	**High uncertainty**
Low ambiguity	Case 1 Variables known Values known Functional relationships known	Case 2 Variables known Values unknown Functional relationships known
High ambiguity **Level 1**	Case 3 Variables known Values known Functional relationships unknown	Case 4 Variables known Values unknown Functional relationships unknown
Level 2		Case 5 Variables unknown Functional relations unknown

Uncertainty reduction refers to the determination of the value of variables, by the use of predesigned models. Ambiguity reduction relates to the determination of the set of relevant variables and of underlying relationships, by designing models that define the variables and their functional relationships. The case of low uncertainty and ambiguity level 2 is not possible, since variables must be known to know their value.

In the case studied in this paper, the existing level of uncertainty and ambiguity will be found in the data collection process, determining in which of the five cases it can be classified. The corresponding strategy to reduce those uncertainties and ambiguities will be defined based on the specific characteristics of that case, depending on the knowledge of variables, their values and the existing functional relationships.

Uncertainty-ambiguity model

There is a second model built around the uncertainty-ambiguity relation. It is a good complement to the previously presented model, since it is more focused on the specific tactics to apply depending on the level of uncertainty-ambiguity identified.

Thiry proposes a model which combines four strategies of project management to deal with the different levels of uncertainty and ambiguity that may be present in the project. It is based in the learning cycle of programme presented in chapter 5.

Table 3: Adaptation of uncertainty-ambiguity model (Thiry 2002)

	Low uncertainty	**High uncertainty**
Low ambiguity	Ongoing operations	Risk analysis & problem solving
High ambiguity	Ongoing conversation	Sense-making & value analysis

Depending on the level of uncertainty and ambiguity found in the analysis, the most appropriate strategy will be chosen and adapted to the case, formulating concrete proposals.

The following section presents the reasons behind the use of a case study to analyze the TIS.

6.2. Case study

The structure of analysis previously presented (figure 2) is built around a Case Study. The reasons for choosing this research method are: the research question includes "how" and "why" questions; there is no control over the events studied; and the focus is on contemporary phenomenon within a real-life context (Yin 2003).

The research question that motivates this thesis is "How to account for ambiguity as a blocking mechanism when planning and managing complex projects: the case of Wind Power in Spain", which can be intended as an explanatory case study. There are links traced over time that connect the different episodes of use of blocking mechanisms, and also contextual conditions which need to be identified and described.

The case study is the preferred method for examining contemporary events, when the relevant behaviors cannot be manipulated (Yin 2003). It includes direct observation of the events, as well as interviews that will help to identify the practices of project managers for the development of wind farms and the blocking mechanisms used by part of local communities.

This study includes the experience of *Developer Alfa* developing wind farm projects, identifying the challenges they face related to local acceptance of their installations. The comparison with a number of successful projects in other countries, in terms of local acceptance, adds value to the study, making it possible to analyze the aspects that could help to reduce ambiguity.

Scientific articles in this topic and previous studies have been reviewed as well, which was especially helpful when the research question was defined, trying to find different points of view that could help to understand the problem. It was also planned to define how to move from the individual case to a more general theory, analytical generalization, by the discussion of key policy issues.

It is expected that more variables of interest than available data points are found, so the challenge is to define a clear plan for data collection and theoretical approach used. The following section describes the data collection process.

6.3. Data collection: interviews and surveys

Summary of the data collection process

The preparation of this study started in January 2014 by reviewing existing literature on local acceptance of wind farms, in order to prepare a proposal for the thesis. The generic process of planning a Wind Farm was the first topic studied for this thesis, exploring the possibility of including local communities in the process. The objective was to understand their reasons for non-acceptance and to make possible an installation process accounting for them.

In February 2014, when the study was approved, various developers of Wind Farms in Spain were contacted, asking for their contribution to this paper. In an attempt to identify their point of view, they were offered valuable input for improving their processes in the future, and *Developer Alfa* was the most active partner.

An interview was arranged with *Developer Alfa* project managers on March 2014. The previous two weeks were used to collect as much information about their projects as possible, as well as reviewing scientific articles in the topic in order to have a valid informational basis to explain the goals of the thesis to them and conducting the first interview.

The interview with an experienced project manager made it possible to understand the current situation of wind power in Spain, the different steps that *Developer Alfa* follows when developing a wind farm, the stakeholders involved in the process, and the case of some wind farms developed by them which faced opposition from part of the local community.

After having reviewed the existing information about the case, the director of energy policies of the AEE (Spanish Wind Power Association) was contacted and an interview was arranged on April 2014. The reason was to get more information about the evolution of the wind power industry in Spain, to discuss with him the findings of the study so far and to ask about his experience regarding local acceptance.

In addition, *Developer Alfa* Project Management section was contacted again and an interview was arranged on April 2014. Some additional questions regarding the specific projects studied in the case were asked. In addition, a survey was answered by them, adding highly valuable information for the identification of uncertainties and ambiguities.

Finally, one of the most active groups of people opposing the installation of the wind farms was contacted on April 2014. An interview was conducted by phone, and a survey was answered as well, making it possible to compare the answers with those given by the developer. The content and characteristics of the interviews and the survey are now described.

6.3.1. Interviews

As mentioned before, the collection of data is based on interviews with project managers directly involved in the development and installation phases of the wind farms studied. By asking open-ended questions, qualitative data is obtained, allowing the interviewee to express his own thoughts.

A number of other stakeholders were also contacted, in order to give robustness to the study. In that way, project developer understanding of the situation can be compared with the perception that other actors may have, making possible to identify the existing uncertainties and ambiguities around the project.

Table 4: Interviews description

Interview	Type	Interviewee
1	Face-to-face	Asset Management at *Developer Alfa*
2	Face-to-face	Energy Policy Director at AEE
3	Face-to-face	Asset Management at *Developer Alfa*
4	Telephone	Spokesperson at local NGO

There were four different interviews, three of them were in person and semi-structured. The fourth was a telephone interview were no specific questions had been prepared and the interviewee, spokesperson at local NGO, was asked to share his thoughts about the projects.

The questions of the interviews, as well as the expected results that motivated formulating them, are presented in the following lines:

Interview 1: Asset Management at *Developer Alfa*

Development and installation processes at *Developer Alfa*

1. *"Which is the typical process for developing and installing a wind farm? Does it match the diagram in your website?"*

The purpose of this question is to define the process followed when developing a wind farm, checking if it is aligned with the procedures they announce in their website.

2. *"Which are the stakeholders in each of the steps?"*

The purpose is to know which are the stakeholders they usually take into account, understanding how they are included in the planning, development, installation and operation phases.

Experience related to acceptance of wind farms by local communities

3. *"Could you describe the episodes of resistance?"*

It should help understanding the Project and the resistance they experienced from part of the local community.

4. *"Could you provide some technical information about those projects (wind resource, selected technology, layout, landscape features, visual impact, noise, land value, etc.)"*

The purpose of this question is to understand the size of the wind farms and to be able to compare them with other projects in following studies, as well as establishing a frame for multiple case studies in the Wind2050 Project.

5. *"How did it affect the Project? And you individually?"*

It question was included to give an understanding on how these events affect the project and those individuals directly involved on them.

6. *"Do you think something else or different could have been done in those projects?"*

In this question the interviewee can contribute to the finding of solutions to the problems he previously experienced.

Interview 2: Energy Policy Director at AEE - Spanish Wind Power Association

Industry situation and expected future

1. *"How would you describe the evolution of Wind Power in Spain?"*

This question will be used to define the background of the Wind Power Industry in Spain and the current situation it is experiencing.

2. *"Which are the future scenarios you consider, attending to the current situation of the industry?"*

As the previous question, this one will be used to explain the expected evolution of the wind energy sector, given the current situation, and the strategies that developers are already implementing in order to adapt to it.

Public acceptance and local involvement in wind farm developments

3. *"Which is the level of public acceptance of Wind Power in Spain? Meaning authorities, citizens, media…"*

This question will give a better understanding on the level of acceptance of wind power in Spain, attending to the experience of AEE with developers and communities where wind farms were successfully developed.

4. *"To which extent do developers involve local communities in the planning phase of Wind Farms?"*

The purpose here is to know the degree of local involvement that typically exists in wind power projects in Spain, as well as his perception of the importance it has over the development.

5. *"Which are the benefits and drawbacks of installing a Wind Farm for the local community?"*

This question provides information about the positive and negative reasons, for a local community, to support or oppose wind farms installations.

Correlation between industry situation and development practices

6. *"Is there any relation between the situation of the industry and the development practices during last years?"*

In this question the interviewee will give his opinion of the hypothesis of a relation between the current situation of renewable energies in Spain and the Project Development practices used during the last years.

7. *"Which should the next movements be? Is there any change needed in the industry?"*

This could provide highly valuable information about possible solutions to the current problems of wind power.

Interview 3: Asset Management at *Developer Alfa*

1. *"What do you understand by local community in relation to wind power projects? Who belongs to it?"*

Understanding what the developer thinks of by the term "local community" is essential. This could help develop an understanding of who the developer approaches in an area considered for a wind farm installation.

2. *"Who were the main stakeholders in this project? Was there any previously established network among them?"*

The specific project of our case study is described and an accurate description of the stakeholders is given, as well as any possible previously existing relation between them.

3. *"Which were the attitudes of the local community towards the project? How did they evolve during the process?"*

The climate in which the project was developed is described, and an evolution on the attitudes of locals can be identified. This is important for our analysis since it gives a clear picture on when there was highest resistance.

4. *"When and how was the local community informed about the project? What were the arrangements to the project made with them?"*

By this question it is possible to understand the communication channels between developer and local community, as well as the specific offers and claims during the process.

5. *"Which aspects of the project usually create resistance in the local communities? In which ways can projects be adapted when any of these episodes occur?"*

This question explores the developer experience related to resistance in this and other projects. The reasons they have identified for those episodes of resistance can be compared with the findings of our study

6. *"Do you follow any standard or any guides of your own organization for planning, developing and installing wind farms?"*

The standards or guidelines followed by the developer can be analyzed so it is possible to get a better understanding on their specific procedures and the impact they may have over the projects

Interview 4: spokesperson at local NGO

As mentioned before, this interview did not follow any specific structure. The spokesperson was called and a conversation was held regarding the project. His thoughts about the process and the reasons that moved them to actively oppose the wind farms were given.

6.3.2. Surveys

A survey has been designed to identify the characteristics of the projects regarding certain socio-technical factors (Loring 2007) as well as confirming the discourses of the interviewees.

Table 5: Surveys description

Survey	Type	Person
1	E-mail	Asset Management *Developer Alfa*
2	Telephone	Spokesperson at local NGO

The questions included in the survey have been inspired by a previous study of wind farm acceptance issues (Loring 2007). The questions have been grouped into four categories, described in the following lines, and they should be answered with "high", "medium" or "low":

Network stability

1. *Strong relationships among actors within the network*
2. *Significant texts or documents*
3. *Multiplicity*

The questions regarding network stability aim to identify the relationships among the different actors participating or affected by the project, in order to understand the framework in which the project was developed.

Community acceptance

4. *Positive results in public opinion surveys about the project during the planning phase*
5. *Significant interest groups generally in favor (or not opposed to the project)*
6. *Attendees to public meetings generally in favor (or not opposed to the project)*
7. *Letters of objection sent to planning authorities and newspapers*
8. *Letters of support sent to planning authorities and newspapers*
9. *Positive media coverage*

Through these questions, the level of local acceptance of the project will be determined. This could provide evidences of ambiguities in case different answers are given by developer and other affected stakeholders.

Community participation

10. *The participants are representative of the views of a full range of potentially affected people*
11. *Barriers to participation were minimized*
12. *Community members impact decisions about the project*
13. *Community members have financial ownership in the project*
14. *Local initiation of the project*
15. *Community will have continued involvement in the project*

These questions provide answers about the process followed, its fairness and the level of participation achieved. Participatory processes usually lead to reduction of conflicts and more robust and higher-quality decisions can be made (Loring 2007).

Planning success

16. *Success of the project*

This question aims to obtain the opinion of developer and affected stakeholders about the overall degree of success perceived around the project.

The complete survey, including the answers, can be found in the appendix.

6.3.3. Review of documents from the project

The Developer provided technical documents, like the Environmental Impact Assessments (EIA) of the project, which were used to look for specific information mentioned during the interviews and from the surveys. It was also a good source of information to describe the technical characteristics of the project.

In addition, the main newspapers of the region, as well as the websites from local NGO's were reviewed. It was found many useful information which is included in chapter 7 and 8.

The following chapter defines the innovation system object of this study: wind power in Spain.

7. Definition of the TIS

7.1. Wind Power industry in Spain

Attending to the information published on AEE website, Spain is the fourth country in the World in terms of installed wind power after the US, Germany and China. The installed wind capacity by the end of 2013 was 22,959 MW. Wind power was the primary power source that year, with an electricity generation of 54,478 GWh and covering a 20.9% of the total demand in Spain.

Wind Power in Spain is regulated by 24/2013 Electric Sector Law, which establishes the norms and rules applying to this sector and which had been preceded by the periodical Royal Decree-Law updates to the 54/1997 Electric Sector Law. This law introduced major changes to norms and rules affecting renewable energies. However, it still does not cover all the aspects around wind power developments, transferring the responsibility of the specific details and plans to the Regional Governments.

One of the most controversial chapters of this Law is the one referring to reductions on subsides to renewable energies, including those installed when the previous law applied. The reduction on investments in new wind farms was very drastic after this announcement.

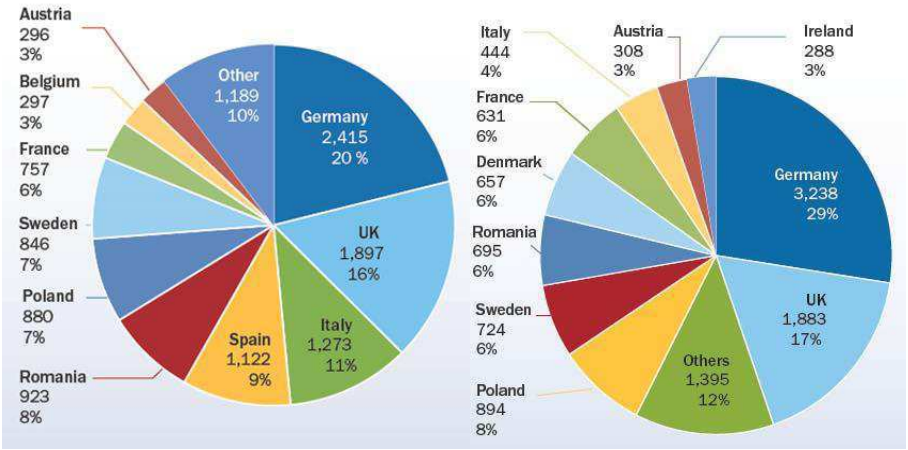


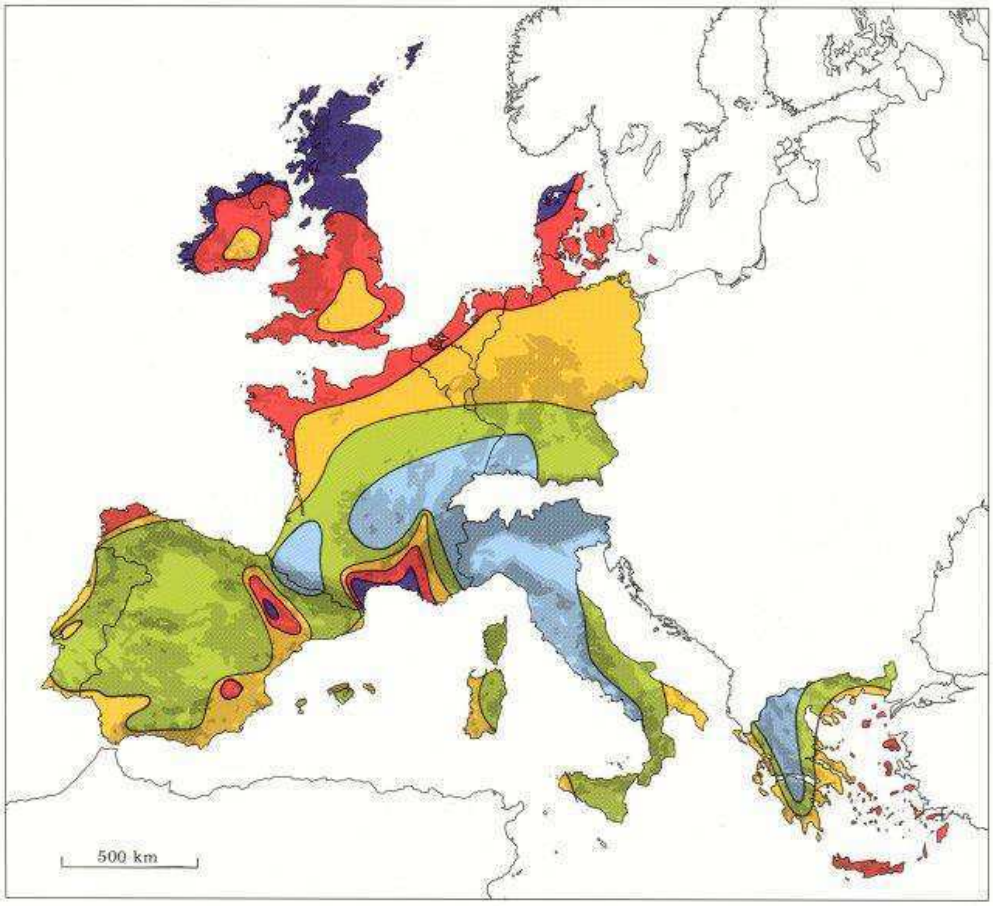
Figure 8: EU member state market shares for new capacity installed during 2012 and 2013 in MW. (EWEA)

The reduction on installed MW during 2013 was very significant, as it can be observed in figure 8 above. Spain passed from a market share of newly installed wind power of 9% to having less than 3% of newly installed capacity in Europe. Some of the largest developers of wind energy in Spain have recently announced the decision on not investing significantly in Spain during the following years, due to these variations in the regulations, focusing instead in other international markets.

The strategic decision of the Government can be understood as short term solutions for reducing expenses in subsides. It is in the middle and long term when the drawbacks can be felt, since the wind industry would dramatically reduce its activity, most small and medium companies would close down and only those big companies, strong enough to face the cuts would be able to reorient their activity to other countries.

The Energy Policies Director at the Spanish Wind Power Association (AEE) was interviewed to obtain a better understanding of the evolution of this industry in Spain. According to his explanations, the successful development of wind power in Spain was a combination of favorable factors:

"Spanish orography is an advantage, there are four different zones with high wind resource"



Wind resources[1] at 50 metres above ground level for five different topographic conditions

	Sheltered terrain[2]		Open plain[3]		At a sea coast[4]		Open sea[5]		Hills and ridges[6]	
	$m\,s^{-1}$	Wm^{-2}	$m\,s^{-1}$	Wm^{-2}	$m\,s^{-1}$	Wm^{-2}	$m\,s^{-1}$	Wm^{-2}	$m\,s^{-1}$	Wm^{-2}
	> 6.0	> 250	> 7.5	> 500	> 8.5	> 700	> 9.0	> 800	> 11.5	> 1800
	5.0-6.0	150-250	6.5-7.5	300-500	7.0-8.5	400-700	8.0-9.0	600-800	10.0-11.5	1200-1800
	4.5-5.0	100-150	5.5-6.5	200-300	6.0-7.0	250-400	7.0-8.0	400-600	8.5-10.0	700-1200
	3.5-4.5	50-100	4.5-5.5	100-200	5.0-6.0	150-250	5.5-7.0	200-400	7.0- 8.5	400- 700
	< 3.5	< 50	< 4.5	< 100	< 5.0	< 150	< 5.5	< 200	< 7.0	< 400

Figure 9: Wind resource atlas (windatlas.dk)

There are up to four differentiated zones where wind blows independently to the other zones: "Cornisa Cantabrica", especially in Galicia; "Valle del Ebro"; "Castilla la Mancha"; and the area around Tarifa, in Andalucía. This makes it possible for the generation curve in Spain to be much more stable (flat) than in other countries like Denmark or Germany, where wind either blows in most of the territory or it does not blow at all.

"Iberdrola made the decision of investing in Wind Power"

By the opening of the electric system to private companies, some leading companies like Iberdrola choose to invest in renewables. Their strategy consists on alternating Combined Cycle Power Plants, generating a basis of 4000-5000 hours/year, and Wind Farms. They were front runners in the renewable market, and most of the other electric companies followed their strategy in the following years.

"Aerospace Engineers were curious about Wind Power technology"

A well-developed industrial sector and the interest of some aerospace engineers looking for alternatives to nuclear power made it possible to research and develop the first turbine prototype. The first wind turbine was produced by Ecotècnia in 1984 and more wind power companies and more developments of wind farms arose afterwards.

"Gamesa started producing Vestas wind turbine patents "

This brought round a large knowledge base for wind power turbines, used by Gamesa to develop their own models once the contract with Vestas expired. Other companies like, M-Torres and Acciona started developing their own turbines as well.

"2002-2008 are considered the "Golden Years" for the easy and cheap financing opportunities"

The low interests on bank loans made it very tempting to invest in wind farms. Banks would pay up to 80% of the cost and payback would be quite easy thanks to the subsidies and the low taxes on renewables during that period.

These five facts contribute to understanding the exponential growth of the Spanish Wind industry during the last years. The following sub-chapter presents the current situation of Wind farm developments in Spain, including the most common practices used by developers.

7.1. Current situation with regards to project development practices

When the Energy Policy Director at AEE was asked about social acceptance, he presented the following facts:

- Around 75% of Spanish population supports Wind Power
- It reactivates the economy of rural and isolated areas, so people living there are usually very interested on the installation of wind farms
- Due to expansion, new locations are needed, including high environment value zones
- As a consequence, the "not in my second house back yard" phenomenon arose
- There is a campaign, both from politicians and the media, trying to convince about negative aspects of renewable energies, including Wind Power
- However, the cost of Wind Power in €/MWh is less than half of the cost of Combined Cycle Power Plants using gas (Ernst & Young 2012)

He suggested to visit the website "Actonfacts.org", where more reasons supporting Wind Power can be found. He said the strategy of the wind industry was to recover its previous importance and activity by informing the general opinion about these "facts" regarding Wind Power.

Some conclusions obtained from the analysis of these statements are that:

- There is a general support to wind power as a renewable energy,
- It has traditionally been well accepted by local communities, since most installations were located in isolated rural areas
- However, more locations are needed, some of them with high environmental value or other reasons that make the development tough.
- People do not feel attached to wind power, since fairly low reactions to the recent Government decisions have been registered.

There might be an opportunity for the industry to adapt its strategy to both the current situation and the expected evolution, in terms of local acceptance. The episodes occurred in other European countries, where there is a strong opposition by some local actors, may be a signal.

This chapter describes the development process of wind farms followed in Spain, in an attempt to understand the procedures followed, the typical initiators of the projects, and the level of involvement that local communities have.

Most wind farms in Spain are planned and designed by both the owner and the project developer, with a low involvement of local actors. The information flow during the process is typically top-down: the developer announces the characteristics of their plan for the area, but he only gives opportunities to local communities to show disconformities and complaints, rather than having an active role from the design phase.

Developer Alfa has been considered a representative company in the Spanish Wind Power sector to analyze the tactics used for the development of wind farms.

Wind farm development process at *Developer Alfa*

Developer Alfa is a global renewable energy company. It first started developing wind farms in the 1990's and it has global presence now.

The following information has been obtained from interviews with experienced project managers at *Developer Alfa*. It consists on a description of their business, with regards to Wind Power, and a summary of the different phases they follow when a Wind Farm is developed:

A. Development phase

The development phase starts by the identification of sites where wind conditions are optimal, and by checking the feasibility of connection to the grid. When this is done, local landowners are contacted and a leasing agreement is negotiated. The next step is the installation of meteorological equipment to analyze the wind profile and to obtain accurate data on existing resources. This process can take several years.

Afterwards, it is necessary to obtain environmental, administrative, construction and other consents and permits, by engaging with local and public authorities. Market analysis is the following step, studying market dynamics in terms of electricity prices, regulation and financing.

B. Construction phase

This phase starts with the design of the layout and the decision on the most suitable turbine for the wind farm. Then, the installation starts by building access roads, preparing foundations, erecting the towers, assembling the wind turbine generators and constructing the substation.

The entire process can extend between six months and one year. Once this is completed, the opening ceremony takes place, results of the development are shared with local inhabitants, business communities, authorities and other stakeholders. Finally, connection to the grid is completed and the operation of the wind farm starts.

C. Operations phase

This is a continuous process during the wind farm life cycle, which extends for at least 25 years. Operational data is monitored in real-time, analyzing performance and identifying opportunities for improvement. Maintenance services keep availability figures at the highest level possible, minimizing the rate of failure.

A real project is now presented, in order to understand how this procedure is applied to practice.

7.2. The case of a number of wind farms in Spain

This case study includes information obtained from a number of projects and interviews to experienced project managers in *Developer Alfa*.

Description of the projects

Wind farms A, B, C and *D* were installed in the border between three municipalities in a rural area with a low density of population and low environmental sensitivity, according to the environmental statement for wind development made by the Government of the Region. The evolution of the population in this region during last years can be observed in table 7.

The high number of inhabitants in *Municipality 1* is due to the existence of an important town in the municipality, but not in the surroundings of the wind farms. The tendency during the last 25 years has been to move from rural to urban areas, leaving traditional jobs in agriculture and livestock and moving to more dense areas where industry and services form the main economic sector.

Table 6: Population evolution in the area of installation

Municipality	Area (KM^2)	Population 1998	Population 2009
1	165	544	432
2	179	472	501
3	283	61469	88975

However, some villages have experienced during the last years a slight increase in their population, as it has been seen in *Municipality 2*. This is due to the growth of neo-rural communities, a phenomenon of people moving from the cities to isolated villages where they recover traditional activities and life styles.

In these municipalities, different neighborhood councils own the lands where the wind farms were installed, so the city hall gets no direct revenue from it and, therefore, part of the community does not get a compensation for the installation.

The following table contains data from AEE regarding the technical characteristics of these wind farms:

Table 7: Technical characteristics of the wind farms

Wind farms	Rotor diameter (m)	Unitary cap. (KW)	Number of turbines (per farm)	Total Installed cap. (MW)
A, B, C, D	< 80	1500 - 2000	5 - 30	125

The process that led to their installation and the following opening of the wind farms has been summarized and structured in the 3 phases presented in the previous sub-chapter:

A. Development

It started by data analysis and the installation of meteorological equipment. There was no problem so far, even a Spanish environmental NGO, sent a letter expressing its support to renewables and the installation of wind farms in the area.

In this phase, the city hall was contacted (it was a neighbor association in this case, most of the mountains are lands of public use) and they were presented the basic project.

A study was conducted in the area, in order to determine the different stakeholders the developer would have to approach. The affected landowners were contacted, as well as the neighbors from the surroundings, like a neo-rural village.

An environmental study of the area was also conducted, identifying the existing species and assessing potential impacts. The Regional Environment Office and environment NGO'S were contacted as well. All of them were introduced to the wind farm development plan. In addition, the Cultural Heritage Office in the Region was contacted to determine the possible presence of special singularities in the area.

Special attention was given to the location of the wind turbines in the border between different municipalities, since it could be a motive for opposition if any of the neighbors were affected by the location but do not benefit from the compensatory measures.

Afterwards, the transaction of public information occurred, by short ads at the city halls. The following documents were presented: Exceptional use of rural lands, Project Competences, and the Environmental Impact Assessment (EIA). Three allegations were received: two landowners, regarding land ownership concerns and the neo-rural community, concerning the visual impact.

The results of the administrative process resolution were the following administrative appeals:

- The local section of the Spanish NGO previously mentioned, the local environmental NGOs *Beta* and *Gamma* and some neighbors sent around 100 administrative appeals (consisting on the same text).
- A TV antenna company was concerned with the possibility of the TV signals having interferences. They sent a study attached to the appeal, referring to some previous cases where it had happened, but the administration concluded it would not necessarily happen again.

B. Construction

During the installation phase they received a demand because of having opened a new road access to the wind farm.

C. Operation

No additional demands, except from Supreme Court resolution in 2011, which considered that both tower and turbine were part of the same civil work and, therefore, an additional tax should be paid to the city halls. The payment was negotiated between the city hall and the developer.

The following chapter presents the typical reasons for opposition to Wind Farms and the specific reasons presented by some opponents to the project.

8. Inducements and blocking mechanisms

Inducement and blocking mechanisms during the implementation of wind farms have been identified in different studies, due to several reasons that include aesthetics, noise, land value or a biased environment in favor of other established TIS. The following section includes the reasons to opposition of the installation in the project in Spain.

8.1. Reasons for opposition in the case studied

The following information has been obtained both from an interview with the spokesperson at *NGO Beta* and the website they created to share their reasons against this project.

The Spanish NGO, and *NGOs Beta* and *Gamma* decided to form a common group to oppose the installation of the wind farms. They gathered a number of signatures among neighbors, around 700, in order to support their reasons. In addition, they created a document were they expressed their reasons for the administrative appeal and they shared it with anybody interested in sending it to the court. Around 100 people individually signed and sent the same document.

Some of the reasons they included in the appeal were:

- There is an important impact in a high environmental, cultural and landscape value area, suitable to be recognized as a Natural Park
- The Regional Government should not have labelled it a low sensitive area
- Two of the villages directly affected by the project, *Villages 4* and *5*, were not included in the environmental impact assessment (EIA). Their future plans passed through a sustainable rural development
- The need of building accesses to the wind farms would dramatically affects the mountain landscape
- The EIA of the grid connection project was not included in the EIA of the wind farms
- There is a fear on the wind farms affecting the birds, especially because the observations lasted two hours only
- The region was already exporting energy to other regions, they think energy should be produced in the areas where it is consumed
- There is a fear on the wind farms affecting an important touristic attraction nearby
- The three wind farms should have been considered one big farm because they were placed together. The EIA would have been more demanding in that case
- Wind energy depends on subsides. There was the fear that the wind farms would stop their activity when they would not receive any more support from the Government.

These reasons are now compared to the sources of controversy identified in previous studies.

8.2. Themes of controversy in wind farm developments

Certain themes have been identified as sources of controversy in previous studies (Borch personal communication). This paper explores them and also tries to find new issues to be added to the list:

- The aesthetic appreciation of the particular landscape
- Fear of impacts on the local environment and economy (Hagget 2012; Firestone 2007)
- The ownership of a development, and local relationships with developers (Van der Horst 2007)
- The decision making process, trust in decision-makers and opportunities for the locals
- Sustainability, meaning dependency on subsides
- How actors construct narratives for or against the projects through mass media and its affection over the acceptance (Borch personal communication).

A clear correlation between the general reasons for opposition and the specific complaints in the case studied can be observed. Most of them are present in the project, which proves the existence of local controversies and the use of blocking mechanisms by part of the local community. Chapters 7 and 8 have made it possible to answer the first sub question:

Sub RQ 1: *"Which are the blocking mechanisms used by local communities when there is no acceptance of these projects?"*

In order to better understand were these complaints come from, and how fair the development process is perceived, an exhaustive analysis on the structure and functioning system of Wind power development is now made.

9. Structure and functions analysis

This chapter intends to explain the functioning system of wind power by analyzing the stakeholders, some technical documents highly important during the development; identifying the actors that form the network around this developments, and the power distribution between them; and presenting the different values and expectations of those actors that lead to higher levels of uncertainty and ambiguity.

9.1. Stakeholder analysis

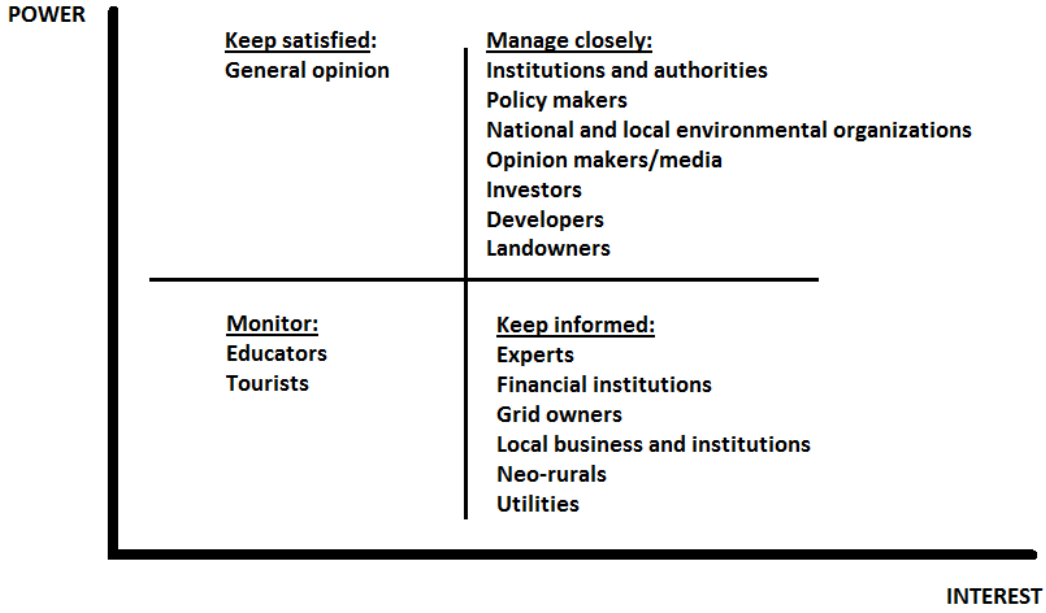
The stakeholders of the project are group or individuals who have a stake in, or expectation of, the project performance, including clients, Project Managers, designers, subcontractors, suppliers, funding bodies, users and community (Newcombe 2003).

The list of stakeholders identified by the developer in each phase of the project in Spain is now presented:

- Site identification and landowner agreement phase: City halls, neighborhood councils and private landowners.
- Wind profile study phase: Internal stakeholders, energy evaluation department
- Consents and permits obtaining: Local authorities, including city halls and neighbor councils, regional and national authorities if the installed power exceeds 50 MW.
- Market analysis phase: Internal stakeholders, market regulation department
- Layout design and construction phases: Internal stakeholders, energy evaluation, engineering, construction, development, project management and environment departments.
- Wind plant operation phase: Operation and maintenance; and business management
- Data analysis phase: Analysis, engineering, energy evaluation and Lean departments
- Maintenance service: Operation and maintenance
- Delivery of energy to end user: Energy supplier

This lists is very precise and includes most of the stakeholders traditionally identified in wind power developments. However, the importance of each of these stakeholders differs, as well as the treatment they should receive from the developer. The following table classifies these stakeholders attending to their power and interest in the project:

Table 8: Stakeholder analysis (power/interest matrix)



The previous matrix shows four different types of stakeholders, attending to their power/interest in the project. Different strategies need to be defined for each of those types. Those who have a high power and high interest in the project should be managed closely, in order to fulfil their expectations and to ensure the project success.

However, some of the stakeholders traditionally kept informed or satisfied only, may have something else to say in the process. As it is discussed in the following sub-chapters, general opinion, local business and institutions or neo-rural communities could be empowered in the planning and development processes, giving more robustness to the decisions made and ensuring a higher attachment to wind power in general.

The Environmental Impact Assessment of the project is now analyzed, in order to identify the considerations made by the developer regarding the stakeholders previously presented.

9.2. Environmental Impact Assessment

An Environmental Impact Assessment (EIA) is a document that evaluates the potential impact that a project has over the area of implementation and its surroundings. It is a highly relevant document in the development process since it includes the considerations made by the developer towards the nature, neighbors, local institutions and organizations, etc.

The EIA is also the first “official” document of the project that is accessible to the public, and administrative appeals and other disconformities can be shown by those individuals affected by its content.

The EIA states that all the municipalities which may be affected by the project are included. However, *Village 4*, where *NGO Beta* is located, and *Village 5* are not part of the study.

Specifically in the sub-chapter of that document, referring to tourism and recreational resources, it only mentions a bar existing in *Village 6*, but not the Association established in *Village 4*, which periodically organizes activities and excursions in the surroundings of the location of the wind farm.

It is surprising that, given their size and distance from the turbine location, *Village 6* is an essential part of the study, but not *villages 4* and *5*.

The fact that two directly affected villages were not identified in the EIA led to obviating them in the corrective measures and, therefore, a strong resistance towards the project was created and extended among the neighbors of these two locations.

This analysis has made it clear that certain documents have a special importance to the project, becoming actors. An analysis on the existing network in wind power developments, and the power relations among the actors forming it, is now presented to understand the dynamics around the project, which motivate controversies and resistance episodes.

9.3. Actors in Wind Power developments

As it has been defined in chapter 1, the actors are someone or something which make a difference and have an importance for a process (Latour 2005)

Some of the actors identified in a typical development include the stakeholders analyzed in sub-chapter 9.1. These are land owner, project developer, neighbors, local organizations, industry associations, NGO's, researchers.

A recent study of the Danish Environment Ministry (Miljøministeriet 2014) has identified 6 different human actors in Wind Farm projects:

- Public institutions, in a local and national level, who apply the existing rules in order to fulfil the Energy targets
- Political authorities, also local and national, who implement the energy plans presented in the elections and which people voted for
- Developer, private organization which designs and implements the project of a wind farm together with the owner
- Landowners, individuals who sell or sublet their properties, where the wind farm is installed
- Proactive neighbors, people who are actively participating in movements and associations, supporting or opposing the wind farm from the beginning of the process
- Reactive neighbors, people who only react at the end of the process, when all the decisions have been made and they final plan is about to be approved.

In the case studied, all these groups of actors can be identified. However, there are some differences with the general situation presented by the study in Denmark. Public institutions in Spain do not follow the same objectives and apply a common rule, since specific rules apply in different regions and there are different targets in terms of renewable energy installed or specific plans for wind power industry.

In addition, political authorities do not always follow the plan they had previously presented. The context in which decisions are made is an argument usually presented to defend variations in the original strategy. An example is the new policy in terms of subsides to renewables in Spain.

Developers and landowners match the profile described. However, proactive and reactive neighbors differ as well. The typical development process does not include a negotiation of the characteristics of the farm or a frame where public can give their opinion. It is usually a one-way flow of information, where developer communicates the plans for the area and the neighbors can present appeals and complaints.

Therefore, neighbors became mainly reactive to the developer plans. There is a subgroup of reactive neighbors, those who are informed about the plans through the media, NGO's or more active people, and who can be convinced with fuzzy arguments to support or oppose the project.

An important impact that this type of process has over local acceptance is the lack of trust that it generates in the community. The project initiation comes from outsiders, the developer together with the owner, who usually gain the trust of locals by offering compensations from the installation.

In addition to the previous human actors, wind turbines, sub-stations, grid connections, or even documents like Environmental Impact Assessments or national and regional regulations can be considered relevant actors as well. The existing networks between these actors and around wind power developments are now described.

9.4. Networks and power distribution

The following chart contains the most relevant actors identified in a Wind Power project and the power relations existing between them. The arrows represent the direction in which that power is applied, meaning that the beginning of the arrow is the most powerful actor and the end of the arrow is the least powerful.

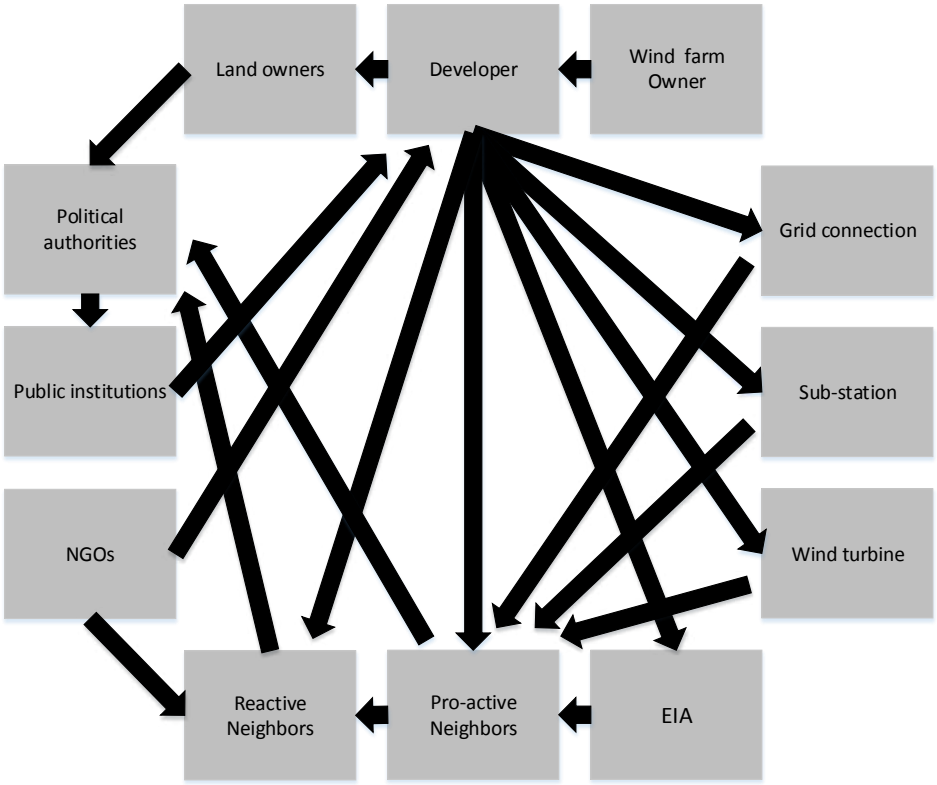


Figure 10: Power distribution in the network

It can be observed that the developer is the actor where most arrows come from, meaning he is the most powerful, while the neighbors, especially those active, are the ones where most arrows end, meaning they have the least power. Figure 14 separates developer and local community power of influence.

In the left side, the developer influence (green) is over the design of the wind farm, including wind turbine, grid connection, sub-station and any additional infrastructure. In addition, it has an influence over the content of the EIA, and the affection that the installation may have over the neighbors and land owners. On the other hand, the developer receives the influence (red) of both the public institutions, which regulate the industry, and the owner of the wind farm.

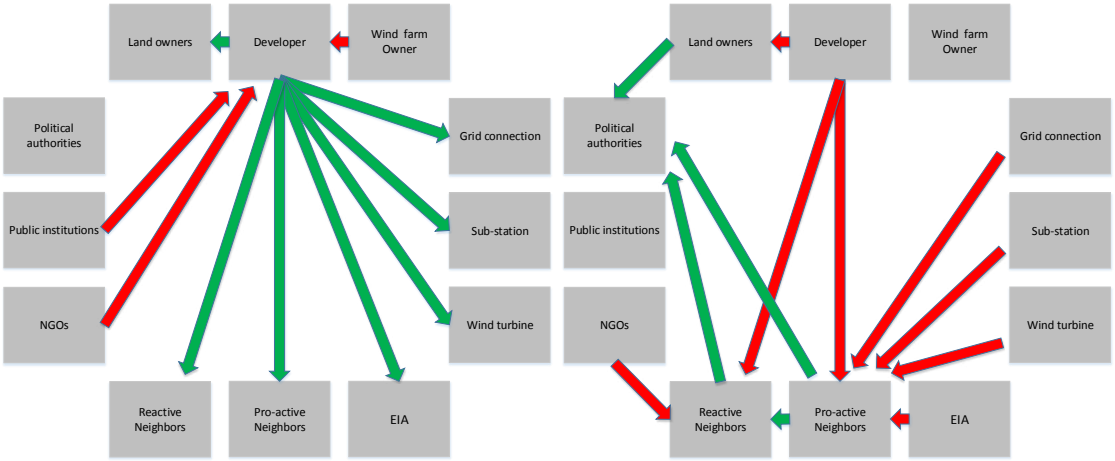


Figure 11: Developer and local community power of influence

In the right side, the local community influence (green), including neighbors and land owners, is over the local and national political authorities, which are elected by them and who make the decisions in terms of regulations and energy strategies. On the other hand, neighbors and land owners are under the influence (red) of the developer and affected by wind turbines, grid connection, sub-stations and the EIA.

These power relations can affect the level of local acceptance. If local community is not given an opportunity to participate in the decision making process, the procedural justice (Wüstenhagen et al. 2007) could be considered low, and the risk of opposition to the installation would be high.

Distributional justice refers to how costs and benefits are shared. If local neighbors identify that the compensation they receive from the installation is considerably lower than the profit the developer is making, resistance may arise.

The following sub-chapter includes an analysis on the different expectations that the project brought to the different actors, as well as a summary of the ambiguities found in the case studied.

9.5. Different values for different actors

An analysis of the case is now made by using the value framework, in order to better understand the different expectations that this and other wind power projects may create in the different actors.

As mentioned in chapter 5, there are four different groups, or levels, of actors in an innovation system. The following analysis is applied to the case of wind power:

User level
This is the wind farm owner, the "initiator" of the project, whose main motivation in the project is typically to make profit out of it, expecting to obtain the maximum value out of the investment. The development of the wind farm is the necessary step to make the business work. He is very often the person designing the plan together with the project developer.

Organization level
This is the project developer, the one making real the plan of the owner. They are very often electric companies with a division in renewable energies. Their motivation is successfully completing the installation of the wind farm, in order to continue growing in the renewable market and to become a stronger actor in this industry.

Ecosystem level
This includes policy makers, regulators, and also representatives of the wind industry like the AEE (Spanish Wind Power Association). There are different expectations and attitudes towards wind farm developments. Different Governments may have different opinions about renewable energies and, therefore, different difficulties may be faced by users and organizations.

Their main goal is to have satisfied citizens that may support them in the future. On the other hand, representatives of the wind power industry contribute to empower the arguments supporting these energies. Their expectation is a growth of the market and the sustainable development of more wind farms.

Society level

This is the highest level of value in the model and all the three previous levels are part of it. Local authorities, neighbors and landowners are part of this group, and they benefit both from an industry successfully performing and for the particular benefits obtained from the installation of the wind farm in their surroundings. The impact of innovations on them is very often underestimated. Sometimes they feel not included in the decision making process, which leads to resistance, and which affects the project development, the time and costs.

An additional consequence of their influence can be seen in the support that citizens may give to politicians, depending on their decisions, which can be related to their strategies in energy policies.

It can be observed from this analysis that the resources considered so far have been related to money, but human capital has barely been taken into account. Local communities are very often not considered a relevant actors, but their satisfaction can increase the chances of a project to be successful.

The different values motivate the different understandings of the episodes, which leads to the appearance of ambiguities. Some examples are presented in the next section

9.6. Ambiguities found and risks

The results obtained from the interviews to *Developer Alfa* project managers and the spokesperson at the local NGO were contrasted with a survey. Some of the most remarkable answers are included in the following table (the complete survey can be found in the appendix):

Table 9: Survey to developer and local NGO

Survey question	Developer	Local NGO
Number of significant texts and documents	Medium	Low
Number of significant interest groups in favor	High	Low
Number of letters of objection	Medium	High
Number of letters in favor	Medium	Low
Positive media coverage	Low	Medium
Participants were representative	High	Low
Barriers to participation were minimized	Medium	Low

These different considerations that various people can make from the same fact, and that can therefore lead to unexpected situations, are the ambiguities this study aims to identify and solve. The explanation may be found in the high level of uncertainty that a poor stakeholder analysis in the EIA brought to project. The developer did not actively include the local NGOs, which ended up fighting against the installation and increased the risks of the project successful completion.

The biggest differences in their answers can be found in the questions regarding the number of significant interest groups in favor and if the participants were representative of a full range of points of view. Developer understands that there was a high support from the locals towards the project, due to the majority of acceptance attitudes they identified in the individual meetings with stakeholders.

However, the local NGO argues that a strong opposition to the project was ignored, as the 700 signatures or 100 administrative appeals demonstrate. In addition, the representativeness of participants to the meetings was low in the eyes of the NGO, since a directly affected community like *Village 4* was not recognized as a stakeholder nor considered eligible for a compensation.

On the other hand, developer states that their local management tactics and the special attention given to equity in compensations to all affected stakeholders ensures that participants are representative of a full range of points of view and avoids discrepancies between local communities.

Not including *Village 4* in the Environmental Impact Study but including *Village 6*, equally big and distanced from the wind farm, was most certainly the fact that led to not considering *Village 4* neighbors as stakeholders of the project. The fact that *NGO Beta* is located in *Village 4* was the motive for them to be very actively opposing the project.

The following chapter discusses the findings of the previous analysis, extracting some conclusions and ideas that may be suitable to be implemented in Spain.

10. Discussion: functional pattern and key policy issues

The previous chapters have made it possible to analyze the TIS of Wind Power. The existence of controversies and the reasons that lead to them have been identified. In addition, an identification of the actors forming the network made it possible to describe the dynamics between them, as well as the levels of procedural and distributional justice.

The current moment of translation, or change, in the actor network is the problematisation. The previous analysis aimed to find the weak points in the innovation system. The following chapters will define the improvements that may attract new actors, the interessment phase. The next steps would then be enrollment, to align expectations, and the mobilization, when the innovation occurs.

High levels of uncertainty and ambiguity have been identified in wind power projects, and specifically in the case studied. The situation corresponds with the case 4 in the model proposed by Schrader and presented in chapter 6.

Table 10: Case 4, uncertainty-ambiguity relation

Case 4
Variables known Values unknown Functional relationships unknown

The variables intervening in the development process, named actors, are known by the developer. However, the values these variables have, meaning their expectations, power and potential effects of their actions, are not known by the developer, who tends to keep them satisfied by giving them some compensations. In addition, it seems like the stakeholder analysis made in the planning phase do not take into account the functional relationships between those actors, meaning their networks and their relevance for the project success.

Table 11: Reduction of uncertainty and ambiguity strategy

	High uncertainty
High ambiguity	Sense-making & value analysis

The strategy to reduce the level of uncertainty and ambiguity, proposed by Thiry and presented in chapter 6, passes by sense-making processes and value analysis. This implies understanding the importance of the different actors affected by the project, recognizing the valuable input of their opinion about the project, and changing the power distribution during the planning and development process, so trust between the actors is increased and a more appropriate frame is established to reach a successful result.

Chapters 9 and 10 have made it possible to answer the second sub-question:

Sub RQ 2: *"Which are the problems project managers face when these episodes happen?"*

The following sub-chapters elaborate more about how this process could be done, attending to experiences in other countries that could be adapted to the specific singularities of the Spanish market.

10.1. Moving from a technocratic to a socio-technical system

The analysis of the technological innovation system of wind power in Spain leads us to classify it as technocratic, meaning a system where technology is the main aspect taken into account and where the projects are designed and implemented attending to pure technological efficiency, obviating other aspects like society or the specific local values. These systems are typical from the urban culture, while the rural areas still maintain traditional ways of interacting and preserve other values apart from just profitability.

It should be considered moving to a socio-technical system (STS), as a new direction of search (Geels and Schot 2007). A STS is a system with new scientific and technological as well as socioeconomic and organizational components, which is reflecting new ideas and concepts on the proffered design of such new systems (Geels 2004).

Campaigns like "Actonfacts", launched by Vestas and supported by AEE in Spain, are continuous in the technocracy of the system. They offer more information to the public opinion, trying to convince them about the benefits of the Wind Energy, instead of reviewing their practices and adapting them to the current situation, making the industry attractive to more people and gaining their support.

In the specific case of the studied project, an aspect which has been identified as risky and possibly source of uncertainty is the strategy of not informing in public meetings about the plans for the area and the possible affections to locals' ways of life.

The Acting Code of the developer includes the local management of the project and the equity in all compensations to affected stakeholders. However, the practice of individually approaching stakeholders to explain their plans and negotiate the compensations makes the process less transparent and more difficult to locals to trust on them. This is an extended practice in Wind developments in Spain that has already been identified in previous papers (González 2008; González & Estévez 2005).

There is a need of increasing procedural and distributional justice and trust, in order to reach higher levels of local acceptance. New ways of involving citizens may be designed, focusing in public participation. In this direction, a double approach is proposed:

Tactical change,
By opening the processes to the public, reaching higher levels of participation and involvement and thus, of trust and acceptance of wind power. This includes a focus on project performance, meaning time and cost; influence on macro and micro risk factors; and the process, which includes initiation, identification, analysis, planning, monitoring and control.

Strategic change,
By offering local communities joining a partnership and together developing smaller scale wind farms. Benefit and risk sharing models, like co-ownership through community founds or power contracting; contractual arrangements; active communication, negotiation, and offering of incentives could contribute to re-activate the activity of the Wind sector in Spain, increasing the levels of local and socio-political acceptance.

The division of the approaches in tactical and strategic is inspired in the scientific article "Management of Investor Acceptance in Wind Power Megaprojects" (Hampl et al. 2012). These two approaches make it possible to answer the third sub-question:

Sub RQ 3: *"How can project developers plan better by understanding the dynamics of the blocking mechanisms?"*

The following sub-chapter describes the new tactical approach, based on participatory processes.

10.2. Tactical level: participatory processes

This sub-chapter includes the review of two cases which describe the risks of not including all actors in the process and the benefits that public participation brings to the success of wind power developments.

The following review refers to the case of a wind farm installed in Southern France, where high controversies occurred when developers initially excluded an important town in the area affected by the installation, and how people reacted when they were finally included.

Blowing against the wind — An exploratory application of actor network theory to the analysis of local controversies and participation processes in wind energy (Jolivet et al 2010)

Jolivet and Heiskanen used ANT to analyze local controversies and participation processes in wind energy, by studying the case of a wind farm in the South of France. It provides a socio-technical approach to analyze controversies and concepts related to decision-making processes and power relationships.

In this context, they define two interesting concepts to understand the origins of ambiguity and resistance to project: framing and overflowing. The definition can be found in chapter 4, where the main concepts and theories on this study are described.

Framing is directly connected to the initial phases of the project, when developers start approaching local authorities and neighbors to explain their plans for the area and how they would impact/benefit them.

In the case of Cape Eole, only the closest villages were informed about the plans for the area at the initial phase, when the frame was being established. Later on, they decided to include Albi in the conversations as well. This is by far the largest town in the area and its initial exclusion provoked a feeling of resistance on many of its 50000 inhabitants and on its local institutions as well.

The overflows started then, with a strong opposition to the project and finally forcing developers to modify the height of the turbines so visual impact, foundations size, noise and affection to birds and bats was decreased.

There are many similarities to the case in Spain: a village directly affected by the installation of the turbines sees how developer excludes it from the project and starts a fight against anything related to the wind farm. In case they would have been included from the beginning, the framing phase would have taken into account their inquiries and a better design of the wind farm would have been possible.

A conclusion from this case is that project planners need to adapt and interpret generic tools and materials to make them fit local specifications. An understanding of the specific area of implementation, the communities established there and their roles inside the network can be obtained by inviting local actors to actively participate in the project, from its initial phases.

A way of doing this is by inviting the local community to take part of the EIA, using their knowledge of the area to elaborate a more accurate document. This would be highly beneficial for both the developer, who would need less resources to complete the very precise study, and the local community, who would feel empowered and important for the project, making sure none of the singularities they know from the area are obviated in the project.

Some additional practices that may serve to open the process and facilitate public participation can be having an open office in-site where the developers can be met and the exchange of information about the project can occur and the celebration of public meetings where the questions that locals may have can be solved and additional information about the siting area can be gathered. The next review refers to a multiple case study where the benefits of participatory processes in wind power developments were evaluated.

Wind energy planning in England, Wales and Denmark: Factors influencing project success (Loring 2007)

Loring studied how actor-network theory and public participation in planning relate to the acceptance and success of wind power projects, by developing a number of indicators and comparing a number of cases in England, Wales and Denmark with regards to these indicators. The conclusions of her study were the following:

- "In cases where the use of participatory methods was high, the stability of the network of project supporters was very often high, and vice versa."
- "High use of participatory methods during the planning process is contributory but not necessary for high levels of public acceptance in the project."
- "Projects with high levels of public acceptance are more likely to succeed in receiving planning permission, while projects with low levels of public acceptance are more likely to fail."
- "A stable network of project supporters is not a necessary condition for the project to succeed during the planning process."
- "If there is a stable network of actors opposing the project, then project success is likely to be low. If network stability of opponents is low, however, then project success is expected to be high."
- "If there is an organized group of opponents to a project, there is a significantly reduced chance of project success. In cases with no organized opposition group, the likelihood of project success is high."

The data from the 19 different cases studied was separately analyzed to determine the possible existence of patterns across countries. No difference in the results was found.

The use of surveys in our study had to finalities: on the one hand it was useful to double check the answers of the interviewees and, on the other hand, it was helpful to determine the levels of participation, public acceptance and network stability. The results are now presented (table 13), in order to check that Loring premises would also apply to wind power developments in Spain.

Table 12: Developer and local NGO perceptions and average

Indicators	Developer	Local Opponent	Average
Network stability	Medium-high	Low	Medium-low
Community acceptance	Medium	Medium-low	Medium
Community participation	Medium-high	Low	Medium-low
Project Success	Medium	Medium-low	Medium

The results show that a medium-low use of participatory methods led to a medium-low network stability, as well as a medium community acceptance of the project. Although it is not a necessary condition for the project to succeed, having identified all the potentially affected members of the community and involving them more actively in the project would have contributed to a higher stability of the network and a higher acceptance of the project as well.

The medium level of acceptance let to a medium successful project, even though the network stability was medium-low. However, project success is expected to have been higher if number of opponents would have been lower, which would again have been reached by involving them form the beginning of the planning phase and taking their inquiries into account.

This analysis shows that the premises set by Loring would also apply in the case studied. Even though the study is limited to one project, it would be expected that it would apply to other projects in Spain as well. The characteristics of this wind farms are present in most of the developments across Spain: siting in rural areas, low density of local population, top-down approach by offering compensations to the local community instead of involving them and becoming partners, and no local initiation of the project.

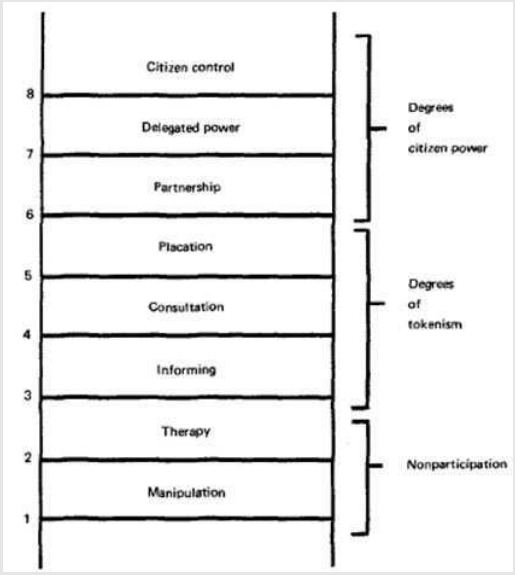
The following review has been included to explain how different levels of participation and distribution of decision power can affect the success of the project. Although it was developed back in 1969, the concepts it includes still apply nowadays. Other authors and organizations, like the International Organization for Public Participation (iap2), have developed similar models to describe the different levels of public participation.

The ladder of citizen participation (Arnstein 1969)

The ladder of citizen participation represents the different levels of citizens' power to determine the plan and/or the program in a project. He subscribes the words of a group of students who highlighted that participation without redistribution of power is "an empty and frustrating process" for the powerless. Arnstein describes the eight different types of participation (and non-participation):

- Manipulation and therapy describe the situation when power holders aim to "educate" or "cure" the participants, rather than enabling them to participate in planning.
- Informing and consultation allows the powerless to hear and have a voice, but it does not ensure that power holders will receive their message.
- Placation is the next level, ensuring that powerless' opinions are received by the powerful, but they still are the only ones with power to decide.
- Partnership enables powerless to negotiate with power holders, while delegated power and citizen control ensures citizens have the majority of decision-making seats or full managerial power.

Since time ago in history, those "nobodies" in the project aim to become "somebodies" with enough power to make the target institutions responsive to their views, aspirations and needs.



The situation of citizen participation in wind farm developments in Spain may be classified as an informing level. The local neighbors are informed about their rights, responsibilities and options. However, the emphasis is placed on a one-way flow of information with only one channel for feedback, administrative appeals, but no power for negotiation.

Information is usually provided at the end of the planning phase, as it happened in the case studied in Spain, when they informed in the middle of summer and with only a short add at one of the city hall information walls. People have, in this way, little opportunity to influence the program.

In the case this paper is studying, there were also individual meetings with some of the neighbors affected by the project, which can be seen unfair by some others who were not contacted or who consider they received a different explanation or compensation. As mentioned before, public meetings would increase neighbors trust in developers' intentions, as they all would get an explanation of the situation at the same time. That would place them into the next levels: consultation and placation.

However, this may not be seen as the desired situation. They could see it as a way of "participating in participation" rather than having an influence in the decisions made by planners.

The real citizen participation starts by establishing partnerships with them, making clear that they have the chance to give their opinion, discuss the contents of the different parts of the project and influence the decisions.

An option to reach this situation if by using a different strategy, offering neighbors not only compensations or certain investments in local infrastructures, but also a large part of the wind farm shares.

The next chapter includes an explanation of the approach used in some successful wind farms, in terms of acceptance and project result, in Denmark and Sweden.

10.3. Strategic level: partnerships with local communities

Even though it was not part of the initial scope of the paper, this new strategy has been identified as potentially appropriate for the case of Wind Power in Spain.

Denmark can be seen as an example of the success of partnering with local communities from many years ago. People feel more attached to the wind farm when they partially own it. In that country, a new legislation from 2009 says that a minimum of 20% of the shares of every wind farm should be owned by the local community (Danmarks Vindmølleforening 2009).

However, there is an associated phenomenon consisting on "wind farm nomads", people who periodically change their homes, moving to those areas where wind farms are being developed and acquiring part of the shares. It represents an opportunity for attracting people from the cities to move to rural areas.

Another common practice in Denmark since the 1980s is the foundation of cooperatives to install small scale wind farms around the members' home towns (Danmarks Vindmølleforening 2009). It is usually formed by a number of neighbors looking for a way of investing in a sustainable business. Shares are also offered to other neighbors apart from the ones initially forming the cooperative, which contributes to a lower investment needed to install it.

A share is usually equivalent to 1000 KWh/y and people generally acquire between 3 and 5 shares. No taxes are paid when the production revenue is less than 940 €/y. Decisions about the project are made by voting and power is equally distributed between all the shareholders, giving one vote per person, no matter the number of shares (Soerensen 2013).

Sorensen et al. explain, through a number of cases in Denmark and Sweden, how these cooperatives made the projects to be successful.

Experience with and strategies for public involvement in offshore wind projects (Sorensen et al. 2003)

They present three approaches to involve local communities:

- through information about the ongoing development
- through involvement in the decision making process
- and through financial involvement in the project

Afterwards, the Middelgrunden wind farm in Copenhagen is described. It consists on twenty 2 MW turbines, half of them owned by a cooperative of neighbors. 8.500 people participated with an average investment of 1.850 €, becoming the World's largest wind turbine cooperative. The other half of the wind farm is owned by Dong Energy, partner for the development and execution of this project.

People were invited to participate in the planning process, being able to make comments and show their disconformity or contribute with suggestions to possible improvements in the design. The wind farm layout was finally changed from three rows to a curved line, and the number of turbines reduced from 27 to 20.

Some of the advantages identified from using public participation in this project are:

- improvement of planning decisions and balancing of different aspects
- more awareness of public concerns
- understanding of possible cooperation between opposing parties
- elimination of misinformation and believed threats
- increase on acceptance and future confidence

Public involvement in wind power projects has been a key-factor in the successful development of wind farms in Denmark. Offering shares to neighbor cooperatives and participatory processes have played an important role in these processes. Around 15% of Danish Wind turbines are owned by cooperatives.

The first approach Sorensen presents is the one applied in the project in Spain. Participation was limited to keep people informed, but no they were not allowed to influence the decisions, nor to be financially involved.

Wind Power developers in Spain, like *Developer Alfa*, could evaluate the possibilities that involving in the decision making process and financially as well could bring the wind power industry. Investing in the promotion of small and medium scale installations would ensure them developing and maintaining a number of wind turbines.

In this moment, no more developments of large scale wind farms are expected, and many people are looking for business opportunities in Spain. Becoming leaders in cooperative developments could contribute to maintain the activity of the industry, continuing with the growth of renewable installations, attracting more people to rural areas and bringing them the possibility of investing in a sustainable business.

A search of existing wind power cooperatives in Spain has been made, and only a few examples have been found.

Eolpop is a cooperative founded in 2009, as a proposal of the Spanish section of Renewable Energies European Association "Eurosolar", to commemorate the 25th anniversary of the first wind turbine installation in Spain. Its objective is to give the chance to participants to obtain the electricity they need in a daily basis from renewable energies. Therefore, a calculation of the annual consumption of each investor is made, and his minimum participation in the project is the cost equivalent to producing that energy.

The project consists therefore in sharing the cost of the installation among the participants of the cooperative, allowing them to actively participate in the decision-making process, and sharing the benefits it generates. 135 people have participated in the project, with a total investment of 720.000 €. The project is currently getting the final consents to start the installation of the chosen turbine, an Alcom model ECO-122.

Goiener is a cooperative founded in 2013 with the objective of "democratizing access to renewable energies". Its aspiration is to make individuals being able to generate and consume green energy coming from their own installations. Their focus is not only in wind power but also in solar and biomass. They already have 1841 associates and they currently continue growing before starting the installation and the generation of renewable energy.

Similar examples are found in solar power, like Ecooo Cooperative. They have 62 solar plants across Spain, with an installed capacity of 4.623 Kw. Anybody can become a member from an investment of 100 €. They pay back a 6% interest per year.

These examples aim to demonstrate that there is an incipient interest in part of the society in Spain for being actively involved in the development of renewable energy installations, especially in wind power.

The strategy proposed passes by engaging with these emerging cooperatives, collaborating in their diffusion and becoming their partner to develop and maintain their installations. The promotion of this activity could lead to the creation of more cooperatives across Spain and developers like Developer Alfa could use their expertise to collaborate with them in the design and execution of the installations.

The situation in Denmark, where high levels of support are found on a national level while on the local is becoming lower, is a typical example of the dynamics that the Wind Power industry is experiencing.

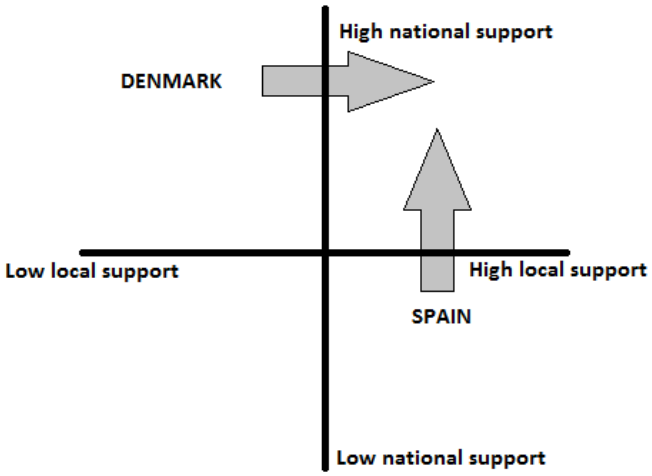


Figure 12: Desired directions to gain support for wind power in Denmark and Spain

The situation in Spain is different and high levels of support are observed on the local level, while on a national level there is not much interest about it. One of the main objectives of this thesis was to investigate and develop methods for maintaining high levels of local support to wind power developments and, if possible, expanding it to a national level. The strategy proposed above can contribute to the achievement of that objective.

11. Conclusion

This study has made it possible to identify the dynamics around the Wind Power industry in Spain, with a focus on the project development techniques and the participation of local communities in the planning phase.

Through to the use of the Technology Innovation System of Analysis, the main actors intervening in the projects, the power relations between them, and the existing networks were identified and analyzed, with regards to Actor Network Theory.

The success of the practices applied by project developers in the past does not ensure its sustainability in the future. In many countries, in which Wind Power is an important industry, local communities have shown several times episodes of opposition to relevant projects, due to the lack of participation in the decision making process. As it has been explained in chapter 10, Denmark is an example of these episodes.

The analysis in this thesis made possible to find that in Spain most power is held by the developer, relegating the local communities to a passive role where only some compensations are awarded to them. The existence of controversial episodes around wind farm development processes may lead to unexpected situations that make the completion of the projects difficult. The first sub-question was then answered.

In addition, the importance of an early identification of key stakeholders, as well as the establishment of active meetings and collaboration with them, was highlighted. The risks of not including them in important documents for the project like the EIA has been mentioned, as well as the connection between this and the arising of "overflows" or ambiguities around the project. This made it possible to answer the second sub-question.

The discussion of the study focused on two approaches to reduce the levels of uncertainty and ambiguity around these complex projects. The first approach presents and analyzes the benefits that participatory processes would bring to wind farm developments. The second approach consists on a new strategy based on partnering with local communities through the offer of shares or the promotion of cooperatives.

This answered the third sub-question and the main research question formulated in chapter 3:

RQ: *"How to account for ambiguity as a blocking mechanism when planning and managing complex projects: the case of Wind Power in Spain"*

These partnerships could benefit the Wind Power sector by creating a wider spectrum of individuals attached to it, thus making possible the continuation of the activity of the industry. This strategy could be an important future area of study for the Wind Power industry.

12. Perspectivation - Critique

This chapter is a reflection on the study presented above, through which the identification of alternative methods that could have contributed to improve the result is attempted.

Although the author's lack of previous experience in wind power may have influenced the result of this study, his knowledge in other engineering projects made possible to understand the processes related to the planning, development, installation and maintenance of wind farms.

Regarding the theoretical approach, Actor Network Theory may be considered too abstract and not formalized. It is difficult to determine the boundaries of such a study, like who or what to include. However, some of its strengths are that it is not limited to humans, including non-humans as an important part of the network; it is good for studying power relations and changes in networks; and it provides with a comprehensive approach to innovation in society. The fact that ANT is abstract means that it is flexible and as such it is valid for different network sizes.

In addition, a multiple case study would have added quality to the analysis, since more experiences would have been included, different development practices would have been analyzed and more concrete solutions could have been obtained. However, due to the limited time available for the research and data collection, as well as the fact that the case was studied from a different country, it was not possible to include more cases than those presented above.

Future studies in this topic should consider exploring the experience of developers in other projects which faced controversies. Some of the examples given during the interviews and which could add valuable information to complete this study are:

- The case of some wind farms which were developed separately to make the approval of the EIA easier and which were recently informed they should have been developed as one single farm due to their proximity
- The case in which a neighbor realized that the connection to the grid was partially occupying his property and who blocked the installation with his body until a compensation was paid
- The case of a neighbor who installed a fence along the paths which the trucks transporting the blades needed to use, in order to avoid them using his property. The trucks could not use the paths anymore and the blades had to be transported by helicopter
- The case of an NGO which opposed very actively to the installation of a wind farm due to its visual impact and which managed to influence the public opinion and the institutions to finally block the project. However, the majority of the local neighbors were in favor of the installation.

The review of previous scientific articles in this topic made it possible to compare the case studied with a number of successful projects in other countries. However, the analysis of more cases in Spain, like those presented above, is expected to make it possible the finding of additional controversial episodes related to public participation that empower the findings of this thesis.

13. References

13.1. List of figures

13.2. List of tables

13.3. Literature

Atkinson, R., Crawford, L. & Ward, S., 2006. Fundamental uncertainties in projects and the scope of project management. *International Journal of Project Management*, 24(8), pp.687–698.

Bergek, A. et al., 2008. Analyzing the functional dynamics of technological innovation systems: A scheme of analysis. *Research Policy*, 37(3), pp.407–429.

Brun, E. & Sætre, A.S., 2009. Managing Ambiguity in New Product Development Projects. *Creativity and Innovation Management*, 18(1), pp.24–34.

Callon, M., 1998. Actor-Network Theory-The Market Test. *The Sociological Review*, 46(S), pp.181–195.

Callon, M., 1986. Some elements of a sociology of translation – Domestication of the Scallops and the fishermen of St-Brieuc Bay. *Sociological review monograph*, pp.196 – 233.

Danmarks Vindmølleforening. 2009. Cooperatives – a local and democratic ownership to wind turbines.

den Ouden, Elke. 2012. Innovation Design: Creating Value for People, Organizations and Society. Springer.

Ernst & Young. 2012. Análisis del potencial de creación de valor de las políticas de energía eólica

Firestone, J. & Kempton, W. 2007. Public opinion about large off shore wind power. *Energy Policy* 35, pp.1584–1598.

Fujimura, J. & Latour, B., 1989. Science in action – How to follow scientists and engineers through society. *Contemporary sociology – A journal of reviews*, 18(5), pp.788 – 790.

Geels, F.W., 2004. From sectoral systems of innovation to socio-technical systems. *Research Policy*, 33(6-7), pp.897–920.

Geels, F.W. & Schot, J., 2007. Typology of sociotechnical transition pathways. *Research Policy*, 36(3), pp.399–417.

González, M.I., 2008. Modernización ecológica y activismo medioambiental : el caso de la energía eólica en España. *Revista Iberoamericana de ciencia tecnología y sociedad* vol 4 num 11.

González, M.I. & Estévez B., 2005. Participación, comunicación y negociación en conflictos ambientales: energía eólica en el mar de Trafalgar. *ARBOR Ciencia Pensamiento y Cultura* CLXXX 715, pp.377-392

Hampl, N. & Wüstenhagen, R., 2012. Management of Investor Acceptance in Wind Power Megaprojects : A Conceptual Perspective. pp.571–583.

Jolivet, E. & Heiskanen, E., 2010. Blowing against the wind—An exploratory application of actor network theory to the analysis of local controversies and participation processes in wind energy. *Energy Policy*, 38(11), pp.6746–6754.

Law, J. (1999). Actor network theory and after. Blackwell.

Latour, B., 2005. *Reassembling the social : An introduction to actor-network-theory*, Oxford University Press.

McLaren Loring, J., 2007. Wind energy planning in England, Wales and Denmark: Factors influencing project success. *Energy Policy*, 35(4), pp.2648–2660.

Newcombe, R., 2003. From client to project stakeholders: a stakeholder mapping approach. *Construction Management and Economics*, 21(8), pp.841–848.

Pich, M.T., Loch, C.H. & Meyer, A. De, 2002. On Uncertainty Ambiguity and Complexity in Project Management. *Management Science,* 48(8), pp.1008-1023.

PMBOK Guide, 2000. *A Guide to Project Management Body of Knowledge*. Project Management Institute

Schrader, S., Riggs, W.M. & Smith, R.P., 1993. Choice over uncertainty and ambiguity in technical problem solving. *Journal of Engineering and Technology Management*, 10(1-2), pp.73–99.

Soerensen, H.C., 2013. Danish experience in connecting local communities and wind power.

Szarka et al, 2012. *Learning from Wind Power*. Palgrave Macmillan UK

Thiry, M., 2002. Combining value and project management into an effective programme management model. *International Journal of Project Management*, 20(3), pp.221–227.

Van der Horst, D. 2007. NIMBY or not?, *Energy Policy*, 35, pp. 2705–2714.

Winch, G.M., 2002. *Managing Construction Projects*. Blackwell Publishing

Wolsink, M., 2006. Invalid theory impedes our understanding: a critique on the persistence of the language of NIMBY. *Transactions of the Institute of British Geographers*, 31(1), pp.85–91.

Wolsink, M., 2000. Wind power and the NIMBY-myth: institutional capacity and the limited significance of public support. *Renewable Energy*, 21(1), pp.49–64.

Wüstenhagen, R., Wolsink, M. & Bürer, M.J., 2007. Social acceptance of renewable energy innovation: An introduction to the concept. *Energy Policy*, 35(5), pp.2683–2691.

Yin, R. K., 2003. *Case study research - Design and methods*. 3rd ed. s.l.: Applied social research methods series

13.4. Websites

http://actonfacts.org accessed on 17/03/2014

http://www.aeeolica.org/es/sobre-la-eolica/la-eolica-en-espana/ accessed on 28/02/2014

http://www.aeeolica.org/uploads/Proyecto_RD_renovables_18012014_Consejo_de_Estado.pdf accessed on 28/02/2014

http://www.ecooo.es/ accessed on 23/06/2014

http://economia.elpais.com/economia/2014/02/19/actualidad/1392811802_474832.html accessed on 28/02/2014

http://www.eldiario.es/norte/euskadi/Llega-energia-verde-cooperativa_0_125988095.html accessed on 27/06/2014

http://elpais.com/diario/2010/01/07/catalunya/1262830045_850215.html accessed on 23/06/2014

http://www.goiener.com/ accessed on 27/06/2014

http://www.somenergia.coop/es/ accessed on 23/06/2014

http://www.viuredelaire.cat/portada-esp.html accessed on 20/06/2014

14. Appendix

This appendix contains the following documents:

- Survey covered by project developer, pp. 60-61
- Survey covered by spokesperson at local NGO, pp.62-63

Project:

Project Developer/Organization: Developer Alfa

1. ***Rate the level of the next statements in relation to the project (High-Medium-Low)***

1.1 *Network stability*

1.2.1 **Strong relationships* among actors within the network**

High	Medium	Low
Network is well developed, as indicated by many relationships between actors.	Network is present , as indicated by some relationships between actors.	Network is very limited, as indicated by few relationships between actors.

*Strong relationships are evident when actors agree on their roles and goals and when they actively participate and interact with others in the network. Strong relationships are also indicated when actors have known each other a long time, worked together before or were good friends prior to their involvement in the project.

1.1.2 **Significant texts or documents**

High	Medium	Low
There is a substantial number of letters, documents, flyers, brochures and posters, produced and distributed among the stakeholders	There are some letters, documents, flyers, brochures and posters, produced and distributed among the stakeholders	There is a low number of letters, documents, flyers, brochures and posters, produced and distributed among the stakeholders

1.1.3 **Multiplicity**

High	Medium	Low
Actors are able to draw upon the resources from one network to help their efforts in another.	Actors may be able to draw upon the resources from one network to help their efforts in another.	Actors are not able to draw upon the resources from one network to help their efforts in another.

1.2 *Community acceptance*

1.2.1 **Positive results in public opinion surveys about the project during the planning phase**

High	Medium	Low
Mainly positive results in public opinion surveys	Both positiveand negative results in public opinion surveys	Mainly negative results in public opinion surveys

1.2.2 **Significant interest groups* generally in favour (or not opposed) to the project**

High	Medium	Low
Many significant interest groups	Few significant interest groups	No significant interest groups

*Interest groups, such as parish councils, local sporting clubs, environmental organizations, groups of local businesses

1.2.3 **Attendees to public meetings generally in favour (or not opposed) to the project**

High	Medium	Low
High number of attendees in favour	Some attendees in favour	Few number of attendees in favour

There are not public meetings.

1.2.4 **Letters of objection sent to planning authorities and newspapers**

High	Medium	Low
Strong feelings against the development project, with a lot of letters of objection to planning authorities and newspapers.	Some letters of objection to planning authorities and newspapers.	No presence of letters of objection to planning authorities and newspapers.

1.2.5 **Letters of support sent to planning authorities and newspapers:**

High	Medium	Low
Some letters stating clear support for the project	Few letters stating clear support for the project	No presence of letters stating clear support for the project

1.2.6 **Positive media coverage**

High	Medium	Low
Strong positive news and articles in favour the development project from the media	No presence of news or articles in favour the development project from the media	News and articles from the media opposing the project

1.3 *Community particpation*

1.3.1 **The participants are representative of the views of the full range of potentially affected people**

High [X]	Medium [ ]	Low [ ]
Extensive measures were taken to include all the view points in the decision-making process	Reasonable measures were taken to include all possible view points, including some beyond those legally requiered by the planning process	Minimal measures were taken to include all possible view points

1.3.2 **Barriers* to participation were minimized**

High [ ]	Medium [X]	Low [ ]
Extensive measures were taken to reduce barriers to participation	Reasonable measures were taken to reduce barriers, including some beyond those legally required by the planning process	No special measures were taken to reduce barriers other than those legally required by the planning process

*Examples of barriers to participation are if public meetings are: not widely advertised; inconveniently located; held in locations that are intimidating for some individuals; or scheduled at times when some interested individuals cannot attend

1.3.3 **Community members impact decisions about the project**

High [ ]	Medium [X]	Low [ ]
Decision regarding the project made by a large group of local community members in collaboration with planners and, if relevant the developer	Decision regarding the project made between the planners, the developer (or landowner), and a small group of interested local individuals	Decision regarding the project made largely by developer and the planners. Local comments such as those made in letters or during 'open days' were considered

1.3.4 **Community members have financial ownership in te project**

High [X]	Medium [X]	Low [ ]
Individuals other than the landowner receive all revenue or all revenue goes to a community fund	Landowners receive revenue from turbines	No community financial ownership in community other than land rental and small community funds

1.3.5 **Local initiation of the project**

High [ ]	Medium [ ]	Low [X]
Community group initiated and submitted application	Landowner(s) initiated and submitted application alone or had a significant role in the application submitted by the developer	Landowner and developer initiated and submitted application together, or the landowner asked developer to consider that site

1.3.6 **Community will have continued involvement in the project**

High [ ]	Medium [X]	Low [ ]
Community group will continue to be involved within the project through receipt of revenues (or decision-making responsibility regarding the use of revenues) and decision-making responsibilities regarding the management of the project	Community group will continue to be involved within the project through significant or high- profile local activities that are directly connected to the project, such as a visitor centre	Minimal continued community involvement through low-profile activities related to the project, such as funding of computers for local schools

1.4 *Planning success*

High [ ]	Medium [X]	Low [ ]
Project obtained planning permission	Project obtained planning permission, but only after appeal or lengthy delays or expensive requests for additional information	Project did not receive planning permission

Project:

Project Developer/Organization: NGO Beta

1. ***Rate the level of the next statements in relation to the project (High-Medium-Low)***

1.1 *Network stability*

1.2.1 **Strong relationships* among actors within the network**

High ☐	Medium ☐	Low ☑
Network is well developed, as indicated by many relationships between actors.	Network is present , as indicated by some relationships between actors.	Network is very limited, as indicated by few relationships between actors.

*Strong relationships are evident when actors agree on their roles and goals and when they actively participate and interact with others in the network. Strong relationships are also indicated when actors have known each other a long time, worked together before or were good friends prior to their involvement in the project.

1.1.2 **Significant texts or documents**

High ☐	Medium ☐	Low ☑
There is a substantial number of letters, documents, flyers, brochures and posters, produced and distributed among the stakeholders	There are some letters, documents, flyers, brochures and posters, produced and distributed among the stakeholders	There is a low number of letters, documents, flyers, brochures and posters, produced and distributed among the stakeholders

1.1.3 **Multiplicity**

High ☐	Medium ☐	Low ☑
Actors are able to draw upon the resources from one network to help their efforts in another.	Actors may be able to draw upon the resources from one network to help their efforts in another.	Actors are not able to draw upon the resources from one network to help their efforts in another.

1.2 *Community acceptance*

1.2.1 **Positive results in public opinion surveys about the project during the planning phase**

High ☐	Medium ☐	Low ☑
Mainly positive results in public opinion surveys	Both positiveand negative results in public opinion surveys	Mainly negative results in public opinion surveys

1.2.2 **Significant interest groups* generally in favour (or not opposed) to the project**

High ☐	Medium ☐	Low ☑
Many significant interest groups	Few significant interest groups	No significant interest groups

*Interest groups, such as parish councils, local sporting clubs, environmental organizations, groups of local businesses

1.2.3 **Attendees to public meetings generally in favour (or not opposed) to the project**

High ☐	Medium ☑	Low ☐
High number of attendees in favour	Some attendees in favour	Few number of attendees in favour

1.2.4 **Letters of objection sent to planning authorities and newspapers**

High ☑	Medium ☐	Low ☐
Strong feelings against the development project, with a lot of letters of objection to planning authorities and newspapers.	Some letters of objection to planning authorities and newspapers.	No presence of letters of objection to planning authorities and newspapers.

1.2.5 **Letters of support sent to planning authorities and newspapers:**

High ☐	Medium ☐	Low ☑
Some letters stating clear support for the project	Few letters stating clear support for the project	No presence of letters stating clear support for the project

1.2.6 **Positive media coverage**

High ☐	Medium ☑	Low ☐
Strong positive news and articles in favour the development project from the media	No presence of news or articles in favour the development project from the media	News and articles from the media opposing the project

1.3 *Community particpation*

1.3.1 **The participants are representative of the views of the full range of potentially affected people**

High ☐	Medium ☐	Low ☑
Extensive measures were taken to include all the view points in the decision-making process	Reasonable measures were taken to include all possible view points, including some beyond those legally requiered by the planning process	Minimal measures were taken to include all possible view points

1.3.2 **Barriers* to participation were minimized**

High ☐	Medium ☐	Low ☑
Extensive measures were taken to reduce barriers to participation	Reasonable measures were taken to reduce barriers, including some beyond those legally required by the planning process	No special measures were taken to reduce barriers other than those legally required by the planning process

*Examples of barriers to participation are if public meetings are: not widely advertised; inconveniently located; held in locations that are intimidating for some individuals; or scheduled at times when some interested individuals cannot attend

1.3.3 **Community members impact decisions about the project**

High ☐	Medium ☐	Low ☑
Decision regarding the project made by a large group of local community members in collaboration with planners and, if relevant the developer	Decision regarding the project made between the planners, the developer (or landowner), and a small group of interested local individuals	Decision regarding the project made largely by developer and the planners. Local comments such as those made in letters or during 'open days' were considered

1.3.4 **Community members have financial ownership in te project**

High ☐	Medium ☐	Low ☑
Individuals other than the landowner receive all revenue or all revenue goes to a community fund	Landowners receive revenue from turbines	No community financial ownership in community other than land rental and small community funds

1.3.5 **Local initiation of the project**

High ☐	Medium ☐	Low ☑
Community group initiated and submitted application	Landowner(s) initiated and submitted application alone or had a significant role in the application submitted by the developer	Landowner and developer initiated and submitted application together, or the landowner asked developer to consider that site

1.3.6 **Community will have continued involvement in the project**

High ☐	Medium ☐	Low ☑
Community group will continue to be involved within the project through receipt of revenues (or decision-making responsibility regarding the use of revenues) and decision-making responsibilities regarding the management of the project	Community group will continue to be involved within the project through significant or high- profile local activities that are directly connected to the project, such as a visitor centre	Minimal continued community involvement through low-profile activities related to the project, such as funding of computers for local schools

1.4 *Planning success*

High ☐	Medium ☐	Low ☑
Project obtained planning permission	Project obtained planning permission, but only after appeal or lengthy delays or expensive requests for additional information	Project did not receive planning permission