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Wind Energy Development in Mexico

A case study of the potential for local socio-economic benefits in Mareña

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Abstract

In the State of Oaxaca in Southern Mexico exist abundant natural resource and excellent wind conditions. Currently in the region of the Isthmus of Tehuantepec in Oaxaca has an extensive area with wind farm projects due to their excellent wind speed conditions. A large wind energy plant – the Project Mareña Renovables that since their origins started in 2004 with Preneal Company. It was planned to be the largest wind power installation in all of Latin America with a capacity of 396 MW. The project was stopped due to resistance from the community. This thesis develops suggestions for how to deal with social problems for wind energy projects in Isthmus of Tehuantepec. These recommendations may be useful to assist future projects of wind energy in other regions with similar social and political contexts.

The focus on wind energy and the project in Mareña is because it was an interesting example of how contextual factors can hinder development of renewable energy. Therefore, the author of this thesis has adopted a multi-aspect framework for analyzing the experiences of the Mareña project. In general the PESTLE framework is used in this thesis to outline and develop causal explanations to the political (P), the economic (E), social (S), technical or technological (T), legal (L), and environmental (E) challenges that constrain the development of wind energy projects in Oaxaca, Mexico. Based on the literature review conducted for this research, the author has build by adding sub-categories of specific factors related to each PESTLE-aspects.

The aim of this research is to explore what caused the halt of the Project Mareña, which structural factors limited the establishment and what future development may learn from this example in order to be more successful.

Based on the PESTEL analysis was possible to draw some conclusions about how experience with the Mareña project can inform the future planning and implementation of wind energy projects in Mexico. In particular the analysis presents a number of issues that the Mexican government needs to manage to ensure the success of these projects. In particular, attention needs to be paid to the political, economic and social stability of the country or the region where the project is being implemented; the achievability of the county's ambitious targets set for renewable energy deployment; and potential need for institutional changes to better encourage future wind energy projects.

Executive summary

The state of Oaxaca in Southern Mexico is abundant in natural resources and has excellent wind conditions. However, local communities have little ability to utilize these. Unemployment is high and many indigenous communities live in poverty. In the region of Isthmus of Tehuantepec in Oaxaca, a large wind energy plant – the Project Mareña Renovable – was planned in 2004 as part of the development of renewable energy in Mexico. If developed, the plant would be the largest wind power installation in all of Latin America.

Previous authors have identified different issues between local communities – the Istemeños – and developers which have hindered deployment of transnational wind energy projects in the Isthmus of Tehuantepec region. The Mareña project was no exception. In January 2011, protests began against Mareña Renovables where the local community fiercely opposed the project. The companies involved claimed that they would ensure to minimise negative impacts, but eventually the opposition stopped the project and kept it in stand-by for several years. Yet, the Mexican government and its external investors still want to pursue these projects. It seems that, in order to succeed with this development, such projects need to better address local issues in the future.

The thesis develops suggestions for how to deal with social problems for wind energy projects in Isthmus of Tehuantepec. These recommendations may be useful to assist future projects of wind energy in other regions with similar social and political contexts.

The following question will be used to answer the research aim:

1. How can the Mexican government use the experiences gained in the Project Mareña Renovable for successfully planning and implementing wind energy projects in other regions?

The focus on wind energy and the project in Mareña is because it was an interesting example of how contextual factors can hinder development of renewable energy. Therefore, the author of this thesis has adopted a multi-aspect framework for analyzing the experiences of the Mareña project. The reason for using the PESTLE framework in this research has therefore been that it covers the significant aspects that often can occur in the deployment of wind energy projects in the context of Mareña. The experiences with the Mareña project were finally analyzed using a PESTLE-framework – looking at Political, Economic, Social, Technological, Legal and Environmental aspects. In general the PESTLE framework is used in this thesis to outline and develop causal explanations to the political (P), the economic (E), social (S), technical or technological (T), legal (L), and environmental (E) challenges that constrain the development of wind energy projects in Oaxaca, Mexico. Based on the literature review conducted for this research, the author has build by adding sub-categories of specific factors related to each PESTLE-aspects.

The data collected about wind energy development in Mexico in general, and the experiences from the Mareña project in particular, were then fitted into the framework adopted. Based on this analysis, the author finally describes which of these aspects have affected the outcome with the Mareña project the most, and why. It was also necessary for the author to develop an understanding of wind energy technology and market development in order to be able to identify the drivers and barriers that exist for wind energy projects in general, and in Mexico in particular. Data has therefore been collected using a literature review and conducting key-informant interviews. The author conducted four semi-structured interviews. Information from interviews with key stakeholders furthermore helped the author understand the current progress of the project Mareña, how the government and companies are cooperating.

Economic growth based on continuous supply and availability of energy sources makes energy security an important strategy for governments to focus on. Governments around the world have implemented a variety of energy policies and ambitious targets to promote RE to reduce GHG emissions. These policy instruments can increase the demand of clean energy technologies with economic incentives.

Over the last decade wind energy has expanded rapidly according. Today, the world wind energy market is dominated by high income countries. However, low and middle income countries are beginning to play a larger role in wind energy deployment particularly in China and India.

Currently, in Brazil, South Africa, Turkey, Mexico and other middle income countries where wind energy is competing directly and successfully with heavily subsidized fossil fuels. China and India are the first middle income countries that are close to catching up with high income countries such as Denmark, Spain and Germany in terms of manufacturing and deploying wind power. They are also the countries with the most Clean Development Mechanisms (CDM) projects. Brazil and Mexico are projected to have a stronger growth in installed wind capacity in 2014 and for first time sub Saharan Africa.

Currently, in Mexico more than 1,050 wind turbines have been installed. As illustrated in Figure 9, Mexico reached an installed accumulative capacity of 1,917 MW in 2013. Mexico has an average capacity factor of 30%. It is expected that by the end of 2024 wind energy capacity will be around 12,000 MW if the government's targets will be met. The region Isthmus of Tehuantepec, located in the State of Oaxaca, is the Mexican largest wind energy resource, but also other Mexican states such as Baja California, Chiapas, Jalisco, Nuevo León and Tamaulipas are potentially interesting regions for the deployment of wind energy in Mexico (ibid.). This year in Mexico the total capacity of all wind energy projects under construction is 714 MW. Out of this total capacity installed, 155.1 MW will be located in Baja California and the rest will located in Oaxaca. Mostly international developers are playing an important role for the deployment of wind energy. Wind energy in Mexico is a competitive option within the Mexican electricity market. The Mexican trend on wind energy deployment it have been leaded by Spanish wind energy manufactures such as, Acciona, Windpower, Gamesa Eólica and as well the Danish Vestas and Swiss Alstom companies. In 2013 it was calculated that the total investment in the deployment of wind power farms was around 2.18 billion EUR or 3.0 billion USD, which a substantial proportion is carried by Foreign Direct Investment (FDI).

Mexico has three legal instruments that the framework for encouraging the deployment of wind energy and as well other RE sources. These three legal instruments are firstly the General Law for Climate Change in Mexico adopted in 2012, secondly, the Law for the Use of Renewable Energy and Finance of the Energy Transition, recently modified and approved, and thirdly, the Energy Reform approved recently by the Congress of the Union.

In Mexico there are four categories relevant for wind energy deployment. Since December, 1992 with the Law of the Public Electric Energy Service private entities can participate in the generation of electricity in Mexico; self-supply, the independent power producer, small scale production and import and export.

The land or agrarian reform was initiated in 1992, changing the Article 27 of the Mexican Constitution. This reform allowed the Mexican Government to the local landholders to transferred, leased, collateralized, and sold to private interests. The most significant barriers for the National Energy Company (CFE) to the deployment of RE in Mexico is that according to the Federal Law they need develop new power capacity but has to be the cheapest electricity source for the citizens. This decision-making process is a relevant barrier for the wind power market in Mexico. As the decisions regarding leasing a plot of land in an ejidal or communal structure is mandated to be carried out by an unanimous assembly vote of their members. Some wind energy projects in the Isthmus of Tehuantepec were blamed for a lack of benefits for the local population, such as no long-term job creation.

The Isthmus of Tehuantepec recorded in 2010 total inhabitants of 1,200,000 people, which the majority belongs to Zapotec ethnic group and the rest belong to other ethnic groups such as Huaves/Ikojts. Tehuantepec with 19 municipalities and Juchitan with 22 municipalities are the two districts that occupy the Isthmus of Tehuantepec. Property rights are critical issues for this case study or in general wind energy projects development because negotiating the land ownership use can differ between projects.

In 2004, Mareña Renovables reserved communal land in the region of Isthmus of Tehuantepec in Oaxaca to develop wind energy projects. Many groups and communities have been formed local assemblies where a community leader defend the rights of the local population and their concerns of their lands. The social situation is very poor and people live in villages where they use the land for commercial agriculture and the sea and lagoon for fishing activities. The wind speed conditions of the Isthmus of Tehuantepec where Mareña Renovables planned to deploy the wind park was unique in Mexico, that is the reason why they call it the Gold Wind. Mareña Renovables was initially an affiliate of Spanish developer Preneal but in 2011, at a late stage in the development of wind energy project in Oaxaca, Preneal sold its affiliate and the project to a consortium comprising Japan's Mitsubishi, Dutch pension fund PGGM and Australian investment group Macquarie for 89 million USD.

This self-supply project with 132 turbines has the potential to be the largest wind park in Latin America with the capacity to generate 396 MW annual. The Mareña projects have faced a number of challenges related to a widespread opposition among indigenous people that were supported by activists around this area and neighbors that have had problems with wind energy projects before. Since then it has been created resistance and mobilizations by the Popular Assembles in places such as Martínez Álvarez to Álvaro Obregón against the project and other projects.

Wind energy can contribute to increasing renewable energy (RE), mitigating GHG and can contribute to economic growth. The “General Law for Climate Change” and the “Law for the Use of Renewable Energy and Finance of the Energy Transition” in Mexico in 2012 set very ambitious targets to increase electricity from clean energy sources to reach 35% by 2024 and 50% by 2050.

The project failed because of lack of communication and trustworthy negotiation between the stakeholders. The community did not get all the information regarding a wind energy farm, their impacts and benefits. The community was not included in the planning and the company not willing to listen to their demands. The absence of the municipality during the negotiations specially with Preneal company. The network that Preneal Company had in Mexico it helps the company to get easily specified transmission permits of energy and evacuation route. Presumably the company did have all the arrangements with few people of the community.

Based on the PESTEL analysis was possible to draw some conclusions about how experience with the Mareña project can inform the future planning and implementation of wind energy projects in Mexico. In particular the analysis presents a number of issues that the Mexican government needs to manage to ensure the success of these projects. In particular, attention needs to be paid to the political, economic and social stability of the country or the region where the project is being implemented; the achievability of the county's ambitious targets set for renewable energy deployment; and potential need for institutional changes to better encourage future wind energy projects.

Social factors appear to be a major barrier. Is important for the government and the project developers to communicate and build support from convincing communities about among other stake holders the importance of regarding renewable energy as a way to combat climate change and improve the life styles and economic situation of the community. Institutional support for wind energy deployment needs to be seen by the public to support long term job creation and respect the, rights, traditions and their land ownership and agreements. On a related matter, opportunities could be identified to link wind energy projects to reducing inequality in Mexican communities. Strategies for the State to provide local high skilled employees or undergraduates for maintenance of the wind project. Also include jobs opportunities to be interesting in working in manufactures of the market and as well in the construction phase of wind energy projects. Land rights and planning is another issue that has to be more carefully considered during the planning including impacts on local communities, traditional land ownership structures and whether the project respects these. The leader of the communal land is responsible for all the administration processes but they could also get support from expertise or knowledge to carry out such a transaction. A general agenda could help the three powers of the Mexican state to coordinate, target, plan, and implement standards and processes for wind energy projects in Mexico.

Renewable energy and wind energy in particular is a good instrument to mitigate climate change and help a country to reduce poverty with those projects. This research illustrates that if there is not a long-term strategy in place for how to keep the benefits of the investments in the region, or if the country cannot distribute the revenues generated to local communities, similar projects will have limited impact in terms of improving social conditions. If the government has a good public policy and good management then it could use all the money that come from the tenders for the registration for these projects to provide services to the community, such as infrastructure, schools, hospitals, recreation fields, etc. Corruption and lack of knowledge of management are the main issues that the government has to deal with in order to host these wind energy projects.

It could be interesting to apply this research method or framework in Mexico in other renewable energy.

1 Introduction

This thesis addresses a wind power project in a special region, with special developmental and social issues in Mexico. Mexico has high potential for renewable energy (RE), particularly wind energy, but so far there has not been much development (Alemán-Nava et al., 2014; Cardona, 2013; GWEC, 2013).

Mexico is a developing country with a large gap between rich and poor. The country is in some parts highly developed and in other parts not developed at all (Gonzalez, 2005). Mexico was nevertheless classified in 2013 by the Economic Commission for Latin America and the Caribbean (ECLAC) as a middle-income economy similar to Chile, Brazil and other countries with predictions of rapid economic growth (Economic Commission for Latin America and the Caribbean (ECLAC), 2013). Mexico has been seen as suitable for foreign direct investments for RE projects (Alemán-Nava et al., 2014). In this context, the Mareña wind energy project in the Oaxaca region of Mexico was expected to bring benefits to the local community, to the region and to Mexico at large in terms of developing RE. However, despite that the development seemed to be potentially valuable to the region on paper, the local community rebelled against the project which ultimately stopped the development (Cymene Howe, 2014).

1.1 Background

The effects of climate change will make sustainable development objectives such as food and livelihood security, poverty reduction, health and access to clean water more difficult to reach (IPCC WGII AR5, 2014). It has been confirmed and accepted that CO_2 and other greenhouse gas (GHG) emissions must peak and decline in less than 10 years, if the target committed by 192 member governments of the UNFCCC of staying below to 2°C of global mean temperature rise will be possible to meet (GWEC, 2013). It is therefore crucial that all countries undertake climate-resilient pathways – whether high income countries or low-middle income countries. These pathways include two main categories of responses (IPCC, 2013[a]):

- Actions to reduce human induced change and its impacts (mitigation and adaptation)
- Actions to ensure that effective institutions and strategies will be implemented to ensure sustainable development

The IPCC summary report WGII AR5 (2014) included climate change mitigation actions which may have co-benefits. Two measures mentioned are the needs to improve energy efficiency and to develop cleaner energy sources, which will lead to reduced emissions of health damaging and climate altering air pollutants (IPCC WGII AR5, 2014). Besides these two actions, other actions include reducing energy and water consumption in urban areas, advancing sustainable agriculture and forestry, and protection of ecosystems (IPCC WGII AR5, 2014).

Low and middle income countries are assumed to be far more adversely affected by climate change than high income countries (Mickwitz, 2003). Low and middle income countries are more dependent on their natural capital (natural resources such as; air, land, soil, biodiversity, minerals, energy), and natural services (such as air and water purification, nutrient cycling and climate control) and human capital and have fewer assets to cooperate on climate change (Miller & Spoolman, 2012). The impact of inequity income distribution, which is reflected on the total carbon dioxide (CO_2) emissions where 15% of the world populations living in the richest countries produce about 50% of the world total of CO_2 emissions in 2003 (Mickwitz, 2003). But current studies shows that the low and middle income countries' emissions between 1999 and 2000 grew by 48% (United Nations (UN), 2013). In 2009 the largest emitters of CO_2 were China in the first place, the U.S. in the second place, and the EU in the third place, followed by Indonesia, Russia, Japan and India (Miller & Spoolman, 2012). For those reasons, both low income as well as high income countries share the same responsibility and commitment for climate change mitigation and adaptation.

The history of wind energy

Human energy generation and use has developed via a number of transitions. The first modern transition was the industrial revolution, changing our main energy generation from wood to coal by the steam engine in the late 18th century. This brought the benefits of transportation and storage of coal (Hoogwijk, 2004). The second transition was the diversification of energy end use technologies and energy supply sources (ibid.). Electricity was the first energy carrier that could be converted to light, heat or work in the use phase (Hoogwijk, 2004). Later, internal combustion brought the chance to deploy different mobility technologies such as cars, buses and aircraft – opening the doors for the use of oil in the transportation sector (ibid.). Since then, energy sources for electricity generation has developed to include for example renewable energy and low carbon technologies, which depend on primary energy carriers such as solar radiation, geothermal energy, wind and bio-waste (ibid.). The first development and experimentation of wind energy turbines was a result of rural electrification, specifically during World War I. It was not until the 1950s, however, that the first wind turbine was connected to the grid in Denmark (Neij & Dannemand Andersen, 2012). According to the International Energy Agency (IEA) global generation of electricity from renewable sources was 4,540 TWh in 2011 (OECD/IEA, 2012). Today, wind energy is the key energy carrier that can contribute to a rise of the share of RE overall (IRENA, 2014a). Wind energy (onshore and offshore) is expected to be the largest contributor of RE electricity generation after hydropower in 2017, with 16.7% (OECD/IEA, 2012).

There are two approaches to evaluate the technical potential of wind energy. Firstly, empirical wind speeds measurements can be used to construct a surface wind distribution. Secondly, weather prediction models can enable the prediction of potential power production (IPCC, 2012). The global theoretical potential for wind has been estimated at 6,000 EJ/yr., however the global technical potential is not fixed and depends on regional factors which are varying (IPCC, 2012). Even if wind resources are infinite, they are not distributed equally across the globe and as a result, wind energy will not contribute equally in meeting the energy demand and possible mitigation of GHG emissions in different countries (ibid.).

Energy development in Mexico

Mexican GHG emissions were 748 million tonnes in 2010 (OECD, 2010). The concept of "greening the economy" aims to enhance economic prosperity and social advance for everyone while at the same time reduce GHG emissions. Renewable energy can be important for this aim. According to IRENA (2014a) "*a greater share of RE can produce greater economic growth for the national economy*". Mexico may therefore be able to improve their economic prosperity by increasing national and foreign direct investment in wind energy. On the national level, this development can provide economic growth and energy security. At the regional and local level, it may also achieve social benefits in the short- and long term, including jobs, education, healthcare, transportation and access to electricity. However, there are different barriers for wind energy projects in Mexico (GWEC, 2013; IPCC, 2012; IRENA, 2014a).

Mexico is rich in fossil fuel energy resources, although the national capacity to extract these resources is low. Therefore, the Mexican government introduced an energy reform in 2014 in order to open the Mexican market for petroleum and gas extraction by foreign companies. This way, Mexico may become less dependent on importing these energy sources. The reform is also aimed to improve conditions for RE generation in the country (Fondo de Cultura Ecónomica, 2014; General Direction of International Affairs, 2014). For more details about the Mexican energy reform, see section **Error! Reference source not found.**.

Mexico still relies on conventional energy sources for meeting most of its electricity demand. Fossil fuel energy sources provide 82.5% of the electricity mix in Mexico, nuclear energy provides 3% and 14.5% is provided by renewable energy. Breaking down the 14.5% of RE, hydropower is the most important with 74.3%, geothermal power second with 13.6%, wind power third with 7.7% followed by biomass with 4.4% and the last, and also largely under-developed is solar energy with 0.1% (Worldwide Electricity Production from Renewable Energy Sources, 2013). Mexico has good conditions for RE generation, for example with the chance to significantly increase wind energy deployment in coming years. Electricity generated from wind energy in Mexico has shown an average annual growth rate between 2002 and 2012 of 85.1% (from 7 GWh in 2002 to 3,298 GWh in 2012). It has consequently been the highest average annual growth rate of all energy sources in Mexico (Worldwide Electricity Production from Renewable Energy Sources, 2013). The Mexican market potential for wind energy is estimated to be 71,000 MW. The installed capacity of wind power in all Mexico in 2013 was 1,917 MW, which is only 2.7% of the total capacity (GWEC, 2013). In addition, another 2,069 MW capacity will be contributed by projects still under construction from 2012 (Alemán-Nava et al., 2014).

1.2 Research Problem

The state of Oaxaca in Southern Mexico is abundant in natural resources and has excellent wind conditions (Alemán-Nava et al., 2014). However, local communities have little ability to utilize these. Unemployment is high and many indigenous communities live in poverty (Cymene Howe, 2014; International Labour Organization (ILO), 2014). The people have limited autonomy and a general lack of faith in the central government. Young people are often leaving the region for a better future elsewhere (ibid.).

In the region of Isthmus of Tehuantepec in Oaxaca, a large wind energy plant – the Project Mareña Renovable – was planned in 2004 as part of the development of renewable energy in Mexico. If developed, the plant would be the largest wind power installation in all of Latin America (Cymene Howe, 2014; Vestas Mediterranean, 2012).

Previous authors have identified different issues between local communities – the Istemeños – and developers which have hindered deployment of transnational wind energy projects in the Isthmus of Tehuantepec region (Hoffmann, 2012; Cymene Howe, 2014; Oceransky, 2008a; Pasqualetti, 2011a; Swart, 2012). Since 2010, there is a tendency in Mexico for citizen activism against the federal government's plans to install large wind projects in the area. Actors claim, for example, violations of right of indigenous peoples, and environmental and cultural destruction (Pasqualetti, 2011c). Those arguments were used mainly because the typical return on investment for the developers is much higher than the compensation that the communities receive for their land and the external costs imposed by the wind energy site modifying existing natural, social and cultural conditions (Pasqualetti, 2011a). Also Howe (2014) point out that many Istemeños argue that the benefits for local communities are not even close to the benefits of what the companies will make.

The Mareña project was no exception. In January 2011, protests began against Mareña Renovables where the local community fiercely opposed the project. The companies involved claimed that they would ensure to minimise negative impacts (*"Mareña Renovables Wind,"* 2011), but eventually the opposition stopped the project and kept it in stand-by for several years (Cymene Howe, 2014; Octavio Vélez A & Rojas, 2013; Peace Brigades International, 2014). Yet, the Mexican government and its external investors still want to pursue these projects. It seems that, in order to succeed with this development, such projects need to better address local issues in the future (*"Mareña Renovables Wind,"* 2011).

1.3 Research objective and research question

The aim of this research is to explore what caused the halt of the Project Mareña, which structural factors limited the establishment and what future development may learn from this example in order to be more successful. The thesis develops suggestions for how to deal with social problems for wind energy projects in Isthmus of Tehuantepec. These recommendations may be useful to assist future projects of wind energy in other regions with similar social and political contexts.

The following question will be used to answer the research aim:

1. How can the Mexican government use the experiences gained in the Project Mareña Renovable for successfully planning and implementing wind energy projects in other regions?

1.4 Scope and limitations

The geographical scope of this thesis is Mexico and the Isthmus of Tehuantepec of the State of Oaxaca in particular. The focus on wind energy and the project in Mareña is because it was an interesting example of how contextual factors can hinder development of renewable energy. Previous authors, including (Hoffmann, 2012; Oceransky, 2008a; Swart, 2012), have studied wind energy development in the Isthmus of Tehuantepec. However, much of this research have focused merely on anthropological or social issues, but have paid limited to environmental aspects and impacts of climate change. These authors seem to agree about the importance of developing renewable energy in this region, but they have also questioned if the development is only a way for these companies to profit. It may also be that other aspects, such as political, technological, or legal, are affecting the success of wind energy projects in this region. Therefore, the author of this thesis has adopted a multi-aspect framework for analyzing the experiences of the Mareña project. For more details about the PESTLE-framework used in this thesis, see section 2.3. The reason for using the PESTLE framework in this research has therefore been that it covers the significant aspects that often can occur in the deployment of wind energy projects in the context of Mareña.

2 Research Methodology

In this section, the author explains the methods used to conduct this research. It presents the overall research structure, methods for data collection and methods for data analysis.

2.1 Research structure

This thesis begins by presenting a literature review of the development of wind energy, both internationally and in Mexico. From the literature, the author derives driver and barriers for future wind energy development in Mexico. The thesis then introduces a case study of a local example of trying to develop wind energy in the Oaxaca state in Mexico. It presents what was proposed in the Mareña wind energy project and how the project developed. This section is based on existing literature and on interviews that the author conducted. It was originally the intention of the author to also compare these experiences with other national and international examples. The intention of this would have been for the author to gain an understanding of how other countries have addressed social issues with wind energy development. From this, the author would have identified factors for successful deployment of wind energy in other contexts, and what could be learned from those experiences and adopted in the case of Mexico. However, due to a lack of time for this thesis project, this comparison with other specific projects was not possible to conduct within a framework at this time. But the other case studies in the world were presented in this thesis and they were related to the issues that Mexico is phasing with wind energy development.

The experiences with the Mareña project were finally analyzed using a PESTLE-framework – looking at Political, Economic, Social, Technological, Legal and Environmental aspects. In each of these categories, the author derived relevant aspects from the literature and integrated these as sub-categories in the PESTLE-framework. The data collected about wind energy development in Mexico in general, and the experiences from the Mareña project in particular, were then fitted into this matrix (for more details about the framework adopted, see section 2.3). Based on this analysis, the author finally describes which of these aspects have affected the outcome with the Mareña project the most, and why.

2.2 Methods for data collection

In order to achieve the objectives of the thesis, it was necessary to examine which arguments were posed by the local community that interfered with the Mareña project and the reasons why stakeholders reacted the way they did. It was also necessary for the author to develop an understanding of wind energy technology and market development in order to be able to identify the drivers and barriers that exist for wind energy projects in general, and in Mexico in particular. Data has therefore been collected using a literature review and conducting key-informant interviews.

Literature review

The literature review is mainly based on peer-reviewed academic material. Articles from local newspapers are used to the extent that it helps describe the 2012 events of the Mareña project. The author acknowledges that this material is not peer reviewed, however considers it relevant for the sake of illustrating what happened in the region at this time. It also helps the author of this thesis to better understand the relevant stakeholders originally involved. In addition, reports and permits from national entities such as the Ministry of the Environment and Natural Resources ¨Secretaría del Medio Ambiente y Recursos Naturales¨(SEMARNAT), the Energy Ministry in Mexico (SENER), reports from the project developers such as Mareña Renovables and the Inter-American Development Bank (IDB) will be used to confirm this information and triangulate the data.

Interviews

The author conducted four semi-structured interviews (see Appendix 1). The author´s intention with these interviews was to confirm the information derived in the literature review and further support the case study. Information from interviews with key stakeholders furthermore helped the author understand the current progress of the project Mareña, how the government and companies are cooperating. The interviews also provided examples of the interviewees´ experiences from other wind energy projects in the same region in Mexico.

The author intended to conduct several additional interviews, however, the author was not able to reach the potential interviewees despite numerous attempts. There were different reasons for this, for example the timing of the research during holiday times (see Appendix 1 for a detailed list of interviews conducted and people contacted).

2.3 Methods for data analysis

As described in section 2.1, the data collected for this thesis was analyzed using the PESTEL framework. The following describes this framework in more detail and justifies why it has been used.

The PESTLE framework

Forbes, Smith and Horner (2008) define the PESTLE framework as a tool or risk management technique for decision support. This analysis is capable to describe all type of risk management problems and also provide more details about those types of risks within each category (Forbes, Smith, & Horner, 2008). The PESTLE framework is used in this thesis to outline and develop causal explanations to the political (P), the economic (E), social (S), technical or technological (T), legal (L), and environmental (E) challenges that constrain the development of wind energy projects in Oaxaca, Mexico. In addition, this framework will help the author understand the reasons for establishing the Mareña project, which actors have been involved, and what happened in this particular case. The PESTLE framework can help identify key issues which policy makers and project developers need to address when establishing wind energy projects in this region, for example to ensure that the autonomy and rights of local communities are respected.

PESTLE frameworks have previously been used to analyze projects that have failed or succeeded, for example in a case on China to examine the necessity for energy efficiency retrofit for existing residential buildings (Shilei & Yong, 2009) and as well the PEST analysis was used to understand the consequences of lack of knowledge on RE sector and more specifically wind sources in Ukraine (Poderienė, 2012). In addition, the same framework was provided to analyze the challenges and constrains for development of RE technologies in Malawi (Zalengera et al., 2014). The author of this thesis developed his PESTLE framework based on two specific examples of how a similar analytical approach has been applied to wind energy projects.

Firstly, the Intergovernmental Panel on Climate Change (IPCC) adopted in 2012 a similar approach looking at Economic, Social, Technological and Legal aspects of successful wind energy deployment (see Table 2-1) applied what he called a STEP-framework (Social, Technological, Economic and Political aspects) when studying wind energy development (see Table 2-2). The reason to look at these frameworks was to understand how previous authors have analyzed wind energy development, and then be able to apply this method to the case of Mexico. The author merged these two frameworks and added Environmental since this factor has been mentioned as important in the literature about the Mareña project.

The IPCC (2012) listed general elements that could be considered in successful wind energy deployment. However, they did not include political and environmental aspects (Table 2-1).

Table 2-1 The analytical approach used by the IPCC (2012)

Elements listed by the IPCC	
Economic	• Support systems that adequate profitability and ensures investors confidence • Strategic transmission planning • New investment for wind energy
Social	• A degree of public acceptance of wind power plants to ease implementation • Knowledge (e.g. wind resource mapping expertise) and technology transfer (e.g. to develop local wind turbines manufactures and to ease grid integration) from those countries with more experience on wind energy can help to facilitate early installations
Technological	• Strategic transmission planning • Access to the existing transmission system • Proactive efforts to manage wind energy´s inherent output variability and uncertainty • R&D by government and industry has to be essential for improvements in onshore wind energy technology and driving improvement in offshore wind energy technology • Knowledge (e.g. wind resource mapping expertise) and technology transfer (e.g. to develop local wind turbines manufactures and to ease grid integration) from those countries with more experience on wind energy can help to facilitate early installations
Legal	• Appropriate administrative procedures for wind energy planning, siting and permitting

The second application of a similar framework was designed to understand the barriers to wind energy development in Canada, Australia, Japan and Taiwan, which was called the STEP framework (Valentine, 2010) (Table 2-2).

Table 2-2 STEP framework of factors influencing wind power development. Source: (Valentine, 2010, 2014)

Social	**Technical**	**Economic**	**Politic**
• "Not in my backyard" • (NIMBY) • Level of activism • Geographic hurdles • Market information	• Stochastic nature of wind power • Multi-stakeholder grid management • Logistical ¨Brother¨ • Distance to grid • Inadequate R&D	• Externalities not internalized • Other competing alternative technologies • Subsidies to traditional technologies • Insufficient	• Political conflict over optimal electricity mix • Level of fossil fuel industry opposition • Diffused alternative energy support • Energy efficiency

asymmetry • Social complacency • Electricity price sensitivities • Concerns over community impact	to improve storage • Underestimated potential	renewable energy subsidies • Long-term fossil fuel purchase commitments • Market player lack investment incentives • Government budget limitations • National advantages in other energy resources	initiatives prioritized • Complacency regarding CO_2 reductions • Vertically integrated utility monopoly • Weak adjoining grid coordination • Lack of R&D support for wind power

The framework has been applied to this research by adopting the categories from these two existing applications and adding "Environmental" aspects. Based on the literature review conducted for this research, the author has added sub-categories of specific factors related to each PESTLE-aspect (see framework matrix in Table 2-3). This is then applied to the situation in Mexico in general (column three in the matrix) and then to the Mareña case study in particular (column four in the matrix).

Table 2-3 The PESTLE-framework as applied in this thesis

Application of Categories to Case Study Mareña			
	Sub-category	**Potential relevance to wind energy in Mexico**	**Case study Mareña, state of Oaxaca**
P			
E			
S			
T			
L			
E			

3 Wind energy deployment, potential, drivers and limitations

This section will firstly describe the need for an energy transition due to climate change and energy security. Against this background, the importance of low carbon technologies will be illustrated. Secondly, it will outline the global trends in wind power development. Thirdly, the employment of wind energy within low, middle and high income countries will be presented. Following this, a focus on the Mexican wind energy market will be presented to familiarize the reader before the case study is presented in the next chapter.

3.1 Need for energy transition and current policy solutions

Economic growth based on continuous supply and availability of energy sources makes energy security an important strategy for governments to focus on (Dominik Rutz, 2014; International Energy Agency (IEA), 2014). Relatively cheap and easy to extract of fossil fuels, including crude oil, natural gas and (ibid.). Due to that depletion of fossil sources energy prices are expected to increase and new approaches for energy generation and consumption will be needed – such as energy efficiency and low carbon technologies (ibid.).

Governments around the world have implemented a variety of energy policies and ambitious targets to promote RE to reduce GHG emissions (Bürer & Wüstenhagen, 2009). These policy instruments can increase the demand of clean energy technologies with economic incentives and market-pull instruments, such as public procurement on RE[1] or production tax credits[2] (ibid.).

Also intergovernmental authorities, such as IRENA have contributed to the diffusion of low-carbon technologies by providing knowledge in this field. Socio-economic elements are one of the key drivers for RE deployment (IRENA, 2014b).

Different solutions and combinations of strategies for energy efficiency, RE penetration, and phasing out subsidies for fossil fuels have to be managed individually and different by each city, state, region and country and backed by a long term policy (GWEC, 2013). Among the available energy carriers, wind energy is highly relevant for energy security and climate change mitigation, as it is an infinite source and can contribute to the reduction and dependency of fossil fuel use (ibid.). Wind Energy Potential and markets around the world.

3.2 Global trends in markets for wind energy

Over the last decade wind energy has expanded rapidly according (GWEC, 2013). In 2003 the global wind energy installed accumulative capacity was 39,431MW and in 2013 reached 318,105MW (ibid.). Today, the world wind energy market is dominated by high income countries as can be seen in the Table 2-1 and Figure 1. However, as will be described in the following paragraphs, low and middle income countries are beginning to play a larger role in wind energy deployment particularly in China and India.

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[1] Public procurement is the purchases of services or equipment such as electricity that are financed by governments or public authorities and in this case to stimulate the development of RE (IPCC, 2012; Mont, O. and Dalhammar, 2008).

[2] Production tax credit (PTC) is financial support by federal entities for the development of low carbon technologies and encourage the increasing of production (IPCC, 2012; Scientist, 2014).

Table 3-1 Top 10 Countries, Cumulative Capacity Wind Energy 20013 MW Source: (GWEC, 2013)

Country	2013 (MW)	% Share
PR China	91,412	28.74
USA	61,091	19.20
Germany	34,250	10.77
Spain	22,959	7.22
India	20,150	6.33
UK	10,531	3.31
Italy	8,552	2.69
France	8,254	2.59
Canada	7,803	2.45
Denmark	4,772	1.50
Rest of the World	48,332	15.19
World Total	**318,105**	**100.00**

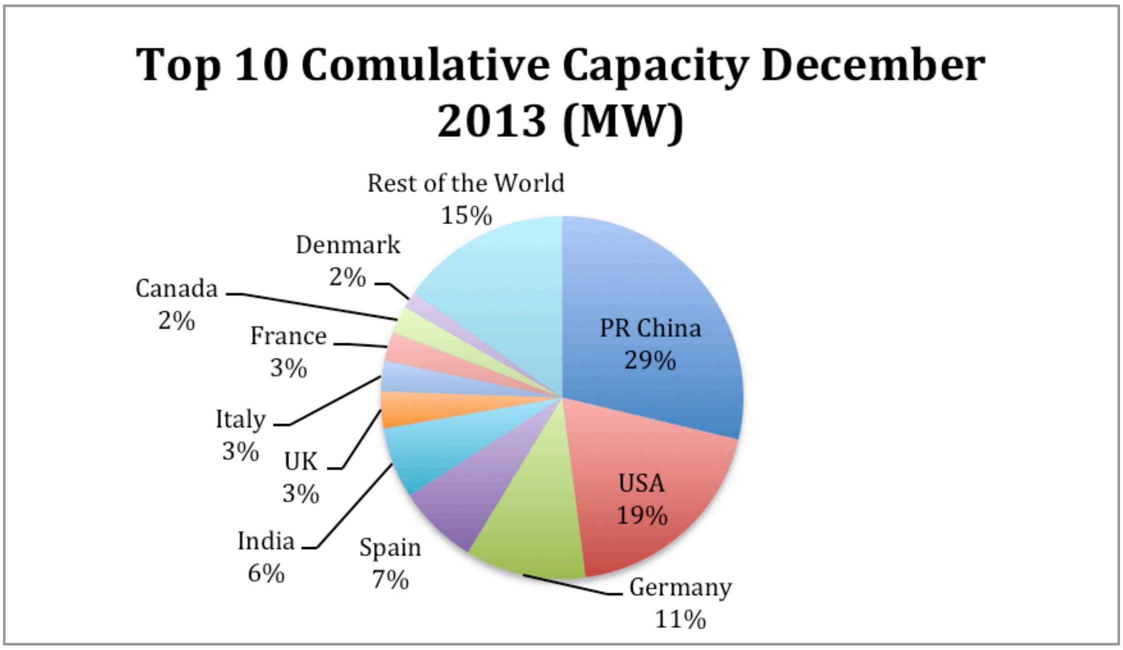

Figure 1 Top 10 Cumulative Capacity December 2013. Source: (GWEC, 2013).

In 2013, for the first time the world wind installations were focused within non-OECD countries, reflecting a shift to installations in low and middle income countries installations (ibid.).

By the end of 2013, 24 countries accumulated more than 1,000 MW each of installed capacity, including 16 countries in Europe, 4 in Asia-Pacific (China, India, Japan and Australia), 3 in North America (Canada, US and Mexico) and 1 in Latin America with Brazil (GWEC, 2013). In addition, by the end of 2013 six countries had more that 10,000 MW each of installed capacity including China (91,412 MW), US (61,091 MW), Germany (34,250 MW), Spain (22,959 MW), India (20,150 MW), and UK (10,531 MW) (ibid.).

It is predicted that in 2014 is likely to be as successful as 2013 in terms of installed capacity, because drivers such as the introduction of policies, targets and frameworks described above, create a more stable market and make wind power more competitive with the global price of electricity produced from burning fossil fuel resources (GWEC, 2013).

The substantial progress can be seen in the graph Figure 2. The last two years show the accumulative global market growth represented 19% at the end of 2012 and 12.5 % at the end of 2013 reaching 318,105 MW in 2013 (GWEC, 2013). This was an impressive growth for the manufacture industry considering the economic climate (ibid.).

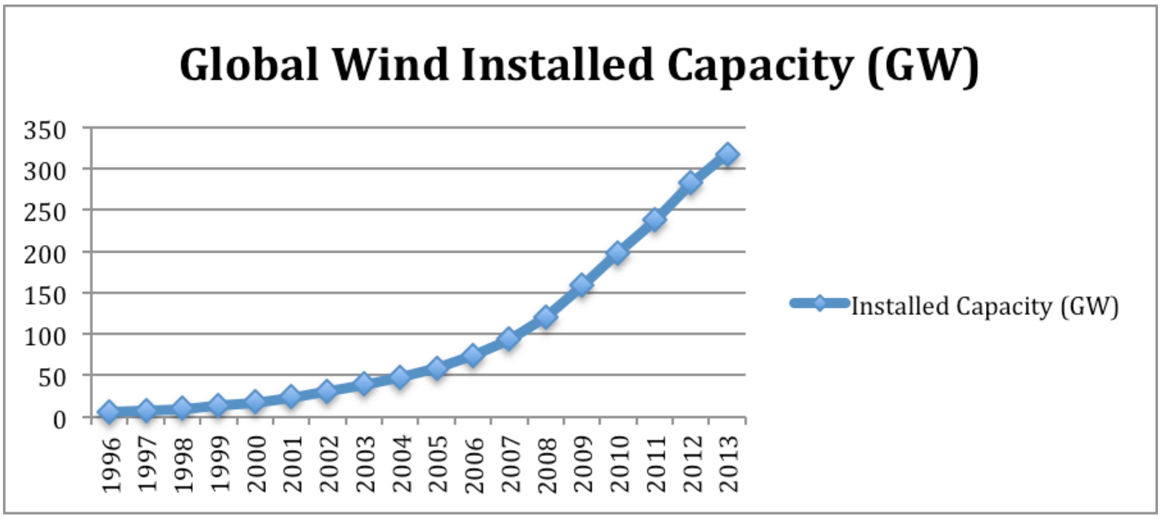

Figure 2Global Cumulative Installed Wind Capacity 1996-2012 Source: (GWEC, 2013)

3.3 Wind energy in high income countries – Early development, growth and current capacity

The generation of wind energy in high income countries was triggered by innovation policies that initially led the research, and then to the development and demonstration of various technologies (Neij & Dannemand Andersen, 2012). The market deployment can be presented in three stages; firstly, wind energy projects were implemented in the 1970´s and early 1980s in pioneer countries such as Denmark, the United States, Germany and the Netherlands (Neij & Dannemand Andersen, 2012). Secondly, the Danish boom of wind energy production led to a wave of innovations in the 1980s. Thirdly, in the 1990s and 2000s emerging economies, such as China and India, became leader in installations and manufacture of wind turbines (ibid.). The latter has significantly increased demand and reduced manufacturing costs of wind turbines for global market (US Energy Information Administration, 2014). *Today the Levelized Cost of Electricity (LCoE) from onshore wind power is already a very low level and will only decrease by a small amount in the future* (Kost et al., 2013).

Danish economic growth has been rapid in the last years, leading to increased demand and a need for increased energy production (Thorning-Schmidt, 2014). The Danish Prime Minister pointed out recently that RE is high priority to match this increased demand (ibid.). Germany was able to follow Denmark´s lead and capitalize on technology spillover to a turbine-manufacture sector due to cost reduction in generated electricity through up-scale and high efficiency wind turbines (Neij & Dannemand Andersen, 2012).

The Danish success has been possible because of different measures and strategies from the Danish Government and participation of the citizens, such as (Thorning-Schmidt, 2014);

- Long-term political vision for acts and targets on RE in 2050
- Regulations and standards
- A whole-of-government approaches for green policies
- An inclusive manner of representatives of business in cooperation with researchers, public sector and stakeholders for their green transition.

This shows the entire innovation system approach supported by policy governments in the past shows that is not enough to just support the deployment of wind turbines and infrastructure, but also the needs of cooperation of actors, networks and market institutions (Neij & Dannemand Andersen, 2012).

In Denmark in 1979 the R&D programme was combined with investment and production subsides, similar to the feed-in tariffs for RE used today and created the interest on the market of smaller actors, such as farmers and entrepreneurs (Neij & Dannemand Andersen, 2012). This successful development of a domestic wind energy market was supported through mapping the wind resource, grid connection regulations, guidelines, and municipal planning and information activities plus certification processes for wind turbines by the Danish Energy Agency (ibid.). This lead to other countries, such as Netherlands to follow suit by introducing subsidies in the 1981, but their approach was focused on creating a competitive market and not to support improvements in turbines manufacturing (ibid.). Also, the Dutch approach it lacked interaction between actors, and lessened the essential learning and feed-back processes seen in Denmark limiting the manufacture improvement (ibid.). The US as well introduced subsidy schemes and the market for wind turbines took off rapidly, increasing the turbines manufacturing and the imports from Denmark (ibid.). In 1985 the Danish-manufactured wind turbines worked much better with less problems as the US-produced (ibid).

Germany and Spain followed the same concept as Danish approach and received the benefits from the technology transfer and spillover (Lewis, 2007; Neij & Dannemand Andersen, 2012). For example in 1994 a joint venture called Gamesa Eolica, was formed between Vestas an Danish company and Gamesa (Spanish) in order to overcome technical barriers in Spain (ibid.).

3.4 Declining costs of wind power

In Denmark, the cost per kW of production installed wind turbines declined by 50% from 1980 to 2000. This is due to economies of scale and the improved technological efficiency of wind mills. The cost of electricity generated by wind mills declined by 70% during the same years (Neij & Dannemand Andersen, 2012). In addition, the declining prices were associated with learning effects in the onshore markets, which have been transferred to offshore wind markets in the EU. Prices for electricity generated by offshore wind farms are still higher than from onshore wind farms. They are affected by the location of the wind farm and the distance to shore (Lewis, 2007). Overall, wind power is already competitive to other energy carriers. Offshore wind power in Denmark was ranked as the second cheapest form of power, after onshore wind energy, which was the cheapest (Energy Market Price, 2014; The Tree, 2014)..

Denmark and US experienced the cost onshore wind projects installed reduction meanwhile the learning improvements curve was increasing but the US reflected reversal and upward price trend in a certain period as it can be seen in Figure 3 (Neij & Dannemand Andersen, 2012).

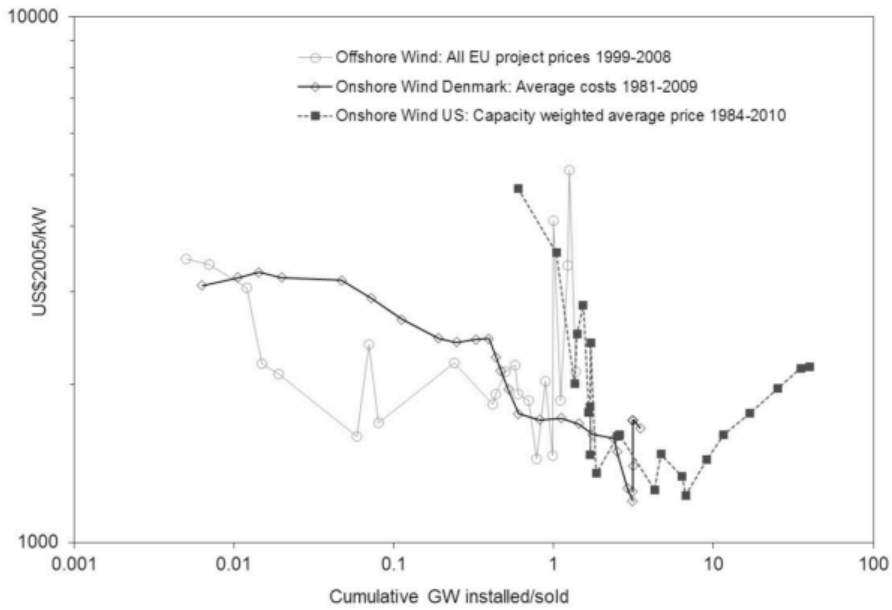

Figure 3 Investment Costs of Wind Power as a Function of Cumulative Experience: Learning Curves Source: (Neij & Dannemand Andersen, 2012)

This figure showed by (Neij & Dannemand Andersen, 2012) that it could be associated a declination of price profile with the learning improvements curve and similar is the current situation with the emerging offshore wing energy market.

3.5 Wind energy in low and middle income countries

Currently, in Brazil, South Africa, Turkey, Mexico and other middle income countries where wind energy is competing directly and successfully with heavily subsidized fossil fuels. For example, in South Africa wind power is 30% cheaper than electricity generated by coal power plants (GWEC, 2013).

International technology transfer typically refers to transferring technology from industrialized to low and middle income countries. Technology transfer can be embedded in foreign direct investments (FDI), licensing, joint-ventures, or governmental multilateral agreements (Lewis, 2007).

China and India are the first middle income countries that are close to catching up with high income countries such as Denmark, Spain and Germany in terms of manufacturing and deploying wind power. They are also the countries with the most Clean Development Mechanisms (CDM) projects (Lema & Lema, 2013). CDM projects are instruments that allow investments in projects that introduce low carbon technologies and reduce GHG emissions in low and middle income countries. The projects generate carbon credits for industrialised countries that need to comply with Kyoto Protocol commitments under the United Nations Framework Convention on Climate Change (UNFCCC) (Lema & Lema, 2013).

The excellent wind resources in India and China and the support of wind turbine markets in both countries in form of power sector reforms and policy support schemes have led to a sharp growth in the wind energy market (Lewis, 2007).

The 1990s and 2000s in China and India were characterized by a rapid diffusion of wind turbines due to the massive support to develop a market, using studies, spillovers of know-how from foreign manufactures and taxes to create incentives for domestic manufactures of wind turbine components. Developing strong support of international networks was a facilitating factor for the diffusion of wind turbines in these countries. For example, in the case of China the wind turbine manufacture "Goldwind" sent employees abroad to improve their know-how on wind technologies and markets. The Indian manufacture and project developer "Suzlon" cooperated with research centers in the Netherlands and Germany and international headquarters in Denmark (Lewis, 2007; Neij & Dannemand Andersen, 2012). A key factor for both countries was the certification standard programme for domestically manufactured turbines to the certification helped to overcome problems in the 1990s, such as poor wind resource data, weak grid systems, poor installation practices and unsatisfying performance regarding the production of local wind turbines (ibid.). According to Lewis (2007) the two crucial factors for the successful technology transfer in both countries were the "*domestic policy environment and firm´s ability to acquire new knowledge*".

Today China is the country with the highest cumulative capacity (GWEC, 2013).

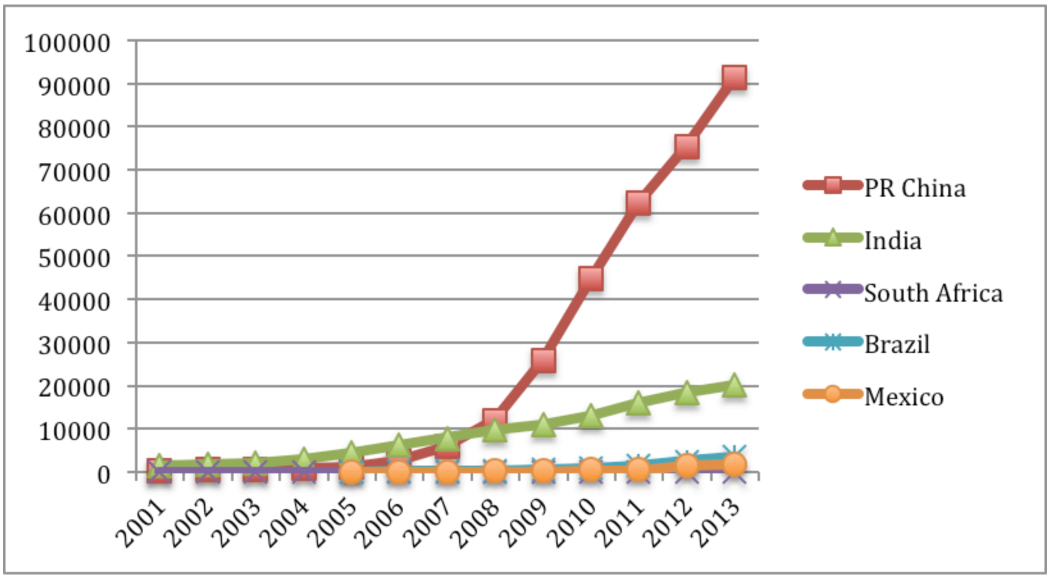

Figure 4 Wind Installed Capacity (MW) in China, India, S. Africa, Brazil and Mexico. Source: (GWEC, 2013)

India's wind market today is the second largest in Asia and it can be expected that it will keep the same pace or even accelerate the capacity installation rate. So far, it is the 5th largest wind power market globally (GWEC, 2013).

The difference between countries such as South Africa, Turkey, Mexico, Argentina, South Korea, and Costa Rica and the two emerging economies China and India is that these two countries aimed to follow of the manufacturing leaders in industrialised countries. Brazil is as well following this line on manufacture (see, **Error! Reference source not found.**). China and India were pioneers in engaging in wind energy CDM projects and Foreign Direct Investments (FDI) (Lema & Lema, 2013). A similar trend was not observed in in other middle income countries, including Mexico.

Brazil and Mexico are projected to have a stronger growth in installed wind capacity in 2014 and for first time sub Saharan Africa (South Africa, Ethiopia and perhaps Kenya) will see an installation of more than 500 MW this year (GWEC, 2013). The total installed capacity in Latin America and the Caribbean is 6,681 MW, including Mexico (ibid.). Currently, within

Latin America, Brazil has been the leader in wind power deployment. From 2012 to 2013 they increased their installed capacity from 2,508 MW to 3,661 MW. Mexico has also seen significant growth and increased their installed capacity from 1,537 MW to 1,917 MW, making them the second largest wind electricity producer in the Central America (ibid.).

Mexico started the first wind power project with a small capacity of 1.57 MW in 1994 and in 2006 the second wind project with a capacity of 83 MW Both projects where located in the State of Oaxaca and were operated by the state-owned Electricity Commission (Comisión Federal de Electricidad, CFE)[3] (GWEC, 2013). The second wind energy project was "La Venta II" and became the first project that received funding from the CDM (Lokey, 2009).

Currently, in Mexico more than 1,050 wind turbines have been installed (Borja, 2013). As illustrated in Figure 5, Mexico reached an installed accumulative capacity of 1,917 MW in 2013 (GWEC, 2013). Mexico has an average capacity factor of 30% (Borja, 2013; GWEC, 2013). It is expected that by the end of 2024 wind energy capacity will be around 12,000 MW if the government's targets will be met (Borja, 2013). These 12,000 MW would equal 5% of the national electricity demand (ibid). During 2013, total electrical output from wind was 1.5% of national electricity demand, accounting for 3.9 TWh (ibid.). The CRE has approved permits of a total of 4,999 MW of wind power capacity (ibid). The region Isthmus of Tehuantepec, located in the State of Oaxaca, is the Mexican largest wind energy resource, but also other Mexican states such as Baja California, Chiapas, Jalisco, Nuevo León and Tamaulipas are potentially interesting regions for the deployment of wind energy in Mexico (ibid.). This year in Mexico the total capacity of all wind energy projects under construction is 714 MW. Out of this total capacity installed, 155.1 MW will be located in Baja California and the rest will located in Oaxaca (GWEC, 2013).

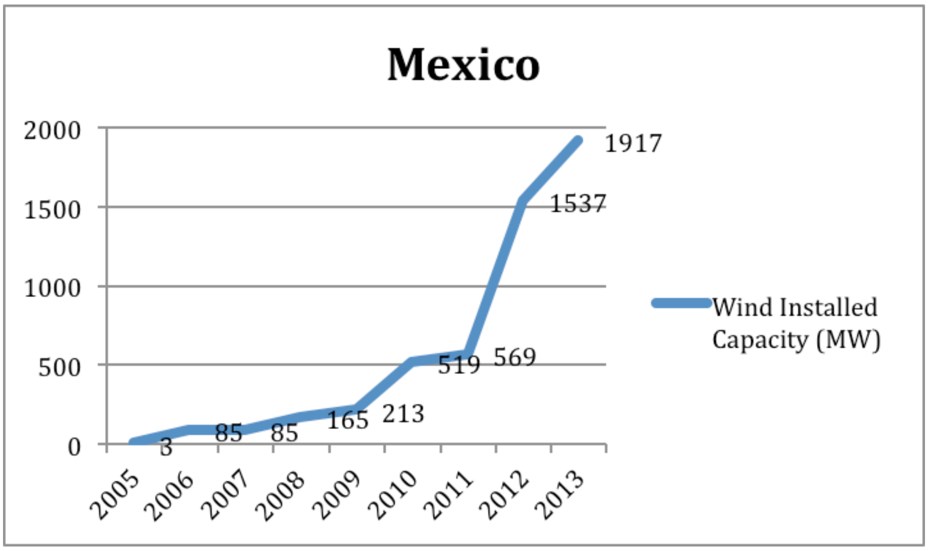

Figure 5 Wind Energy Installed Capacity in Mexico. Source: (GWEC, 2013)

Mostly international developers are playing an important role for the deployment of wind energy. The electricity is often used for self-supply, such as in the case of the Mexican company CEMEX and the Spanish company Iberdrola where electricity is directly produced for different consortiums (Borja, 2013). In 2012, the cut of CO_2 emissions due to wind power

[3] The Federal Electricity Commission (CFE) is a state owned company that currently can compete with other generators for the production of electricity but still owns the transmission and distribution lines (GWEC, 2013).

generation was 2.2 million tons using a mitigation rate of 0.58 tons of CO_2 per each wind-generated MWh (Borja, 2013).

Wind energy in Mexico is a competitive option within the Mexican electricity market (Borja, 2013). On other hand the Mexican trend on wind energy deployment it have been leaded by Spanish wind energy manufactures such as, Acciona, Windpower, Gamesa Eólica and as well the Danish Vestas and Swiss Alstom companies have been playing an important role in the Mexican wind energy deployment (Borja, 2013). In 2013 it was calculated that the total investment in the deployment of wind power farms was around 2.18 billion EUR or 3.0 billion USD, which a substantial proportion is carried by Foreign Direct Investment (FDI) (Borja, 2013). In addition is estimated that addressing properly social requirements on wind energy deployment the capacity could increase significantly (ibid.). The wind energy scientific progress in Mexico it started in 1994 and from all the research publications of RE just 4% have been focused on wind energy in Mexico (Alemán-Nava et al., 2014).

Wind energy potential in Oaxaca, Mexico

A 2000 MW, 400-kV, 300km electrical transmission line was commissioned for the deployment of wind energy projects in the region Isthmus of Tehuantepec (Borja, 2013). For 2014, it is estimated that the Isthmus of Tehuantepec will close the year with a total generation capacity of at least 1,867 MW (ibid.). In additions, it is projected that this region can host 6,000 MW of wind power, using efficient and reliable wind turbines and an annual capacity factor around 40% (ibid.). In the Isthmus of Tehuantepec the investment cost for installed wind energy are around 1,450 EUR/kW. Depending of the project's characteristics, the buy-back price for independent power producer (IPP) generators is around 0.049 EUR/kWh (Borja, 2013).

3.6 Drivers to Wind Energy Development in Mexico

Mexico has three legal instruments that the framework for encouraging the deployment of wind energy and as well other RE sources (Alemán-Nava et al., 2014). These three legal instruments discussed below are firstly the General Law for Climate Change in Mexico adopted in 2012, secondly, the Law for the Use of Renewable Energy and Finance of the Energy Transition, recently modified and approved, and thirdly, the Energy Reform approved recently by the Congress of the Union.

The benefits of wind energy to help reduce GHG

According to IRENA, Mexico´s profile in 2009 the total primary energy supply was 7,311.8 PJ[4] of which 698.7 PJ (9.6%) were renewables. The electricity generation was 261.0 TWh and which renewables were 36.8 TWh (14.1%). 7.6% of renewable capacity by 2012 the 4.34% is from wind, small hydro 0.77%, geothermal 1.65%, biogas and biomass 0.85% (IRENA, 2012).

Wind energy can contribute to increasing renewable energy (RE), mitigating GHG and can contribute to economic growth. The "General Law for Climate Change" and the "Law for the Use of Renewable Energy and Finance of the Energy Transition" in Mexico in 2012 set very ambitious targets to increase electricity from clean energy sources to reach 35% by 2024 and 50% by 2050 (Environmental Law Institute, 2012).

[4] PJ: petajoule

The General Law for Climate Change in Mexico

The General Law for Climate Change is the framework for further adaptation and mitigation policies, in order to achieve targets set in the same law. This General Law has set an aspirational goal to reduce GHG emissions by 30% by the 2020 with respect to the baseline scenario in the year 2000 as well as a 50% GHG reduction by 2050 (Environmental Law Institute, 2012). In the General Law the participation of the Secretariat of Energy (SENER), in coordination with the Federal Electricity Commission (CFE) and the Regulatory Energy Commission (CRE), sets targets for clean energy. The current target is to generate 35% of electricity from clean energy sources by 2024 (Environmental Law Institute, 2012; GWEC, 2013). Regarding that target, 12% of energy generated should come from wind energy by 2020 and base line of 2000 which will become 12,000MW (Alemán-Nava et al., 2014; Borja, 2013).

Renewable energy capacity has increased significantly over the last 10 years. In 2003 total power generation was 26TW and in 2012 this increased to 39TW representing a 50% increase. The increase of RE capacity is therefore not reflected in a higher share in the total electricity mix which has remained stagnant at 16% (Alemán-Nava et al., 2014). This shows the importance of not only increasing RE installations, but also reducing demand for energy and the reliance on fossil fuel electricity generation in order to reach Mexico´s RE targets. For more details about the General Law for Climate Change in Mexico see Appendix 2.

The Law for the Use of Renewable Energy and Finance of the Energy Transition (LAFAERTE)

The Law for the Use of Renewable Energy and Financing of Energy Transition was established and has been in force since 2008 and was modified in 2013. It introduces incentives for renewable energies, defined as wind, geothermal, solar, waves, and hydropower (Camara de Diputados, 2013). The law comprises regulatory and economic policy instruments.

It establishes among other issues legal requirements for the use of renewable energy and clean technologies (Alemán-Nava et al., 2014). An additional objective is the interest to reduce the dependency on fossil fuels to move towards sustainable development (Borja, 2013). Additionally, this Law creates a Fund for the transition to clean and renewable energy and technologies. This Fund supports the Technical Committee for the administration (Alemán-Nava et al., 2014). The main elements besides the strategic goals and a special programme for RE and the green fund are providing RE with access to the national grid and implement technical standards for interconnection and infrastructure for electricity transmission, provide support for R&D programmes(Borja, 2013). The reduced tariffs for electricity transmission and accelerated depreciation up to 100% in one year some of the existing incentives in Mexico (ibid.).

Energy Reform 2013 in Mexico

This reform came because the lack of financial resources of the National Oil and Gas Company PEMEX, which has the monopoly on oil explorations in Mexico. *The Mexican oil reserves are becoming more expensive to exploit*, which is reflected in the on their peak on their oil production, exports and revenues and as well (Sen & Upadhyaya, 2014). In 2014, the annual crude export revenues are expected to fall from $49.4 billion dollars in 2011 to $36.9 billion dollars (ibid.).

The main changes with this reform were amendments of the articles 25-27 of the Mexican Constitution, allowing private investments in the energy sector (Alemán-Nava et al., 2014; Sen & Upadhyaya, 2014). Beforehand FDI in electricity projects were only implemented for the self-supply of larger companies, as these projects did not receive access to the national grid. Now, projects financed by FDI will be able to generate electricity for other consumers, which opens the market to more actors with a high interest in the RE sector (Sawyer, 2014). This Reform also regulates the private participation other companies than the PEMEX, regarding the exploration and extraction of oil and natural gas (Alemán-Nava et al., 2014). When the revenues of oil reach up to 4.7% of the Mexican GDP, with a baseline of 2013, these revenues will be allocated to a long-term Fund (Alemán-Nava et al., 2014). The Fund will use 10% of the revenues for financing science projects, technology and RE, 10% for pension systems, 10% for university and postgraduate scholarships, and 30% for oil projects by the Energy Ministry. (ibid.).

The Law states that the Mexican Ministry of Energy (SENER) will design, technical guidelines and permits for oil and natural gas activities and for the electric power sector. It will do the planning and monitoring of energy related operations, including the formulation of requirements for low carbon technologies (Mexican Ministry of Energy (SENER), 2013). In addition, this Reform with the help of the State will create sustainable criteria to obligate the participants (investors) to protect the environment when generating clean energy and reducing GHG and other air polluting emissions (Mexican Ministry of Energy (SENER), 2013).

The reform establishes that the Ministry of Energy (SENER) will be in charge of the permitting of operators and generators in these sectors. Previously, foreign firms were only allowed to distribute electricity to CFE for participants in the electric power industry with clean energies and reduce polluting emissions (Mexican Ministry of Energy (SENER), 2013).

The CFE will still be the owner of the transmission and distribution network, but private investors will be allowed to participate in those areas and also in the wholesale power market (León, Martén, Livas, & Mereles, 2014). The current system will become a single free market for power generation removing the regulatory rigidities, which will be a driver for RE projects (ibid.).

Mexico foreign direct investment importance and wind energy

In a webinar hosted by the Global Wind Energy Council (GWEC), Steve Sawyer the Secretary General of Global Wind Energy Council stated that Brazil and Mexico are the best countries for investing in wind energy in the next five years (Sawyer, 2014).

Mexico has signed 28 Investment Promotion and Protection Agreements (IPPAs)[5] and as well Double Taxation Treaties (DTT)[6] with more than 40 countries, which gives more confidence to place for foreign investment in the Mexico (PROMEXICO Business Intelligence Unit, 2013).

The main challenge for Brazil and Mexico are (Sawyer, 2014):

1. How much the local requirements are going to interfere with the target of the RE.?
2. Whether the necessary infrastructure can be built quickly enough in order to meet the demands of the massive pipeline of contracting projects.

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[5] Investment Promotion and Protection Agreements (IPPAs) are international treaties that give confidence on the FDI where the is a reciprocity of promotion and legal protection of capital flows on the production sector (Undersecretariat of Foreign Trade, 2009).

[6] Double Taxation Treaties (DTT) are conventions between two countries that agree to eliminate one taxation in one territory and paid to residents of another territory ("Double Tax Ttreaties (DTT)," 2014).

Legal framework for transmission and distribution

In Mexico there are four categories relevant for wind energy deployment. Since December, 1992 with the Law of the Public Electric Energy Service private entities can participate in the generation of electricity in Mexico (Cardona, 2013; Oceransky, 2008b).

1. Self-Supply

Under the self-supply category, energy produced in excess of consumption can be sold to the CFE, but not higher than marginal production costs. The profitability of these projects is that companies consume the self-produced electricity during peak tariff hours, which is during the day when CFEs price to power consumers are the highest (ibid). The lack of transmission capacity in some regions can be a major limitation for these projects (ibid.). This situation was the origin of in 2006 the Open Season process (ibid.). Within the Open Season the private producer declared the capacity they wish to install in the region in order to be integrated to a new 145 km long transmission line with a variable cost of this new line (ibid.).

2. The independent power producer (IPP)

In the IPP category a private holder produces electricity to sell it to the public utility. Here, the IPP has a service contract with the CFE. The IPP, or the investor, is the owner of the infrastructure and delivers the power to the CFE in exchange of a fixed payment for the installed capacity and a variable payment for the delivered energy (Cardona, 2013; Oceransky, 2008b).

Mexico does not have a general feed-in-tariff[7] system that guarantees the economic viability of RE projects and neither a production or investment tax credits for RE[8] (Lokey, 2009; Oceransky, 2008b).

3. Small Scale Production

This category is for private power generators with a capacity below 30 MW that sell all the energy to the CFE (Cardona, 2013; Oceransky, 2008b). This can apply to *self-supply of rural communities that lack electricity services* but projects must be below 1 MW (ibid.). In addition this can also apply for export projects below 30 MW (ibid.).

4. Import and Export

The imports are only permitted for self-consumption and the export has no restrictions (Oceransky, 2008b).

Ejidos or land ownership structure reform from 1992

The land or agrarian reform was initiated in 1992, changing the Article 27 of the Mexican Constitution. This reform allowed the Mexican Government to the local landholders to transferred, leased, collateralized, and sold to private interests (Baker, 2011; Cymene Howe, 2014; Rueda, 2011).

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[7] The feed-in-tariff system aims to promotes RE deployment and cogeneration with a guaranteed fixed price received by the private companies that generate and supply electricity to the network to the electricity companies (Cardona, 2013).

[8] The production tax credits provides extra revenue of each KWh of RE generated making this RE more competitive than fossil fuels (Lokey, 2009).

This implies that within this reform the Mexican government allows to transfer "ejidal"[9] or common land to a private ownership form (ibid.). This privatization requires an assembly vote of all members which makes the process of selling land highly complex,. It has created a certain legal issue when land leased has been for various wind projects, as it was not clear whether the land is in an "ejidos" structure or private ownership (Baker, 2011).

Providing decent and fair social benefits to wind landowners before and after the permits and in the run of wind power projects is critical to the planning of the deployment of wind power at the national level. This has not been carried out efficiently (Borja, 2013).

Three types of regimens for land use for wind energy projects

Three types of land are the ones that normally exist in South of Mexico, Oaxaca for host wind energy farms (Personal communication, Edith Barrera Pineda, 18-09-2014)

1. Private ownership

In this type of regimen the private owner normally can get more benefits because they can set their own fees for leasing the land and they can take their decision by their self (Personal communication, Edith Barrera Pineda, 18-09-2014).

2. Agrarian Community

This regimen is a communal land holding form which is located within smaller indigenous communities (Castañeda Dower & Pfutze, 2013). In this regimen the whole group should do agree on a distribution of the profit. The share is typically very low per family and is the most difficult for negotiation (Personal communication, Edith Barrera Pineda, 18-09-2014). Within this communal regimen everything has to be decided in consensus (Dávalos et al., 2013). The amount of leasing the land here it varies depending their community plot (hectares), because some people may don't have their plots within polygon of the farm (Dávalos et al., 2013; Personal communication, Edith Barrera Pineda, 18-09-2014). In addition there is a leader as well as the Ejidal. For an approval at least 50.1% of all votes need to be in favor of leasing the land to a wind energy operator (ibid.). The case under analysis, the Project Mareña, was the first project, which was decided on under this type of land regimen (Personal communication, Edith Barrera Pineda, 18-09-2014).

3. Ejidos

In this regimen now within the land reforms the leader has more freedom to decide what to do with the land (Personal Communication, Edith Barrera, 2014). In order to privatize any plot of land in this regimen is possible but needs to be approved by at least two-thirds of the majority of the ejidos assembly (Castañeda Dower & Pfutze, 2013).

3.7 Barriers to Wind Energy Deployment in Mexico

The most significant barriers for the National Energy Company (CFE) to the deployment of RE in Mexico is that according to the Federal Law they need develop new power capacity but has to be the cheapest electricity source for the citizens (Alemán-Nava et al., 2014; Lokey, 2009). The main reasons for underperformance of RE in Mexico is the culture and laws that

[9] The ejidos right was granted by the Mexican Constitution in 1917 in order that a group of farmers were had the right to redistributed and organized the land within communal land holdings, which are know as ejidos (Castañeda Dower & Pfutze, 2013). The members of the ejidos, which were called ejidatarios had individual right to use their plots of lands for cultivation or other activities (Castañeda Dower & Pfutze, 2013).

are leading the state-owned companies such as CFE do not develop RE projects and as well the lack of transparency in CFEs own accounting and planning processes (Lokey, 2009).

The main barriers to investments in wind energy projects in Mexico is firstly that no reform that has been able to expand the transmission and distribution grid (Dávalos et al., 2013). Secondly, it is argued that the Mexican financial sector is not able to provide capital for the deployment of projects falling in the self-supply category. Thirdly, it is very difficult and complex to lease land for wind energy projects due to the described land regimes in Mexico (ibid.).

This decision-making process is a relevant barrier for the wind power market in Mexico. As the decisions regarding leasing a plot of land in an ejidal or communal structure is mandated to be carried out by an unanimous assembly vote of all ejidos members. This gives each member the right to refuse the transfer of the land due to different interests regarding wind energy projects (Baker, 2011).

The Mexican government lacks of policies that promotes hosting manufacturing facilities and investment on research, education and training from foreign wind companies (Commission for Environmental Cooperation, 2010; Lema & Lema, 2013; Personal communication, Edith Barrera Pineda, 18-09-2014). Not permitting technology transfer from high income countries with wind energy deployment (see, Case 2 – An example of an alternative approach to wind, Brazil) (Lema & Lema, 2013).

Mexico has not very efficient power generation system in large part because for a every new entrant in the electricity market will be reluctant by the capacity of the Mexican national energy provider (Comision Federal de Electricidad or CFE) (León et al., 2014). In addition the CFE and its limited conditions for private participation for access to the grid and in defining all contracts above 30 MW of capacity (León et al., 2014).

In addition the Mexican transmission and distribution networks, which are controlled by CFE doesn't not cover the demand, are old and outdated (León et al., 2014). Electricity tariffs are also very high especially for the industrial consumers, which pay more 70% more than those in the U.S (ibid.). Besides that the government subsidizes covers more than 60% of the cost for residential and agricultural consumers, representing losses for CFE (ibid.). Natural gas and coal consumed for electricity generation has growth significantly, however power plants using fossil fuels comprise majority of the Mexican electricity generated (EIA, 2014; The Oxford Institute for Energy Studies, 2014).

Strong activist groups

Mexico has historical of political resistance and activism (Pasqualetti, 2011a). This happen since Benito Juárez a Mexican lawyer from Oaxaca an historic figure, defender of the rights of all citizens, who give the Equity Law or Ley de Juárez in 1855 and who as well served as Governor of Oaxaca from 1848 to 1852 and then President of Mexico in 1861 after the new liberal Constitution of 1857 was promulgated and after his exile to New Orleans, Louisiana because at the actual President Antonio López de Santa Anna (Banco de Mexico, n.d.). In that time he and his army mostly with citizens of Juchitán defeated the French invasion (Pasqualetti, 2011a). By 1980 Juchitán had attracted attention by the left wing, prosocialist municipal government and by 2001 the military caravan of the Ejército Zapatista de Liberación Nacional had arrived in Juchitan reflecting a clearly anarchist bent by many residents in the region (Pasqualetti, 2011c).

Juchitán de Zaragoza is the largest city of the State of Oaxaca where Coalition of workers, Peasants and Students of the Isthmus make their home influencing popular movements since the 1970 with the merge of local socialists, peasants, students and indigenous people (Pasqualetti, 2011a).

Favorable surroundings for an agricultural economy and a relative autonomy from their political influences of Mexico City have contributed to form solid relationships between the people and the land (Pasqualetti, 2011a). This gives an historical and cultural background about the resistance of wind energy projects.

Resistance of communities to wind farms in Oaxaca

As 80% of all wind projects are located in Oaxaca, due to its very good wind conditions, this is also where most protests are located (Baker, 2011). Since 1994, different projects have been implemented in La Venta, Oaxaca. This gave the region the chance to gain experience on the deployment of wind energy, but as well as meeting different concerns from local communities that raised public resistance against wind farms (Baker, 2011; Pasqualetti, 2011b). People affected by the wind farms have formed local assemblies for their defense of their land such is the case of The Assembly for the Defense of Land and Territory (APIITDTT) formed in 2007 by the people in the Isthmus of Tehuantepec" (ibid.). The first concerns of the communities is that the wind farms are controlled mainly by foreign companies and more projects are expected to come in the future (Peace Brigades International, 2014). Secondly, the communities that rely on their land are worried that the wind projects will limit their access to the leased land (ibid.). Thirdly, concerns were raised with regards to the negotiation and consultation processes between developers and communities, such as language barriers, lack of interpreters, lack of signatures in contracts, and contracts containing misleading information on the duration of the project and price for the leased land (ibid). Fourthly, the consultations did not accurately reflect on profitability, compensation and information in case of damaged land use (ibid.). Fifthly, it has been criticized that no adequate local environmental assessment was carried out, which analyses how the project is affecting the region in the long term (ibid).

Some wind energy projects in the Isthmus of Tehuantepec were blamed for a lack of benefits for the local population, such as no long-term job creation (Oceransky, 2008b). Employment contracts for the local population during construction phase were often on a weekly basis, which prevents workers from registering in the Mexican social security system (ibid.). As a result, these workers have no access to health security services (Peace Brigades International, 2014). After the construction phase of the project the only highly skilled employees are needed. The maintenance phase requires normally around one person per 15 wind turbines and local workers usually do not have the formal education to fulfill the requirements (Dávalos et al., 2013; Peace Brigades International, 2014). Communities demanded from programme operators to receive education on wind energy technologies and markets.

Furthermore, project operators were blamed for an unequal distribution of benefits from wind power generation between families and communities. For example the total amount between each communal and private land owner could vary between $405 - $486 USD for ejidos and $121,630.58 USD for private land plots (Dávalos et al., 2013). Concerns regarding wind energy projects profitability in Oaxaca, came due to private companies owned and sold to third parties the vast majority of energy created from wind farms (ibid.).

Often, the reimbursement was regarded as insufficient when compared to all the changes that communities have to go through, regarding their culture, traditions, landscape, economic activities and religious (Pasqualetti, 2011a; Peace Brigades International, 2014). People leasing their land will receive around $125 dollars per hectare per year for a single turbine, which is very low compared to the U.S. where wind turbines yield returns of around $3,000 to 5,000 dollars per year (Pasqualetti, 2011b).

Misinformation about wind energy and climate change mitigation strategies by the companies, combined with a lack of education and participation from municipalities has been reflected by a strong opposition to RE (Pasqualetti, 2011b; Dávalos et al., 2013). In addition there is a lack of unique plan and agenda that can be followed by the federal, estate and municipality governments to combat climate change ("Entrevista Sinai Casillas Cano," 2014). Climate change mitigation projects have been linked to a neoliberal logic and was met with anti-capitalist sentiments by a few communities in the region (Dávalos et al., 2013). For example, members of those communities believe that the concept of emissions trading was formalized and introduced to create a new commodity in the international financial market. Companies are blamed for using carbon credits in order to sell those credits on the international market and get huge profits, while the local population is not benefiting from these revenues (Peace Brigades International, 2014).

The absence of the Mexican municipalities within their administration irregularities of the tender's payments to distribute it between the communities on social work such as infrastructure, primary schools and hospitals, which in a little few case has been seen but just by a wind energy developer and not the government (Personal communication, Edith Barrera Pineda, 18-09-2014). No adequate environmental impact assessments (EIA) have been carried out such as noise and vibration during construction phase and also regarding the impact to migratory birds and bats during operation (Baker, 2011). In addition in a few projects this EIA were not consulted to the communities in a democratic manner (Oceransky, 2008b). In the Isthmus of Tehuantepec, which all most take all wind projects in Mexico and with a large number of wind towers installed in the area are creating visual claims by the public (Pasqualetti, 2011a). This landscape change has not been considered by policy makers to expand projects in other areas of Mexico (ibid.).

Concerns were raised regarding the increasing violence related to wind farms between community leaders against the project's development and the once in favor (Peace Brigades International, 2014).

Indigenous populations in the Isthmus of Tehuantepec

Tehuantepec with 19 municipalities and Juchitan with 22 municipalities are the two districts that occupy the Isthmus of Tehuantepec. Tehuantepec district has a territory of 6,675.11 km^2 and Juchitan district has 13,300.46 km^2(Dávalos et al., 2013). The Isthmus of Tehuantepec recorded in 2010 total inhabitants of 1,200,000 people, which the majority belongs to Zapotec[10] ethnic group and the rest belong to other ethnic groups such as Huaves/Ikojts[11] (Dávalos et al., 2013; Personal communication, Sinaí Casillas Cano, 11-09-2014). In Mexico adults indigenous people do not study more than three years in average, which compared to non-indigenous people have six years of elementary school (ILO, 2009). Besides that, teachers in indigenous schools have less experience in education (ibid.). Bilingual education is poorly implemented which leaves them on an inequality position (ibid.). Efforts to support the indigenous people in the national agenda with in a particular educational system have not been adopted as the Nordic countries with the indigenous Sami culture, see section 4.3 (ibid.).

[10] Zapotec or Binniza is an ethnic group that have inhabited in the Isthmus for many centuries (Cymene Howe, 2014).

[11] Huaves or Ikojts is an ethnic group that have inhabited in the Isthmus for many centuries (Cymene Howe, 2014).

Since 1992 it has been observed that the relation between the Government and indigenous people have been particularly complicated with conflicts, manifests, and violent events (ibid.).

Bettina Cruz Velázquez, Mexican activist and human rights defenders and founder of the The Assembly for the Defense of Land and Territory (APIITDTT) (Tovar, Hernández, & Sandell, 2013) have explain few times in the media that indigenous communities in Oaxaca have been affected *"on their autonomy and capacity to decide collectively about their future"* from wind energy projects (Oceransky, 2008b). They are not against wind energy sector but more in the way companies have been taking the lands without consultation to the communities on the impact to their life, culture and territory (ibid.).

Other authors have stated that the communities in the Isthmus of Tehuantepec have experience that with wind farm projects in the past have lost ownership of their lands (Hoffmann, 2012). Some of the members of the ejidos (type of land ownership) do not have ownership over their land just the right to use it and belongs to the Mexican state (Oceransky, 2008a). This causes a lack of compensation to the people that relays or live nearly the wind projects because they are not able to have the same lifestyle as before of the project (ibid.). In other wind energy projects in the region, construction roads or lines of generators have affected people (ibid.). Bettina Cruz Velázquez, have explained that some of this lands have been declared communal lands by the government years ago, besides that the project developers reported that all farmlands were privately owned when it was not like that (Tovar et al., 2013).

Transaction costs and externalities

Transaction costs (TC), which was defined by Ronald Coase in 1960 as costs that are not directly involved in the production of goods or service such as electricity nevertheless are the costs that arise from transactions or contracting activities essential for the trade of goods and services such as the land use (Mundaca, Mansoz, Neij, & Timilsina, 2013). TCs as part or elements of the market failures can be bad for the diffusion and commercialization of low carbon technologies (LCT) and for instance the potential for carbon emission reductions (IPCC, 2012; Mundaca et al., 2013; Virginia Sonntag-O´Brien & Eric Usher, 2004). More information will come later in next chapters and together with the PESTLE framework used. Critical barriers for wind energy such as; financially unprofitability for investors, lack of information such as; timely, appropriate and truthful information that markets needs in order to don't overrate underlying project risk and transaction costs that can increase as compared to conventional fossil fuel technologies (IPCC, 2012; Mundaca et al., 2013; Virginia Sonntag-O´Brien & Eric Usher, 2004). As well this law for RE instructs the SENER and the Secretary of Economy to promote wind energy manufacture in Mexico and wind power equipment shifted to Mexico (Borja, 2013). More that 200 companies in Mexico have the capacity to produce parts for wind turbines and wind power plants but projects are not still in place (ibid.). Design standards for wind turbine size and design or generator capacity, or also the importance to reduce material usage are necessary for technical constrains) (Lema & Lema, 2013). For example to avoid overloading grid the control systems, which is part of the operation and maintenance procedures it will depend on the level of obligations that the supply side (global investing firms) have from the demand side (governments) (Lema & Lema, 2013).

This RE investments are more exposed to risk in long term because the lack of information, which is an issue of financial and institutional structure. In addition RE are also expose to financing issues (higher costs and lower operating cost than fossil fuel technologies) and transactions costs as an issue of project scale and which can be a barrier to RE financing (IPCC, 2012).

Property rights are critical issues for this case study or in general wind energy projects development because negotiating the land ownership use can differ between projects. Property rights of the land use can bring different transactions costs to the deployment of wind turbines in the communities. Convincing a single person who owns a peace of land could be different than convincing a group of people who owns the land. Transactions costs may arise at various stages in a project including planning, implementation, monitoring, verification, certification and in certain cases trading (Mundaca et al., 2013).

A FRAMEWORK for analysis of wind energy in Mexico

The categories of political, economic, social, technological, legal and environmental are general parameters that are relevant to the Mexican wind energy projects and as part of the ground for potential failures.

PESTLE CATEGORY	SUB - CATEGORY	POTENTIAL RELEVANCE TO WIND IN MEXICO
Political	Stability of the country or region	• Remote communities where wind energy deployment has a difficult relation within the municipalities and lack of communication between national, federal and local government (see page 32)(ILO, 2009)
	Ambitious targets for RE increase	• Quick expansion of wind energy deployment in short term not allowing the government to have a national, federal and municipal plan and agenda to avoid social impacts within their strategies (see page 32) ("Entrevista Sinai Casillas Cano," 2014)
	Institutional change for wind energy deployment	• Lack of RE policies requiring knowledge transfer and technology from foreign companies investing in Mexico in wind energy (see page 31) (Pasqualetti, 2011b; Dávalos et al., 2013)(Commission for Environmental Cooperation, 2010; Lema & Lema, 2013; Personal communication, Edith Barrera Pineda, 18-09-2014) • Lack of public investment on new Institutes or Universities to provide this new professions for wind energy market (see page 31) (Pasqualetti, 2011b; Dávalos et al.,

		2013) (Commission for Environmental Cooperation, 2010; Lema & Lema, 2013; Personal communication, Edith Barrera Pineda, 18-09-2014)
Economic	Externalities not internalized	• The needs to associate and internalize externalities of social and environmental impacts of any type of electricity generation technologies such as coal and natural gas which are still promoted more than RE. Largest barrier to wind energy deployment (see page 33) (León et al., 2014; US Energy Information Administration, 2014)
	Other competing alternatives	• Prioritize technologies and investments on coal and natural gas rather than wind energy or RE (see page 29) (León et al., 2014; US Energy Information Administration, 2014)
	Insufficient RE instruments such as subsides	• Still a gap between the cost of fossil fuel electricity generation and wind power generation (León et al., 2014). • Non feed-in-tariff system (see page 28)(Lokey, 2009; Oceransky, 2008b).
	Long term fossil fuel commitments in the new Energy Reform,	• Encouraging investments in the exploration for crude oil and natural gas (see page 29) (The Oxford Institute for Energy Studies, 2014)
	Unemployment level	• The needs of high skills education for the maintenance phase limit the number of people that can work during that phase of the project from rural regions (see page 31) (Dávalos et al., 2013)
	Cost of wind energy	• High cost of electricity in Mexico - domestic prices for electricity are heavily subsides by the government or by the CFE making

		RE less competitive on cost to coal or natural gas (see, Energy Reform 2013 in Mexico) (The Oxford Institute for Energy Studies, 2014)
	Economic policies for wind energy	• Government budget limitations for conventional coal and gas and not for RE (see, Energy Reform 2013 in Mexico) (The Oxford Institute for Energy Studies, 2014)
	Public financing support to national wind energy technologies	• Lack of financing Institutions, researchers, manufactures and mapping wind energy in Mexico (see page 31)(Commission for Environmental Cooperation, 2010; Lema & Lema, 2013; Personal communication, Edith Barrera Pineda, 18-09-2014)
Social	Lifestyles	• Affect peace for individuals (see page 32) (Oceransky, 2008b) • Demands or promotes change of life style and work (see page 31) (International Labour Organization (ILO), 2014) • Communities without basic services but still aiming development in different way as the society or with more autonomy (see page 31) (Oceransky, 2008b)
	Demographics	• Foreign workers come in to the territory with the wind projects and communities feel they are losing their autonomy (see page 31) (Oceransky, 2008b)
	Education and income levels	• Market information asymmetry such as knowledge of external cost of fossil fuels and nuclear power (see page 29)(Pasqualetti, 2011b; Dávalos et al., 2013) • Information regarding what is a wind energy park, climate change, clean energy, impacts and benefits of wind energy, impacts on their main activities and life style (see page 29)(Pasqualetti, 2011b; Dávalos et al., 2013)
	Religion, costumes and	• Lack of knowledge of Spanish can

	language	difficult the negotiation and planning process of a project with the community (see page 32) (ILO, 2009)
	Social welfare policies	• Few companies but not all of them investment on social work such as hospitals, primary school, infrastructure (light, water and waste management and pavement on the street) (see page 31) (Personal communication, Edith Barrera Pineda, 18-09-2014)
	Work and leisure	• Local employment (see page 31)(Dávalos et al., 2013; Oceransky, 2008b; Peace Brigades International, 2014) • Short term contracts and lack of insurance at work (ibid.) • High skills and education for the trend market in this case with energy (ibid.) • Cost-benefit regarding change of activity becoming constructor of the wind park and leaving the agriculture work (ibid.)
	Land ownership	• Special conditions for indigenous (see page 32) (Hoffmann, 2012; ILO, 2009; Oceransky, 2008b; Tovar et al., 2013) • Depending the land ownership it will depend the profitability per family; private and communal lands (ibid.)
	Inequality	• Communities without basic services such as electricity (extreme poorness situation) (see page 31) (Oceransky, 2008b) • Number of hectares per family or per member of the communities payment per power generation and hectares or plot of land (see page 28) (Dávalos et al., 2013; Personal

		communication, Edith Barrera Pineda, 18-09-2014)
	Public or social acceptance of wind power farms to ease implementation	• Inequality, use of land and modification of the social, cultural, habitat and religion of the regions and communities (see page 31) (Oceransky, 2008b) • Level of activism has increase since the last year from the way of how this projects were grabbing the land of indigenous communities (see page 31)(Hoffmann, 2012; Cymene Howe, 2014; Oceransky, 2008a; Pasqualetti, 2011a; Swart, 2012)
Technological	Grid integrations	• Power generations not very efficient with transmission and distribution line old and outdated (see page 26 and 29) (Dávalos et al., 2013; Lema & Lema, 2013; León et al., 2014) • Challenge to build new transmission and distribution lines due to national company that decide the contracts (ibid.)
	Technical constrains, innovation system of wind energy technology	• Wind turbine (size and design), generator and rotor capacity, reduce material usage, control systems (overloading grid), operation and maintenance procedures are obligations from the demand size for the supply size (see page 33) (Lema & Lema, 2013)
Legal	Connection to the grid	• Limited conditions for private contracts to access to the grid or build new lines (see page 26 and 29) (Dávalos et al., 2013; Lema & Lema, 2013; León et al., 2014)

	Foreign participation	• Complexity to lease land to wind power projects due to land ownership or regimen and the pressure from the government to FDI to invest on RE which has to be in this remote areas (see page 29) (Baker, 2011; Dávalos et al., 2013; Oceransky, 2008b; Tovar et al., 2013)
Environmental	Wildlife impacts	• Birds and bats which in context of other fossil fuels are not a big impact (see page 31) (Baker, 2011; Oceransky, 2008a; Pasqualetti, 2011a) • Migratory and endemic birds which can be mitigated by installation planning (ibid.)
	Opponents to wind energy using environmental concerns	• Vibration and noise during construction phase of the wind turbines installed onshore (see page 31) (Baker, 2011; Oceransky, 2008a; Pasqualetti, 2011a) • Noise and visual aspects during operation phase of the wind turbines (ibid.)

4 Case study of Mareña Renovables wind projects in Oaxaca

In 2004, Mareña Renovables reserved communal land in the region of Isthmus of Tehuantepec in Oaxaca to develop wind energy projects (Cymene Howe, 2014; Octavio Vélez A & Rojas, 2013). Before describing the Mareña Renovables wind projects and their socio-economic benefits, a short description of the regions weather conditions and inhabitants will be given.

4.1 Isthmus of Tehuantepec, Oaxaca Mexico

Inhabitants in Isthmus of Tehuantepec

In Oaxaca the number of inhabitants in 2014 were 3.8 million whereof 56% consider themselves to be indigenous (Peace Brigades International, 2014). But not just indigenous inhabitants exist in Oaxaca also other communities who their main activities are farmers, artesanians, fishers and so on (Peace Brigades International, 2014). Many groups and communities have been formed local assemblies where a community leader defend the rights of the local population and their concerns of their lands (Peace Brigades International, 2014).

In the state of Oaxaca there is a region called Isthmus of Tehuantepec where most of the population is indigenous (Howe, 2014; Personal communication, Sinaí Casillas Cano, 11-09-2014). The social situation is very poor and people live in villages where they use the land for commercial agriculture and the sea and lagoon for fishing activities (ibid.). The Pacific coast of the Isthmus of Tehuantepec is inhabited by five indigenous groups. The largest groups are Binniza and Ikoojt. Binniza is part of the culture of Zapotecs and Ikoojt belongs to the culture of the Huave. (Oceransky, 2008a; Peace Brigades International, 2014). These inhabitants groups have their territorial rights, which are recognized and more regularly collectively organized in *ejidos* which means that the land is communal property whereby each member of the community has an equal level of power to decide how the land is used. There is no individual ownership (*"Mareña Renovables Wind,"* 2011; Oceransky, 2008a; Pasqualetti, 2011a; Peace Brigades International, 2014).

Legal instruments that protect the rights of the ejidatarios or the minorities' groups' leaders are The Mexican Constitution and Agrarian Legislation. According to the UN and International Working Group on Indigenous Affairs there is a general agreement on the concept of the ancestral land and territory, which should be central and where it doesn't, exists working definition of indigenous people (ibid.). In addition in the Convention 169 of the International Labour Organisation protect the indigenous people giving them the right to free, prior, and informed consent regarding any issue with their land (International Labour Organization (ILO), 2014; Peace Brigades International, 2014).

Wind in the Isthmus of Tehuantepec

The wind speed conditions of the Isthmus of Tehuantepec where Mareña Renovables planned to deploy the wind park was unique in Mexico, that is the reason why they call it the Gold Wind (Dávalos et al., 2013; Personal communication, Edith Barrera Pineda, 18-09-2014). "*After crossing the open waters of the Golf of Mexico, the wind come onshore and concentrates their power as they funnel through the narrowing topography on their move southward*" (Pasqualetti, 2011a).

Places like La Venta, which is located in the Isthmus of Tehuantepec has been also good locations for deployment of wind parks across a broad area of farmlands (Pasqualetti, 2011a).

The potential of wind power density in Oaxaca is class 4, which is 400-500 watts per square meter (w/m^2) and in other large areas sometimes even exceeds 700 w/m^2. The latter, gives a wind power class greater that 7 being among the best wind energy sites anywhere and therefore the region is very interesting for the Mexican government and wind project developers (Elliott et al., 2003; Pasqualetti, 2011c).

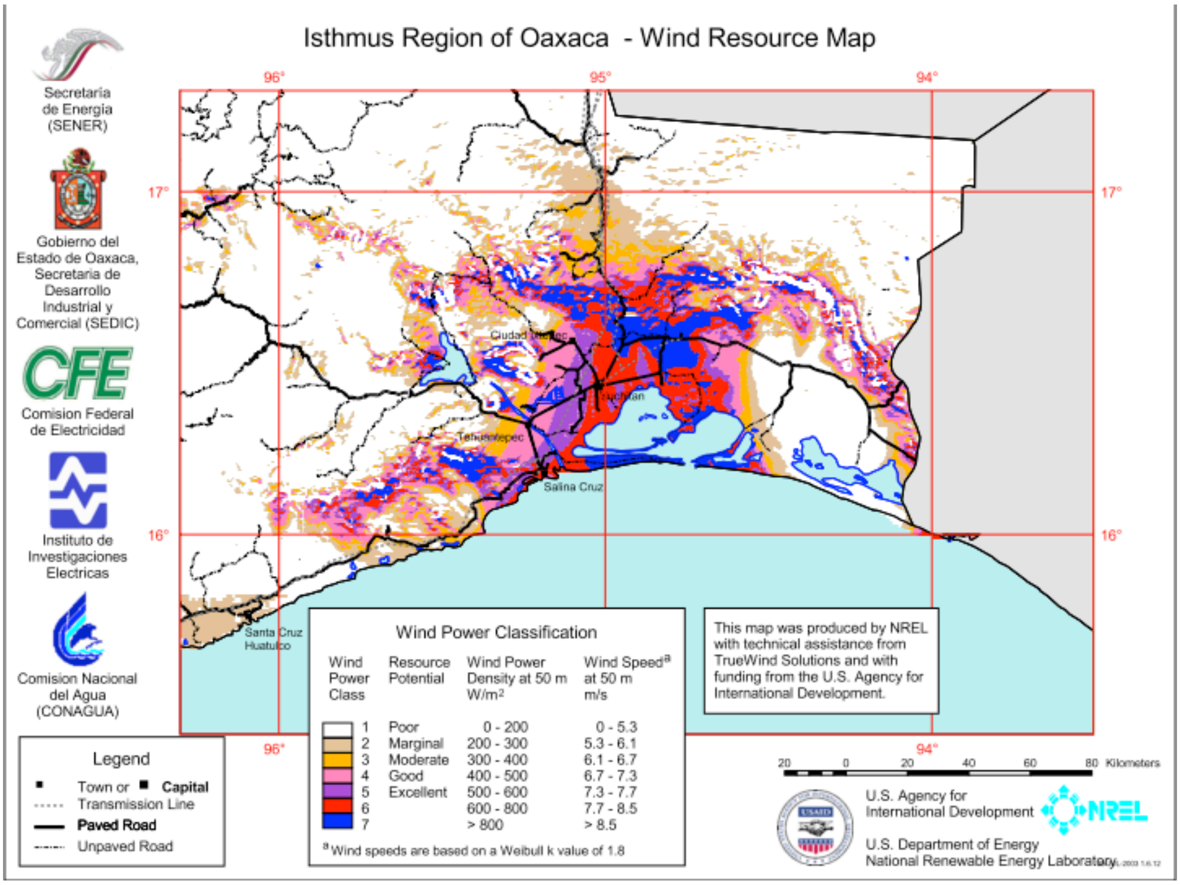

Figure 6the purple, red and blue parts show the most appropriate areas for the wind power development in the Isthmus Source: (Elliott et al., 2003)

The best wind power class are concentrated in the southeastern region of the state, primarily in the southern part of the Isthmus of Tehuantepec including la Mata and la Venta as is shown in the figure 7 (Elliott et al., 2003). The strong winds that come from the north in the Isthmus region are particularly during wind seasons from November through February (Elliott et al., 2003).

Estimations from 2003 have determined lands with good to excellent wind resource and claim that such land represents slightly more than 7% (or about 6637 km^2) of Oaxaca. . Adding a conservative assumption of 5 MW per km^2, this windy land could support more than 33,000 MW of potential installed capacity. And if only areas with class 7 wind resource potential are considered the estimation of total windy land area is about 1200 km^2 giving a potential of 6000 MW of installed capacity (Elliott et al., 2003). The table below shows the total area of land with 3-7 wind classes from Oaxaca.

Table 4-1 Good to excellent wind resource at 50m in Oaxaca´s land area-totaling 91,500km2 Source: (Elliott et al., 2003)

Wind Resource Utility Scale	Wind Power at 50m W/m^2	Wind Class	Total Area Km^2
Moderate	300 – 400	3	2,234
Good	400 – 500	4	2,263
Excellent	500 – 600	5	1,370
Excellent	600 – 700	6	1,756
Excellent	>800	7	1.248
Total			**8,870**

With 97% of the pacific coast of Oaxaca, Mexico (Alemán-Nava et al., 2014) the Isthmus of Tehuantepec has today the majority of wind parks. Total wind farms in operation are 15 with a capacity of 1,331.65 MW (Cardona, 2013; Dávalos et al., 2013). Ten of them are self-supply, two financed by the public authorities and three independent power producer (IPP) (ibid.).

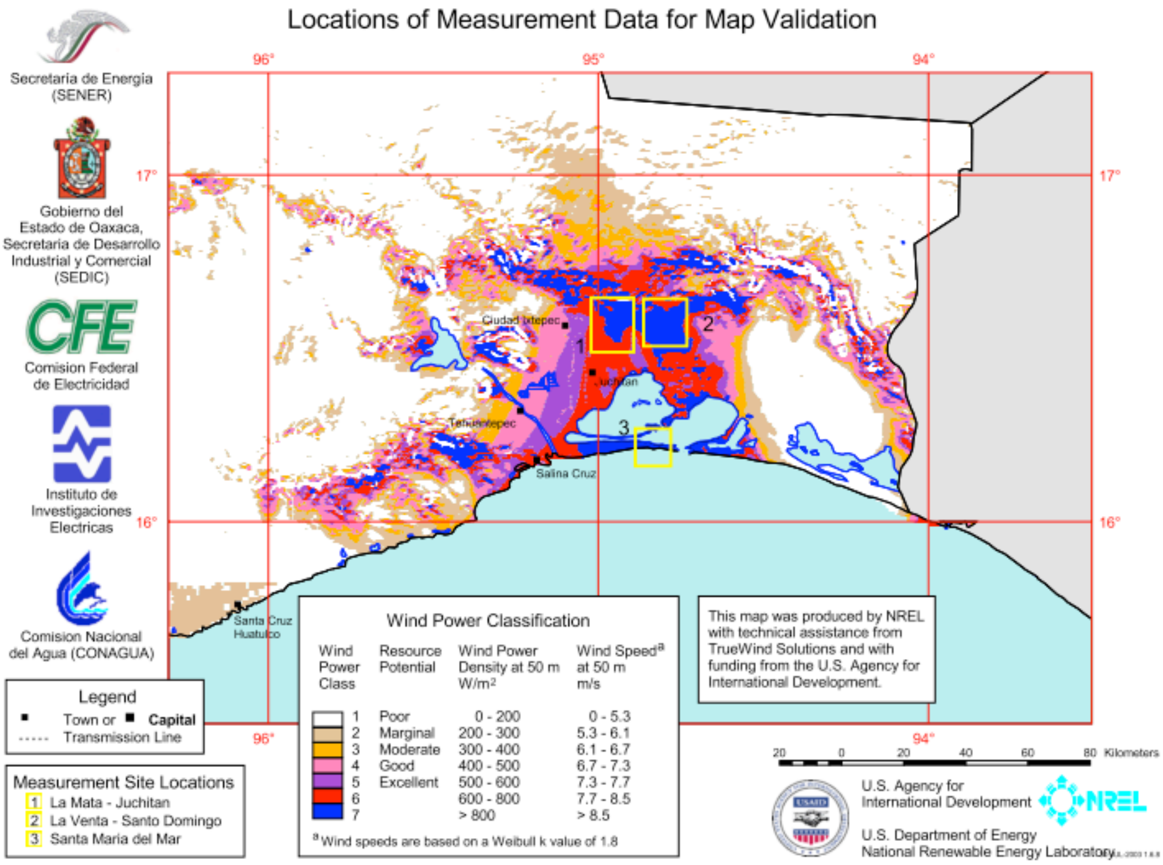

Figure 7 Shows the site locations on the map; #1 La Mata, #2 La Venta and #3 Santa Maria del Mar Source: (Elliott et al., 2003)

4.2 The Mareña Renovables projects

In 2004, Preneal Company reserved communal land in the Isthmus of Tehuantepec to develop a wind energy project (Paccieri, 2012). The Preneal Company was the first company to try to open a wind project with the Agrarian community type of communal land holding (Personal communication, Edith Barrera Pineda, 18-09-2014 (C. Howe, Boyer, & Barrera, n.d.). The Preneal Company sold the contract rights of the project to Mareña Renovables in 2011 (Octavio Vélez A & Rojas, 2013). The development of 396 MW wind energy project in Oaxaca a purchasing power agreement was financed by the Inter-American Development Bank and was eligible for CDM credits (Kiene, 2013; OECD/IEA, 2012; Dávalos et al., 2013; Interamerican Association fo Environmental Defense (AIDA), 2012). This consortium is comprised by the Japan's Mitsubishi, Dutch pension fund PGGM and Australian investment group Macquarie paid 89 million USD for the rights of the project (Octavio Vélez A & Rojas, 2013; Personal communication, Sinaí Casillas Cano, 11-09-2014;(FEMSA, 2013; C. Howe et al., n.d.)

According to the local newspaper La Jornada, Preneal Company signed land contracts with the community of Santa María del Mar and San Dionisio del Mar in 2006 (Octavio Vélez A & Rojas, 2013). The contract with Santa María del Mar was a land contract of 30 years reserving 2000 hectares for installing 30 wind turbines with capacity of 90 MW (Octavio Vélez A & Rojas, 2013). The contract with Santa María del Mar second contract was similar but referred to 102 wind turbines planning to be located in the Barra of Santa Teresa, which is a silver of sand bar between the Superior and Inferior lagoons (C. Howe et al., n.d.; Octavio Vélez A & Rojas, 2013). In addition to the contracts the communities were given an initial payment of 276 000 MXN or around 25 000 USD, according to the journal (it is not specify if was for both projects). That payment includes one year of rent for the reservation of the land, plus taxes and 36 000 MXN or around 3200 USD for educational projects (Octavio Vélez A & Rojas, 2013).

This self-supply project with 132 turbines has the potential to be the largest wind park in Latin America with the capacity to generate 396 MW annual (Cymene Howe, 2014; *"Mareña Renovables Wind,"* 2011; Vestas Mediterranean, 2012). The 396 MW has the potential to replace around 879,000 tons of CO_2 (C. Howe et al., n.d.). The project Mareña it was planned to be located in a windy, sunny dry, poor and seismicity active area in Oaxaca in the southern part of Mexico, with the sea on one side of the Pacific Ocean and the low hills on the other side and the lagoons; Laguna Superior, Laguna Inferior and Laguna del Mar Muerto (Barber & Klicka, 2010; Barrier, Velasquillo, Chavez, & Gaulon, 2000). Many residents in that region earn their livelihood fishing and harvesting shrimp (Cymene Howe, 2014). The Laguna Superior is located in the North of the Golf of the Isthmus of Tehuantepec and is connected with the Laguna Inferior and the lagoon of the Mar Muerto that is located between Oaxaca and Chiapas, in addition Mangroves are located in the Barra (Luis & Muñoz, 2012).

Figure 8 Map showing the three lagoons in the Isthmus of Tehuantepec (Superior, Inferior and Mar Muerto) Source: Wikimapia Satellite, Google Map, 2014

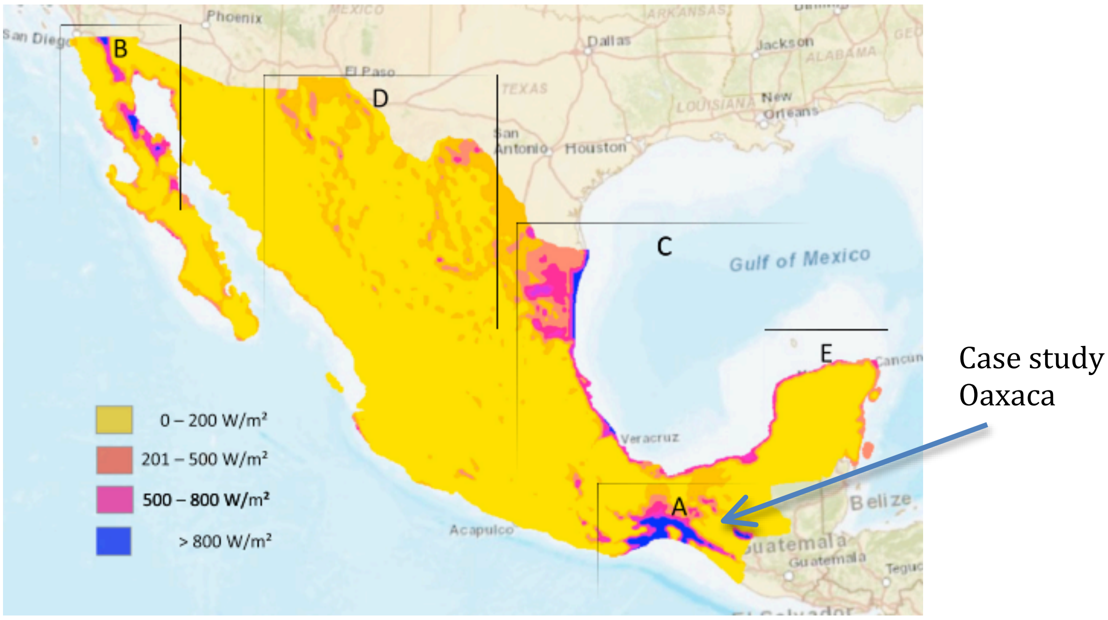

Figure 9 Mexican Map showing the 4 main areas suitable for wind energy projects and in particularly Oaxaca for the Project Mareña Source: (Alemán-Nava et al., 2014)

In order to implement the projects Mareña Renovables signed a contract with Vestas Mediterranean in 2012 (*"Mareña Renovables Wind,"* 2011). The contract included that Vestas would install and operate the 132 wind turbines with a height of 80m and blades with a diameter of 90m (ibid.). The power generated by these plants would be bought for 20 years by Cuauhtémoc Moctezuma, an operating company of Heineken N.V and subsidiaries of Fomento Económico Mexicano S.A.B de C.V. (FEMSA), which is the largest Coca-Cola bottler in the region (Cymene Howe, 2014; Vestas Mediterranean, 2012).

In the case of Santa Maria del Mar where the 132 turbines will be installed the community will receive around 1000 pesos or 77 USD a year for their consent to the construction. In addition the company has agreed to pay a fee of 1 866 623 pesos or 140 000 USD to the locals once the project starts to generate electricity. Each of these sums can be used on social works such as schools, health clinics, and road paving (Cymene Howe, 2014).

Opposition

The Mareña projects have faced a number of challenges related to a widespread opposition among indigenous people that were supported by activists around this area and neighbors that have had problems with wind energy projects before. In 2007, the Isthmus of Tehuantepec Peoples´ Assembly for the of Land Territory (APIITDTT) was formed in order to organize the resistance (Crippa, 2012; Cymene Howe, 2014; Peace Brigades International, 2014). Because of issues of corruption of the Municipality representatives, the Isthmus of Tehuantepec Peoples´ Assembly does not have a good relationship with authorities and private investors (Personal communication, Edith Barrera Pineda, 18-09-2014; Kiene, 2013).

The project of 132 wind turbines create resistance by, among others, the Ikjoots community from Pueblo Viejo who argued that that wind farm will impact in their fishing activities which they claim is their main economically activity. Since then it has been created resistance and mobilizations by the Popular Assembles in places such as Martínez Álvarez to Álvaro Obregón against the project of 396 MW in Santa Maria del Mar and San Dionisio del Mar (Cymene Howe, 2014; Octavio Vélez A & Rojas, 2013). By the end of 2012 the people together the APIITDTT group stopped the project (Cymene Howe, 2014).

The impacts from the construction of the wind turbines and construction of roads were not informed to the communities (Crippa, 2012). The winds turbines were estimated that will cause an impact in to the biodiversity of the lagoons, which for the Mexican government are a prioritize conservation areas (Crippa, 2012). In addition impacts identified on the flora and fauna during the construction of the transmission lines over the soil or over the ground (ibid.).

Another impacts such as; soil erosion, noise, dust and limiting access to the areas (Crippa, 2012). According to the IDB bank said that overall the impact such as soil erosion, noise, dust generation, traffic disruption "*are likely to be of limited significance and can be mitigated through routines standards procedures"* (*"Mareña Renovables Wind,"* 2011).

The impact in to the migratory birds and bats will be affected from the wind turbines (Crippa, 2012). According to the IDB bank the environmental impact during the construction phase was planned to be temporary and in short term and the significance of potential impacts for the migratory birds but they will be further assessed during the due diligence and a precautionary plan (*"Mareña Renovables Wind,"* 2011). As it was mentioned before the wind towers had a height of 80 m and the blades have a diameter of 90m (*"Mareña Renovables Wind,"* 2011). "*The risk of collision will be present for any birds that flies 35m and 125m of altitude"* and exist reports with specific recommendations such as; bird monitoring plan, preventative measures during migratory seasons (ibid.). In general habitant disturbance is expected in short term (ibid.).

There is little tree cover on land areas and due to the height of the wind turbines there is a little mitigation measures possible to reduce the visual impact of the wind farm – however according to the EIA´s this aspect does not represent an issue for population living in the vicinity area (*"Mareña Renovables Wind,"* 2011).

The community's autonomy and life style was not respected within this investments (Interamerican Association fo Environmental Defense (AIDA), 2012). All community members of the project developers gave non-prior and transparent consent (Crippa, 2012; Cymene Howe, 2014; Interamerican Association fo Environmental Defense (AIDA), 2012).

Irregularities in the negotiation - No translator was provided for the negotiation and neither to sign the contract (ibid.). The community concerns regarding the change of life style this project has been helping to decrease the public and social acceptance to wind farms in that region since local and state authorities are not respecting the rights of indigenous groups (Tovar et al., 2013). Economic and social inequality issue of Mexico and more important in those regions – just few people earn a large profits of leasing their lands and often these people have already a good economic position (Personal communication, Edith Barrera Pineda, 18-09-2014).

Lack of permanent jobs for this wind energy project were provided (Cymene Howe, 2014). Locals are low skilled (fishers and farmers) and do not have the administrative or technical capabilities to maintenance phase of the wind project (Personal communication, Edith Barrera Pineda, 18-09-2014). The social benefits such as hospitals or school that could been provided in the contract were not satisfactory and neither the payment for leasing the land, which were very low reducing the willingness to accept the project (Dávalos et al., 2013). It seems that climate change impacts and strategies for the indigenous groups is not clearly understand or perhaps not part of their life's (Dávalos et al., 2013).

The reasons for the failure of project

The project failed because of lack of communication and trustworthy negotiation between the stakeholders. The community did not get all the information regarding a wind energy farm, their impacts and benefits (Dávalos et al., 2013). The community was not included in the planning and the company not willing to listen to their demands (ibid.). The absence of the municipality during the negotiations specially with Preneal company (Personal communication, Edith Barrera Pineda, 18-09-2014).

Local communities do not have the incomes to afford the high prices of electricity and the rents for their land did not represent an incentive (Dávalos et al., 2013; Cymene Howe, 2013). During the negotiations the price of the land that the company would lease was manipulated (Cymene Howe, 2014). The public relations that Preneal Company had in Mexico it helped them to get easily specified transmission permits for wind energy projects (Personal communication, Sinaí Casillas Cano, 11-09-2014). Presumably the company did have all the arrangements with few people of the community (ibid.). All these peculiar events alarmed the community and the opposition activists (Personal communication, Edith Barrera Pineda, 18-09-2014).

4.3 Other Case Studies in the world

There are other wind projects around the world that are expected to provide other local socio-economic benefits and different approaches. This part gives the reader other different perspectives that exist around the world and as well as what currently is happening with consultation process in Mexico.

Case 1 - An example of potential "deal-making" with host communities, Yansa Case Study

Yansa Group was founded in 2008 by Sergio Oceransky a Spanish business man and strong social activist towards creating a partnership between indigenous groups in Oaxaca and using a community owned model of wind farm by involving and consulting the people (Hoffmann, 2012; Oceransky, 2014). The main idea of this project was to face the conflicts between communities and project developers by providing socio economic benefits (Hoffmann, 2012). The idea of this community wind farm on the City of Ixtepec, Oaxaca, was accepted by the assembly of the commune in beginning of 2009 (Hoffmann, 2012). The project planned to install 44 wind turbines with the capacity to generate 110 MW (ibid.). The area is mainly occupied by farmers and other economic activities such as animal grazing, hunting and wood supply (ibid.). The 44 wind turbines were planned to be built in an area of about 1000 hectares where the average wind speed is around 8.5 m/s (ibid.).

The community owned model of wind farms, which was offered to the community in Ixtepec, is a model that will provide benefits to the community such as future ownership and financial return investment (ibid.). The organization of this project is based on different processes and actors.

1. First the commune, in this case the Ixtepect Community, will grant the land use to a Community Trust.
2. This Community Trust will lend the land to the Community Interest Company (CIC), in this case Yansa Ixtepec CIC. Yansa Ixtepec CIC will be constituted by The Yansa Group and the Ixtepec Community.
3. Yansa Ixtepec CIC will finance the wind farm through bank loans and investors and they will own and manage the project.
4. The electricity produced from the wind farm will be transferred to the grid of CFE, who will pay Yansa Ixtepec CIC for the electricity.
5. Yansa Ixtepec CIC will pay 50% of the surplus to Yansa Group and 50% to the Community Trust.
6. The money that comes back to the Community Trust will be used to pay land owners and to invest in community development.
7. Yansa Group will consult and support the community in social development and monitor the use of funds.

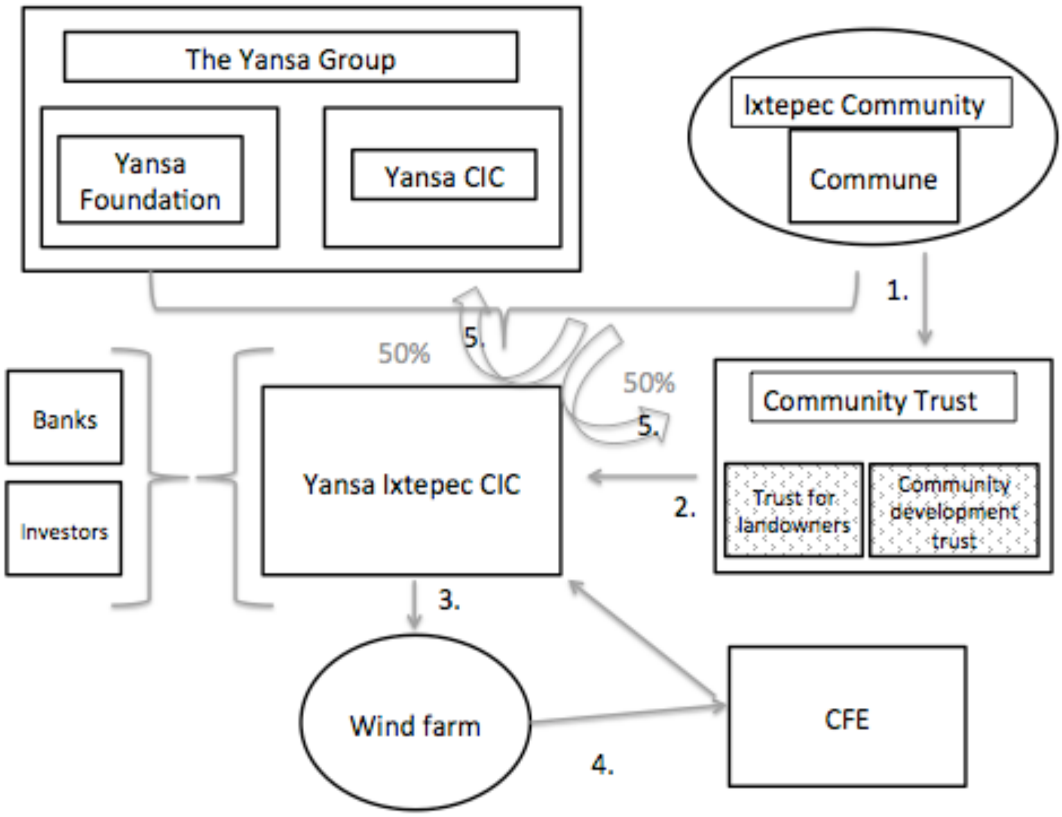

Figure 10 Simplified version of the community owned model of the Yansa wind farm in Ixtepec: Source: (Hoffmann, 2012)

This project has all the requirements to provide socio economic benefits including return investment that could be used to the needs of the community (Hoffmann, 2012). The interaction and consultation approach would have given the information about the positive and negative impacts that this wind farm could have on the people and the environment in the region (ibid.). With this model, Yansa could contribute to RE transition and at the same time create jobs, revive economic activities such as agriculture, and give education opportunities (ibid.). Involving the community through this type of consultation process it the way that this model would have given more deeply participation with their opinions and interests (ibid.). The project is still not realized, but Yansa Foundation is currently working with indigenous communities in Oaxaca to plan and build community wind farm (Ashoka, 2014; Oceransky, 2014).

Case 2 – An example of an alternative approach to wind, Brazil

The case of Brazil, where wind energy has been advanced further than in Mexico, has shown a better results on the general investment on the wind energy market, including manufacturing facilities of wind turbines and deployment of wind energy projects (OECD/IEA, 2013; Simas & Pacca, 2014). Besides, in Brazil, wind projects have been largely financed by the national government, together with the projects from the IDB and a few under review as part of CDM projects and Foreign Direct Investment (Brown, 2011). Brazil´s federal renewable energy policy, PROINFA, acts to generate more investments of manufactures of wind turbines (Brown, 2011; Dutra & Szklo, 2008). This policy requires that 60% of the wind project equipment is manufactured inside Brazil (ibid.). In 2010, Wobben, a German company, built a wind turbine manufacturing factory located in Ceará (Brown, 2011; Lema & Lema, 2013). In addition, since the last two decades the state of Ceará in the north of Brazil have experienced rapid economic growth on wind energy besides being the fifth poorest state ranked (Brown, 2011).

This approach observed a direct employment created by wind energy projects during construction, operation and maintenance and indirect jobs in the manufacturing and infrastructure in the northeastern region (ibid.).

In Ceará, there has been a financial pressure on the state to enhance road, port and electrical infrastructure for the construction of wind energy projects and also pressure from the tourism industry due to visual effects of wind farms (ibid.). Psitive and negative impacts from wind projects has been happened in the village of Cumbe in Ceará since 2005 (ibid.). Most residents' economic activities are fishing crab and lobsters and small subsistence on agriculture where many of the opponents to the wind project come from (ibid.).

Looking at CDM projects in Latin America, Brazil is the only country that does not depend on the imports of wind turbines and technology hardware for this market from countries such as Denmark, Germany, China and India (Lema & Lema, 2013). This is, as mentioned, part of the Brazilian policy to support the needs of technology transfer and local capabilities for hosting wind turbines manufactures and creating more jobs in the region (ibid.). They have done this technology transfer with foreign subsidizers such is the case of Wobben Company, but it can also be done with joint ventures or licenses arrangements (ibid.).

This policy for energy transition from fossil fuels to RE and global market conditions has as well contributed to a positive effect on the number of green jobs in Brazil (Simas & Pacca, 2011). Most of the wind energy jobs are located in manufacturing facilities (ibid.).

The Wind Farm of Camocim, also located in Ceará, planned to install a transmission line of 135 km for 50 wind turbines with a capacity of 104.4 MW (Jeovah, Meireles, Gorayeb, Raquel,

& De, 2013). In this project, socio environmental damage and conflicts with traditional local communities were recorded (ibid.). The negative results of the environmental and social aspects of the planning, installation, and operation of the project brought more opposition for wind energy in the region (Jeovah et al., 2013). The damages identified for this project were on the vegetation of the dunes for the land construction of access roads, network access and subterranean ducts for the electric cables (ibid.). In addition, locals from the community had suffered insomnia due to the noise of the turbines because some of them are located nearly 100 meters from some houses (ibid.). Not to mention the lack of access of the community to the main routes for their economic activities (ibid.). This shows that even with what appears to be a sustainable energy policy, is still ignoring licenses for preventative socio and environmental impacts, justice and equity from wind energy projects will tend to generate conflicts between societies and increase the opposition from the public (Brown, 2011; Jeovah et al., 2013; Simas & Pacca, 2011).

Case 3 Active communication with communities for wind in Sweden and Denmark

The social opposition for wind energy can be found even in high income countries and with best practices policies[12] in places such as Sweden and Denmark (Devlin, 2002; Valentine, 2014).

Visual impact, noise disturbance from the wind turbines, criticism to the hazard to birds and bats, land utilization and degradation from the wind turbines, access roads and grid connections are factors that can be solved in some way (Devlin, 2002). These environmental aspects will be taken into consideration when municipalities explore potential areas for wind energy (Johansson, 2011). But the main aspects to determine the social acceptance for wind turbines in the landscape are the level of financial gain, level of participation, perceived need for wind energy and the view of nature (Aitken, 2010; Devlin, 2002).

Sweden has increased the willingness to accept wind turbines by increasing the level of trust from the public with more information presented and with sufficient details about the plan (Devlin, 2002). In Sweden, green certificates[13] are incentives to invest in RE (Swedish Energy Agency, 2014). Denmark has refocused efforts on offshore wind power to avoid community opposition, but the Danish government has also adjusted tax incentives to encourage individual and co-op ownership, such as feed-in-tariffs (Valentine, 2014).

In 2008, an important project in the Markbygden area applied for permission to install 1101 wind turbines in the municipality of Piteå, which is located in the north of Sweden (Johansson, 2011; Svevind, 2014). The goal of this wind farm is to have an annual energy production between 8 – 12 TWh (ibid.). It is planned to be the largest wind farm project in Europe with its 450 km^2 when the project is finished in 2025 (ibid.). Svevind AB is the project designer of

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[12] Garcia's best practices principle from wind energy to overcome 1. Economic barriers (elimination of coal subsidies, compensation for the negative externalities of fossil fuels, remuneration for positive externalities of RE, compensation for higher initial costs, increased access to financial and fiscal capital and ensuring sufficient demand) 2. Non-economic barriers (general legal security, capable bureaucracy, quality on regulations in RE, competition and technology friendly policies in generation and in manufacturing) (García, 2011; Valentine, 2014).

[13] Green Certificates are according to the Swedish Energy Agency are certificates that electricity producers from RE receive and that can be traded (sell and buy) on an open market with the price being determined by supply and demand. In Norwegian and Swede one certificate will be received per each MWh of electricity produced (Swedish Energy Agency, 2014). The electricity producers from RE are free to sell their certificates in both countries, thus generating extra revenue for their electricity production (ibid.). The size of quota obligations are set by the Swedish and Norwegian Act Concerning Electricity Certificates (ibid.).

Markbygden and are together with The Wind Power Center of the Barents Region[14] looking for methods to provide benefits from wind power to the local citizens (Johansson, 2011). The Wind Power Centre of the Barents Region focuses on the general knowledge for politicians and the wind energy potential for this region and the importance for the municipality and people (ibid.). In 2008, Enercon, one of the largest manufacturers of wind turbines in Europe, became a joint owner with 25% ownership of the project with Svevind AB, together forming Markbygden Vind AB (Johansson, 2011; Svevind, 2014). This area is geographically favorable with good wind conditions and a little existing infrastructure. Improved infrastructure would provide opportunities for locals (ibid.). Representatives from the villages have been involved, especially the Sami Parliament[15], in order to set standards for how the Sami[16] will be treated in this project (Johansson, 2011). The Sami village Östra Kikkejaure will be affected on their reindeer industry, according to the study that was carried out in 2006 during the consultation meetings (ibid.). The aim of this study was to investigate the consequences of the pastures areas of the reindeer (ibid.). In addition, this study was intended to predict, evaluate and reflect the socio-economic benefits that this wind farm can provide to the villages (ibid.).

Svevind AB prioritized good contact with as many actors as possible including the property owners (Johansson, 2011). Due to the large number of property owners, the company decided to start with two pilot projects to give closer dialogue during the process and to see the functionality of the wind turbines in cold weather and the potential impact on the environment (ibid.).

Three consultation meetings with the public were performed between 2006 and 2007 (Johansson, 2011; Markbygden Vind AB & Svevind AB, 2008). About 40 questions were approached during the consultation meetings regarding topics such as noise and sun reflex of the wind turbines, difference of production costs of electricity from wind power or nuclear power, and the risk to run out of electricity due to wind fluctuations (ibid.).

The first consultation meeting was between the company Svevind and the Sami community to inform about their plans and how the wind farm was designed and answer questions from the participants (Johansson, 2011). Communication regarding the comprehensive plan and the environmental impact assessment (EIA) was generally organized through informal planning meetings, although some official consultation meetings were also organized (ibid.). A large local information campaign of new roads in the early process of the planning was also performed (ibid.). As a requirement from the municipality, the company needed to show a photo-montage of the affected landscape (Johansson, 2011; Markbygden Vind AB & Svevind AB, 2008). The consultation report, which was another study required by the municipality of Piteå to the project developers to investigate the level of agreement between Sami Village Östra Kikkejaure, revealed that Sami people were afraid that the wind turbines would interfere with their reindeer husbandry (Johansson, 2011; Markbygden Vind AB & Svevind AB, 2008). The environmental assessment delegation responded that the wind power development would prioritize their reindeer industry in the area (ibid.).

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[14] The Wind Power Centre of the Barents Region is financed by different municipalities of Piteå, the County Administrative Board of Norrbotten, the County Council, and the Swedish Energy Agency and the municipality of Piteå is the legal representative of this centre (Johansson, 2011). The aim of this centre is to make Piteå the central part of wind energy projects in Barents.

[15] Sami Parliament "is a blend of a popularly elected parliament and a State administrative agency with limited and legally regulated tasks" (Sametinget, 2014)

[16] Sami are an indigenous people in the north of Scandinavia with their own culture, language, livelihoods and a clear connection to their traditional land and water areas (Sametinget, 2014). Their main right is that they can preserve and develop their societies in parallel to the majority society (ibid.).

During the consultation meetings and informal discussions, media was also included (ibid.). The agreement between the representative from the Sami Villages and the Markbygden Vind AB was achieved after more consultation meetings with the municipalities and the Wind Power Centre (ibid.). The representatives from the Sami villages have strong commitment to the process and share the same goals as the individuals from the village (ibid.).

Magnus Johansson establishes in his research from KTH University that, in the Markbygden case, there were disagreements from the project developers toward the municipalities (Johansson, 2011). The disagreement was regarding the power of the municipalities to decide where the wind farms can be built, without necessary wind measurements because the high costs that these studies represent (ibid.).

According to Svevind AB, the project is divided into three stages, where stage one has been approved and have in its first phase led to 36 wind turbines in operation (Svevind, 2014). Stage two has been approved but the approval has been appealed. Stage three is awaiting approval (ibid.). It is important to mention that the company Svevind in their website are open about the process of approval and appeals, and shows a transparence which is part of the obligation of the public system.

Case 4 New consultation processes with indigenous communities in Mexico

The project "Eolica del Sur" is the new name for the project Mareña, following all the previous issues between the community and the project developers (Energía Eólica del Sur S.A.P.I. de C.V. & Especialistas Ambientales, 2013; "Entrevista Sinai Casillas Cano," 2014). The project Eolica del Sur involves the same consortium as the project Mareña ("Entrevista Sinai Casillas Cano," 2014). The location for the 132 wind turbines with a capacity of 396 MW, and a consultation process, are the only changes (Energía Eólica del Sur S.A.P.I. de C.V. & Especialistas Ambientales, 2013; "Entrevista Sinai Casillas Cano," 2014; Mexican Ministry of Energy (SENER), 2014a). The two new areas of Juchitan de Zaragoza and El Espinal in the Isthmus of Tehuantepec are relatively close with around 40 km away from the last location planned (ibid.). The people's willingness to accept the wind project in this area is higher, possibly a result of almost 90% of the people in El Espinal having a university profession degree ("Entrevista Sinai Casillas Cano," 2014).

The company Eolica del Sur and the Ministry of Energy established an interest to ensure more participation from the communities in these areas with the consultation processes that have been performed (Energía Eólica del Sur S.A.P.I. de C.V. & Especialistas Ambientales, 2013; "Entrevista Sinai Casillas Cano," 2014; Mexican Ministry of Energy (SENER), 2014d). In the meetings it was informed the potential impacts and benefits for the indigenous community in Juchitán Zaragoza, which belongs to the Zapoteca group (Mexican Ministry of Energy (SENER), 2014b). The first stage of the consultation meeting have been performed on the 3th to the 6th of November 2014 (Energía Eólica del Sur S.A.P.I. de C.V. & Especialistas Ambientales, 2013; Mexican Ministry of Energy (SENER), 2014b). The protocols and reports of those meetings were transcript in Spanish and Zapoteca language by the Ministry of Energy. According to the consultation protocol in the previous meetings six groups of participants assisted such as (Mexican Ministry of Energy (SENER), 2014b):

A. Authorities and representatives from the municipalities, as well the National Commission for the Development of Indigenous People (CDI)[17] and the municipal

[17] The National Commission for the Development of Indigenous People (CDI) was created in the 21st of May 2013 as an institution that requires obligatory consultation process on indigenous affair for the Federal Public Administration (CDI, 2014b). In addition it evaluates the government programs and acts that can improve the indigenous communities life

commission for the social development of rural areas. The participants of this group are mainly authorities from the Federal Government, the Estate of Oaxaca, and the Municipality of Juchitán de Zaragoza. In addition, the Ministry of Energy (SENER), which is in charge to establish and manage the Mexican energy policy and supervise energy projects and the consultation process.

B. Land owners, other nearby habitants from the localities and habitants affected, representatives from academic and cultural institutes and other society representatives assisted.
C. Representatives and members of rural productivity institutions, farmers associations and irrigation districts located in the area of influence of the project, as well representatives of economic organizations active in the municipality and representative of cooperatives and associations assisted.
D. Representative of community committees, representative of civil society organizations, and representative of social organizations relating to the wind energy project assisted.
E. Members of basic register of communards and landowners who are part of the municipality of Juchitán de Zaragoza assisted.
F. Indigenous women where important in the participation on this meetings.

November 2014 was the first time consultation was adopted according to the fundamental principles which constitute the cornerstone of the Convention No. 169[18] of the International Labour Organization (CDI, 2014a; Mexican Ministry of Energy (SENER), 2014b; REVE, 2014). The consultation process was an important learning process from the project Mareña, and it turned out to be a better way to interact with indigenous communities ("Entrevista Sinai Casillas Cano," 2014). During the approval of secondary laws of the Energy Reform in 2014, it was introduced that contract bids have to be public and transparent and available for consultations (ibid.). The consultation process was divided in to five phases, which are (Mexican Ministry of Energy (SENER), 2014d):

1. **Prior agreements** – This phase implies that a prior session with protocols, elements of institutional framework and practicalities were put in consideration for the consultation meetings. In this phase have been defined the model and time for the next phases.
2. **Informative** – This phase implies enough period of time for the information to be provided to the indigenous people regarding the project. This phase requires following the aspects of the guidelines from the Convention No. 169. The informative phase can consist of one or more meetings with the representatives of the community.
3. **Deliberation** – This phase implies a process where a dialogue inside the representatives and authorities of the indigenous community potentially affected will take in place regarding the information obtained from the informative phase. The representative and authorities from the communities are able to request more information if necessary to be able to have a deep knowledge about the project and potential impacts. In order to ensure a clear share of the information of the project to the people inside the community.
4. **Consulted** – It is the period needed for meetings to achieve an agreement and it can be developed through workshops and forums or other models. However, it is established that

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(ibid.). The CDI promotes the respect of indigenous cultures and language of the country with intercultural dialogue and contributing to eliminate discrimination (ibid.).

[18] The Convention No. 169 is a legally binding international open to ratification, where the rights of indigenous and tribal people plays the most important role (International Labour Organization (ILO), 2014). Mexico has ratified in 1990 together with another 19 countries (ibid.). The fundamental principle of this convention is non-discrimination. This convention calls to adopt especial measures to safeguard the person, institution, labour, culture and environment of these people (ibid.). This convention requires that indigenous groups are consulted on issues that affect them with guidelines of how consultations should be conducted, which should be with appropriate procedures, in good faith and though representatives of institutions of these people (ibid.). This consultation is the cornerstone of this convention because established that effective consultations are those that have the opportunity to influence in the decision taken (ibid.).

an excellent mechanism is through assemblies with all members of the community. For Eolica del Sur, the assembly-consulted phase was carried out in all the places where the informative phase was carried.

5. **Implementation and monitoring** – Is the period for implementing the agreements. It is required that all the agreements follow the normative requirements. An Implementation and Monitoring Committee will be created and was determined in the consulted-phase. The aim of this committee is to guarantee a suitable procedure and participation. Local actors will integrate this Committee.

The protocol and process of consultation arranged by SENER for the Project Eolica del Sur follow the three elements of the principles from the Convention No. 169, which are (ILO, 2009; Mexican Ministry of Energy (SENER), 2014c):

Prior: It implies prior consent with sufficiently time in advance of any authorization of activities and respect the time required for indigenous consultation.

Informed: It implies that all the information required has to be gathered and provided. The information has to cover aspects such as the nature, size, pace, reversibility and scope of the project; reason or purpose and period of the project; preliminary environmental, economical, and social assessment, with potential risks and fair and equitable sharing benefits that respects the precautionary principles; as well people that can be involved in the projects including indigenous people, private sector staff, research institutions, governments employees; and procedures that the project may need.

Consent: This means that all consultation and participation is a critical point for a consent process. Consultation requires preparation time, in good faith, with appropriate solutions for dialogue, respect and equitable participation. This process may involve withholding consent and reasonably understood of any agreement.

5 Analysis of case study Mareña Renovables

The Mareña project is an example of trying to develop a large-scale wind energy in an emerging economy context, and in a politically and socially complex region. The project is a foreign direct investment with support of Clean Development Mechanism (CDM) allowing investments in projects that introduce low carbon technologies and reduce GHG emissions in low and middle income countries (Dávalos et al., 2013; Interamerican Association fo Environmental Defense (AIDA), 2012). This illustrates a political component of the project, and the project was meant to provide social benefits. Local indigenous communities opposed and ultimately stopped the project. There seem to have been several aspects explaining these events.

The subheading of the P E S T L E present the results of the case study Mareña from the POLITICAL context, the Environmental context, the SOCIAL context, the TECHNOLOGICAL context, the LEGAL context and the ENVIRONMENTAL context together with the case study Mareña Renovables.

This section will present the analysis of the Mareña case study utilizing the PESTLE framework. This will allow the political, environmental, social, technological and economic contexts to be analyzed and conclusions to be made on their impact.

Application of Political Category to Case Study Mareña			
PES TLE	**SUB - CATEGORY**	**RELEVANCE TO WIND IN MEXICO**	**Case study Mareña Oaxaca**
	Political stability of the country or region	• Unstable relationships between local communities and municipal governments makes negotiations difficult • No agenda between the local, state and national governments (poor communication)	• The community does not have a good relationship with the municipal government nor with the current mayor (Personal communication, Edith Barrera Pineda, 18-09-2014; (Kiene, 2013)
	Ambitious targets set for renewable energy deployment	• Quick expansion of wind energy deployment in the short term does not allow the government to implement a national, federal and municipal plan and agenda to avoid negative social impacts within their strategies.	• The community is under pressure from the municipality and the company to agree to deploy the wind farm (Interamerican Association fo Environmental Defense (AIDA), 2012)
	Institutional change for wind energy deployment	• Lack of public investment in institutes and universities to offer training for new professionals to enter the	• Training for local communities was missing in the initial implementation

		wind energy market	program (Commission for Environmental Cooperation, 2010; Lema & Lema, 2013; Personal communication, Edith Barrera Pineda, 18-09-2014).

Political category

There were a number of political factors that directly impacted the development of the Mareña project. The lack of stability in the region caused by poor communication between federal, state and municipal governments, the rapid growth of wind farms in the country and the pressure to install more as well as a lack of public and private investment into training for the local community (ILO, 2009; Commission for Environmental Cooperation, 2010; Lema & Lema, 2013; Personal communication, Edith Barrera Pineda, 18-09-2014)). These were the significant aspects that increased resistance of the local community towards the Mareña project (ibid.).

The lack of community that general agenda in particular could help the three powers of the Mexican state to coordinate, target, plan, and implement standards and processes for wind energy projects in the region ("Entrevista Sinai Casillas Cano," 2014).

The ambitious targets set by the national government to achieve 35% electricity production from renewable energy sources by 2024 has meant renewable energy projects have been promoted and pushed aggressively in the Isthmus of Tehuantepec (Dávalos et al., 2013). This has meant communities have been put under pressure to allow projects to be undertaken on their land (Interamerican Association fo Environmental Defense (AIDA), 2012). This has caused friction between local communities, municipality authorities and government originations leading to political instability in the Isthmus of Tehuantepec region (ibid.).

Although planning for the project began in 2004, jobs and training were only offered at the beginning of 2012 when Mareña Renovables reported that they will contribute to the creation of high-quality jobs and competencies (Vestas Mediterranean, 2012).

The lack of institutional support for wind energy deployment has affected the image of past wind energy projects in the public eyes and therefore impacted its acceptance in the Mareña case. Reflected with short periods for job creation (Commission for Environmental Cooperation, 2010; Lema & Lema, 2013; Personal communication, Edith Barrera Pineda, 18-09-2014).

Application to Economic Category to Case Study Mareña			
PESTLE	**SUB - CATEGORY**	**POTENTIAL RELEVANCE TO WIND IN MEXICO**	**Case study Mareña Oaxaca**
Environme	Externalities	• Negative externalities of conventional fossil fuel power generation have not been accounted for and	• Positive externalities of wind power were not fully accounted or communicated to the

		therefore the full cost is not incorporated into the price of generation.	communities. They might care if they know that they can help on climate change mitigation and reduce the impacts of this in their regions.
	Other competing alternatives	• Competing technologies and investments such fossil fuel energy sources and natural gas rather than wind energy	• No obvious technology competition in this region due to constantly high wind speeds making wind energy economically viable
	Level of unemployment	• A need for highly skilled engineers for implementation and maintenance	• Locals are low skilled, living mainly from fishing and farming activities and do not have the administrative or technical capabilities for maintenance of the wind project.
	Cost of wind energy	• Cost of wind power production dropping significantly.	• Project becomes more economically viable with lower costs of production
	Public financing support for national wind energy technologies	• Requires significant foreign direct investment in parallel to public funding.	• The project consisted of a majority foreign capital

Economic category

The lack of incorporation of externalities into the cost of other forms of energy was a not a factor in the obstruction of the development of the wind farm. This is an area the government has to consider and not the community.

The community did not stop the project because the price of electricity will increase or decrease. Other fossil fuel alternatives fossil fuels or renewable energy alternatives were not a reason for the community to be against the project. Their lack of access to electricity in their communities makes them more indifferent to other type of energy sources. Their main concern is to have electricity in some form.

More investments on hydrocarbons and natural gas rather than wind energy R&D and national market support is reflected by the lack of support of economic incentives for wind energy such as subsidies and feed-in-tariff system. Beside that the cost of wind power production in Mexico is still high (see, section Transaction costs and externalities) in contrast with Denmark (see, in the chapter 3.4) where has dropping significantly making, wind energy more competitive than other sources. This is not a main factor in the obstruction of the development of the wind farm. This is an area the government has to consider.

Application of Social Category to Case Study Mareña			
PES TLE	**SUB - CATEGORY**	**POTENTIAL RELEVANCE TO WIND IN MEXICO**	**Case study Mareña Oaxaca**
	Lifestyles	• Affect peace for individuals	• Company not willing to listen and understand communities concerns regarding the change of life style this project could construct (see page 45)
	Demographics	• An influx of foreign workers into the territory	• No prior consent given by all community members for a foreign company to operate in their land and the community feels it is losing autonomy in the decision of their land (see page 45)
	Education	• Asymmetric information on the external cost of fossil fuels and nuclear power given to the community. A lack of education on the negative externalities of conventional power given to communities • Information regarding the basics of the wind energy park, climate change, clean energy, impacts and benefits of wind energy, impacts on their main activities and life style is lacking	• Misinformation and miscommunication among stakeholders regarding renewable energy as strategy to combat climate change and to improve the life styles and economic situation of the community. But as has been mention (see page 45) the communities would not perhaps understand it or have not been part of their reality
	Religion, costumes and language	• Lack of knowledge of Spanish can be a barrier during the negotiation and planning process of a project with the community	• No translator was provided for the negotiation and signing of the contract (see page 45)

	Social welfare policies	• Government and companies investment more heavily in social work such as hospitals, primary school, infrastructure (lighting, water and waste management)	• The community considered that the other benefits the company was obligated to provide, including investing 8% of their investment to social work, was not enough (see page 45)
	Work and leisure	• Local employment increases • Short and long term contracts • High skills and education for offered to local community • Insurance for work offered	• Community was informed that other projects in the Isthmus of Tehuantepec do not have long term contracts or offer any insurance (see page 45) • Community is happy to live a subsistence lifestyle and do not need or want any other forms of employment or skills (see page 45)
	Land ownership	• Special conditions for indigenous communities • Depending on the land ownership it will depend the profitability per family of any wind farm • Land is either private land, ejidos (communal land that has more freedom) and communal land and this determines who receives the benefits. Communal land is a more complex situation.	• It was the first time a wind energy project was to be deployed in a communal land holding making the situation more complex with many actors involved (see page 45) (Dávalos et al., 2013) • Payment is made to communities based on power generation per hectares or plot of land where the polygon of the wind farm pass by (see page 45) (Dávalos et al., 2013)

	Inequality	• There are communities without basic services such as electricity (energy poor)	• This is a macroeconomic governmental issue however electricity from the wind farm could be able to provide energy to poor communities in the region as an stipulation of the project (see page 45)
	Public or social acceptance of wind power farms to ease implementation	• Level of activism plays a role in local acceptance	• Within this project the level of activism increased (see page 45)

Social category

Social factors appear to be the major barrier to the Mareña project. A lack of understanding was seen between the project implementers and the local community about how they wished to live their lives (Interamerican Association fo Environmental Defense (AIDA), 2012). The project Mareña would bring employment to the community however part of the community is happy living a subsistence life from fishing and agriculture (Personal communication, Edith Barrera Pineda, 18-09-2014). The project failed because of lack of communication and trustworthy negotiation between the stakeholders (Dávalos et al., 2013; Crippa, 2012; Cymene Howe, 2014; Interamerican Association fo Environmental Defense (AIDA), 2012).). The absence of the municipality during the negotiations specially with Preneal company (Personal communication, Edith Barrera Pineda, 18-09-2014).

The public and social acceptance of the wind farms was an obvious issue for the project due to their loss of autonomy of their ecological spaces and environmental resources (Cymene Howe, 2014). Activists developed a very strong support from the community following and built a strong case against the implementation of the wind farm. They were able to come together and place enough pressure on the project implementers to have the wind project. Threats and violence against the locals that were in opposition of the project (Interamerican Association fo Environmental Defense (AIDA), 2012).

The way land is divided in this community was a another complexity that was not understood or overcome in the early stages of the project (Personal communication, Edith Barrera Pineda, 18-09-2014). The local tradition of land ownership or the communal sharing of land needs be respected however this brought consequences for the project (ibid.). Payment is made to communities based on power generation per hectares or plot of land where the polygon pass by the wind farm, however the revenues needed to be shared equally (Dávalos et al., 2013). For the company is important to pay an appropriate amount for the land leased however the way these funds will be distributed in the community is different to standard lease payments (ibid.). The leader of the communal land is responsible for all the administration processes but does not have the expertise or knowledge to carry out such a transaction (Personal communication, Edith Barrera Pineda, 18-09-2014).

Both economic and social inequality has been an issue in Mexico and the local community well before the Mareña project was to be started. The inequality that exists in the community is a very complex problem that could be solved together with the government strategies and plans (Personal communication, Edith Barrera Pineda, 18-09-2014). The project that was not developed did not reach this phase so is difficult to see if it really lack of this qualitative benefits (Personal communication, Edith Barrera Pineda, 18-09-2014). Even complains about lack of translators from Spanish to their language were not carried during the negotiation and signing contract with the company (C. Howe, n.d.; Interamerican Association fo Environmental Defense (AIDA), 2012).

However the people who are earning in some occasions a lot of money with leasing their lands for these wind energy projects are often people who were already in a good economic and social position (Personal communication, Edith Barrera Pineda, 18-09-2014). Others who receive little compensation for their land have been since all their live in a very poorness situation so nothing change (ibid.).

It may be that I found an answer for this question, but also, it could be possible that the locals still don't want the windmills or that sort of development, and they want a different sort of assistant. So maybe is not going to work and it will be the need to choose somewhere else in Mexico or other part of the world. But we did have a situation, where we have a poor private system that can be make it to work, and if so, how you minimize risks? Perhaps is the best technical place (Oaxaca) for windmills, and if they really want to put them there they need to design this wind projects better and make it interesting to the locals to host so the windmills can be place there. It may be that project developers will have to convince the local population with evidence of benefits for them to agree to host wind energy development. If the developers cannot, the locals are able to stop the projects because they own the land (Russell, 2013).

Application of Technological Category to Case Study Mareña			
PESTLE	**SUB - CATEGORY**	**POTENTIAL RELEVANCE TO WIND IN MEXICO**	**Case study Mareña Oaxaca**
T	Grid integrations	• Connection issues with main transmission lines • New transmission infrastructure needed • Costly to build new transmission infrastructure	• The company had signed a connection contract with the grid
	Design standards	• Current technological capacity of wind turbines for wind load factor and wind speed	• Design standards had been put in place for this project to deal with the high wind speeds

Technological category

The project mainly addressed all technology concerns. Other concerns about capacity and high wind speeds have been dealt with and do not directly impact on the local community. Grid integration, regional factors, storage and variability of wind within technical standards are not concerns for the community to stop the project. Those technical aspects are beyond worries for the community. The main concerns regarding the technical aspects were that during construction phase they will close the access to their lagoon where they do the fishing activities (*"Mareña Renovables Wind,"* 2011). The company when realize that provide a solution which this issue can impact depending how much work is for the community to adapt for those changes (ibid.).

Wind resource mapping and technology transfer is a key aspect to be considering for the government. However, was not a key aspect for the community to stop the project directly.

Application of Legal Category to Case Study Mareña			
PES TLE	**SUB - CATEGORY**	**POTENTIAL RELEVANCE TO WIND IN MEXICO**	**Case study Mareña Oaxaca**
	Environmental and social impact assessments	• Speed and height of the wind towers to reduce impact on birds and bats • Social impact assessment could also be completed	• It is important for the company with further due diligence

Legal category

According to the Mareña Renovables the environmental and social report that was submitted and accepted by the Environmental Agency (INGESA S.A. De C.V., 2008). This aspect does not represent an issue for the community to stop the project. A Transmission line of 52km was planned to be build to be connected with another substation (*"Mareña Renovables Wind,"* 2011). In addition it be will require to make road improvements for that wind park (ibid.).

Application to Environmental Category to Case Study Mareña			
PES TLE	**SUB - CATEGORY**	**POTENTIAL RELEVANCE TO WIND IN MEXICO**	**Case study Mareña Oaxaca**
E	Wildlife impacts	• Impact on migratory birds can be mitigated by planning on installation	• Activist concerns about the impact on migratory birds were raised (see page 45) (Crippa, 2012)
	Opponents to wind	• Impacts during construction	• Misinformation to the

	energy using environmental concerns	phase of the wind mills installed onshore	community regarding the impact of the wind farms would have on their fishing activities and live species in their lagoons (see page 45) (Crippa, 2012) • Vibration, dust and noise during construction phase of the wind turbines and transmission lines installed onshore (see page 45) (Crippa, 2012) • Noise and visual aspects during operation phase of the wind turbines (see page 45) (Crippa, 2012)

Environmental category

Environmental concerns were not the major constraints that caused the project to be stopped. However the project was found within a migratory bird routes. But as the project was not implemented it is difficult to know what the full impact may have been (*"Mareña Renovables Wind,"* 2011). However, the impact on migratory bird populations will be assessed during due diligence within the planning and installation process of the company. The Due Diligence will confirm the potential impact to this species (INGESA S.A. De C.V., 2008; *"Mareña Renovables Wind,"* 2011). The monitoring and mitigation measures will be provided by a Due Diligence report which has to include the concerns for the impact in the birds and bats (*"Mareña Renovables Wind,"* 2011).

Opponents of the project provided misinformation about the impact the wind farm could have on the shrimp populations in the area during the construction phase (See page 45) (Crippa, 2012). This was not based on any anecdotal evidence even that the company claim that within a due diligence will determine if the project will have any impact on marine life during maritime traffic but never for vibration during the construction phase (See page 45) (*"Mareña Renovables Wind,"* 2011).

According to the Mareña Renovables the environmental and social report that was submitted and accepted by the Environmental Agency (INGESA S.A. De C.V., 2008) the impact on migratory birds will be reduced, within installations and planning processes from the company. According to Miller & Spoolman (2012) the bottom line is that *Wind power is much less of a threat that other hazards* (page 410.).

Answer to R/Q

Based on the PESTEL analysis presented above it is possible to draw some conclusions about this how experience with the Mareña project can inform the future planning and implementation of wind energy projects in Mexico. In particular the analysis presents a number of issues that the Mexican government needs to manage to ensure the success of these projects. In particular, attention needs to be paid to the political, environmental aspects, economic and social stability of the country or the region where the project is being implemented; the achievability of the county's ambitious targets set for renewable energy deployment; and potential need for institutional changes to better encourage future wind energy projects. The following points may help to improve the prospects for these types of projects:

- Social factors appear to be a major barrier. Is important for the government and the project developers to communicate and build support from convincing communities about among other stake holders the importance of regarding renewable energy as a way to combat climate change and improve the life styles and economic situation of the community.

- Training for communities and investors is needed

- Institutional support for wind energy deployment needs to be seen by the public to support long term job creation and respect the, rights, traditions and their land ownership and agreements. On a related matter, opportunities could be identified to link wind energy projects to reducing inequality in Mexican communities.

- Strategies for the State to provide local high skilled employees or undergraduates for maintenance of the wind project. Also include jobs opportunities to be interesting in working in manufactures of the market and as well in the construction phase of wind energy projects.

- Land rights and planning is another issue that has to be more carefully considered during the planning including impacts on local communities, traditional land ownership structures and whether the project respects these.

- The leader of the communal land is responsible for all the administration processes but is important that they also get support from expertise or knowledge to carry out such a transaction.

- A general agenda from the federal, state and municipal government could help to coordinate, target, plan, and implement standards and processes for wind energy projects in Mexico.

6 Discussion

Regarding Methodology

The use of literature peer-review on social, political, environmental and regional aspects were critical for understanding the origin and the transition of the project Mareña. Previous studies on the Mexican wind energy market were a fundamental base to understand the potential of wind energy development and interest from authorities in Mexico.

Material with strong angles on anthropology analysis can lead the results to subjectivity. This includes reports from activist groups, as well as the collected data from academic researchers and the mass media. All this information was collected during the last ten years since this the project Mareña started with Preneal Company in 2004. I did not have the chance to do first hand observations of the reality in the region. However, that time that would have been used to visit the site in the Isthmus of Tehuantepec was useful to find more articles and studies regarding the project. I made attempts to contact the involved companies for interviews but these were not successful. I assume that this case was delicate topic for authorities and the companies. If I had the opportunity to interview the involved parties could lead me to answer more directly even if there is a risk of subjectivity. The interviews that I did perform with one researcher and one authority gave me very important input and could have led me to key people. Unfortunately these interviews came to late in the research process and did not leave me the opportunity to follow up on new leads and suggestions.

The PESTLE framework applied helped me to outline the significant aspects that have had impact in the Mexican context and in the Mareña case study. The fourth column (specific to Mareña case study) in the matrix was helpful to explore the causal explanations for each category, but it was difficult to define which aspects were critical in stopping the project. Furthermore I had difficulty to categorize each aspect. Some aspects belong in more than one category, but to be clear to the reader I chose to only place them in one category. For example the impact of the wind turbines on migratory birds was put it into an environmental category. It could, however, also be considered from legal and technological aspects. Nevertheless this does not necessarily mean that my results would have changed significantly.

The most important is the way I manage the framework in in order to be able to highlight the main issues and to be able to provide suggestions easily. After filling in the PESTLE framework in chapter fourth, I found it necessary to give a summary of the highlights of the analysis in my case study. This was with the intention to show the reader that these aspects had an importance for the community to stop the project. However the way to do this could have been done differently.

If I would choose another framework, I would have used a framework that can divide the specific benefits into quantitative, qualitative and tacit. In addition I would have chosen a framework that would including the cost-benefits. These two frameworks would have given a different angle to my study. They could lead to know the opportunity cost for a community hosting a wind farm and for a company set a wind energy project in a particular region or somewhere else. This could show for example the real cost-benefit of a farmer or fisher to become part of the work force of the wind farm parks as a constructor and the changes that this implies. It is clear that this will lead to other objective research questions and problem definitions. However, this would have taken up too much time.

Another option for my research would have been to in parallel compare two or three case studies around the world with the same framework in order to give a wider scope. That approach would require the same amount of background per case study to give a proper analysis. Alternatively I would have to focus in a few specific questions to be able to compare the cases.

Key observations regarding the thesis

The Mexican energy transition using wind energy deployment started with a strong impetus since the geographical location for wind energy deployment was mapped in 2003.

In my opinion, Mexican authorities need to develop strategies for manufacturing wind turbines and research and development instead of just focusing on developing wind parks. The National Development Plan needs to be more integrated with the Law of Climate Change in Mexico and the Law for use of RE, which would lead to combat social issues such as poverty. All strategies for combating climate change will be much improved if they focus on sustainable development applicable in the three levels; federal, estate and municipal government.

Rural electrification is more needed in low-middle income countries than in middle-high income countries. However RE is important for all countries that are committed to combat climate change. To succeed in strategies to mitigate climate change collaboration between countries is needed. Countries with large experience can help those with lesser experience, for example with learning processes or by investing in wind energy projects. The capabilities and needs of the country, will decide which assistance is more useful.

It is important to consider climate change and social development at the same time. Political aspects of a country, such as level of transparency and corruption, will determine results of climate change strategies. To take the example of the Mareña case, where the main reasons to stop the project were social and political. Lack of trust of the community in the municipalities and the government representatives plus the ambitious targets of RE caused the project to fail. In addition, environmental, legal, and technical aspects are also important to take into consideration. These will help to reduce the impact on the community and environment.

The important thing here is that the Mexican government have to consider all of the above mentioned aspects to make their policies, regulations and laws for the use of RE in Mexico. It is equally important project developers consider the technical, environmental, economical and social aspects in their planning, which will lead them to take the right decisions.

Suggestions for the Mexican social welfare, labour and climate change mitigation

Creating manufacturers, research institutes and universities with the new market trend will create more employees in long term. Wind projects contracts tend to be for thirty years and the life period for wind turbines are twenty years. This requires new demand for wind turbines and the Mexican market with national manufactures can compete with foreign companies on supplying new turbines. In the future Mexico should be able to develop wind farm projects on their own. In order for this to happen Mexico needs to include requirements and innovation policies for technology and knowledge transfer in the law for the use of RE. Mexico cannot start building this new market of RE without technology spillovers. The approach of knowledge transfer has been seen in other high and middle income countries such as Denmark, Germany, China, India and Brazil. In parallel learning processes of proper public policies to address distribution of incomes in less industrialized countries are needed.

Families within the indigenous population or in rural areas need more support from the wind energy projects. It is necessary to assist with orientation for the community to administrate and effective production plans for development not related with the wind energy projects to distribute economic benefits. Long term plans for qualitative benefits for the communities are needed immediately.

The region of the Isthmus of Tehuantepec is already crowded with wind turbines. There is a significant amount of money from foreign companies that is invested in the State of Oaxaca, but is not seen by a number of communities. Looking to expand in other areas for wind energy in Mexico is necessary. There is potential in other states such as Baja California, Puebla, Nuevo León and Saltillo, and expansion in is happening. For example the construction of the wind farm Parque Eólico Saltillo B&E is ongoing in Saltillo, with a capacity of 714 MW. However, this expansion of wind energy development in other regions require to learn from the experiences of previous projects in order to not make the same mistakes that have recently stopped important projects. Off-shore wind energy is a possible solution to avoid social issues or public acceptance, even though this is more expensive. It also requires other considerations in terms of the environmental aquatic impact, such as in Denmark. Furthermore it is necessary to consider the potential capacity of other RE, such as sun energy, in Mexico. Some regions will be more suited for wind energy than others. These alternative solutions are potential research areas for Mexico or other middle income countries.

7 Conclusions

The Mareña project was located in the Isthmus of Tehuantepec region of Oaxaca because of its favorable wind conditions, and to contribute to social development. However, the project was stopped due to fierce opposition from the local community. The question now is, if the government aims to develop wind energy elsewhere to bring regional social benefits and contribute to mitigating greenhouse gas emissions nationally, how can they make it work? There are several lessons to learn from the experiences with the Mareña project in Oaxaca.

Renewable energy and wind energy in particular is a good instrument to mitigate climate change and help a country to reduce poverty with those projects. This research illustrates that if there is not a long-term strategy in place for how to keep the benefits of the investments in the region, or if the country cannot distribute the revenues generated to local communities, similar projects will have limited impact in terms of improving social conditions. If the government has a good public policy and good management then it could use all the money that come from the tenders for the registration for these projects to provide services to the community, such as infrastructure, schools, hospitals, recreation fields, etc. Corruption and lack of knowledge of management are the main issues that the government have to deal with in order to host these wind energy projects.

There is also a need for assisting local communities with how to distribute the benefits derived from foreign investments into local entrepreneurship that can generate benefits also in the long run. This can also help to empower these communities and support better trust in the authorities. This development may furthermore provide incentives for young people to remain in the region and contribute to the overall progress of these societies.

The contribution of this research to the body literature is a framework that was built from the author literature research that can be useful in a case study with contexts as the Mexican country. In addition it could be interesting to apply this research method in Mexico in other renewable energies.

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Appendix 1

List of interviews

Date	Name	Position	Organization	Department
24 - 06 - 2014	Mirgam Palm		SIDA	Stockholm Renewable Energy Developing countries
14 – 07 – 2014	Julia Hoffmann	M.Sc. Environmental Studies and Sustainability Science (Thesis in Yansas, Ixtepec, Oaxaca)	LUMES	Wind Energy
11 – 09 – 2014	Sinaí Casillas Cano	Director	Secretaría de Turismo y Desarrollo Económico del Estado de Oaxaca	Energías Renovables
18 – 09 - 2014	Edith Barrera Pineda	Professor and researcher	Universidad Del Mar (UMAR) del Estado de Oaxaca	Energy and social aspects

Contact by E-mail list:

14 – 07 - 2014	Samuel Herculano	Evaluación de Impacto	Sustentavia NGO Mexico	
15 – 09 - 2014	Martin J. (Mike) Pasqualetti	Professor	Arizona State University	School of Geographical Sciences and Urban Planning

Non-able to contact list:

Name	Institution	First date of	Status

		contact	
Sergio Oceranski	Yansas Ixtepec, Oaxaca	14/07/2014	Did not reply
Alexandra Lindfors	OX2	12/8/2014	Suggested other person
Jeff Johanson	OX2	11/7/2014	No time available
Jan Olof Dahlin	OX2 Glötesvålen Project Manager	18/7/2014	Did not reply
Maurice Wilbrink	PGGM Netherlands	18/7/2014	Did not reply
Kunieke Luth	PGGM Netherlands	18/7/2014	Still waiting
Jefferson Easum	IDB Team leader	17/07/2014	Did not reply
Paula Chirhart	Macquarie	17/07/2014	Did not reply
Jan Daniel Kämmer	VESTAS	15/07/2014	Suggested other person
Patrik Darsund	VESTAS	17/07/2014	Suggested other person
Jan Daniel Kämmer	VESTAS Senior Sales Engineer, Mex	17/07/2014	Did not reply
Francisco Acosta	CFE	16/07/2014	Did not reply
Ing. David Rafael Perez	SEMARNAT Subdelegado de Gestion Ambiental y de Recursos Naturales de la Delegacion Federal de Semarnat	13/08/2014	No time available
Ernesto Feibogen	GIZ President Sustainable Energy in Mexico	4/7/2014	Did not reply
Mikael	VESTAS	24/06/2014	Did not reply

Appendix 2

Article 2 of the General Law for Climate Change in Mexico ((Environmental Law Institute, 2012):

I. Guarantee through public policies on climate change the right to a healthy environment and to establish harmony between governments, states and municipalities authorities to take the adequately measures to adaptation on climate change and mitigation of GHG and compounds.

II. Regulate and stabilize the concentration GHG emissions in the atmosphere

III. Regulate the different action that are needed for climate change

IV. Create strengths capacities to respond to adverse effects of climate change in order to protect the population and ecosystem

V. Promote R&D, education, transfer of technology and innovation for climate change adaptation and mitigation

VI. Motivate the public participation on all this climate change transition

VII. Promote low carbon technologies and strategies for a good transition to a sustainable economy

According to the Article 5 of this law it is established that governments in all levels should have climate change mitigation and adaptation strategies in accordance for this Law and in all other applicable Laws with the same ambit (Environmental Law Institute, 2012).

According to the Article 7 it is established that the Federal Government is responsible to formulate, design, propose, develop and publish of (Environmental Law Institute, 2012):

- The National Climate Change Policy, Acts and Fund
- Criteria's for policy instruments provided by this law
- An update national risk atlas
- A public National Strategy Program with procedures for consultations
- Ratified international treaties for the preservation, restoration and conservation of natural capital and human capital including education, energy, food security, etc.
- Emissions trading
- Encourage scientific and technological research and transfer of knowledge for climate change mitigation and adaptation.
- Competent authorities that can implement all economic, fiscal, financial and market based instruments that are related to climate change engagements.

- Develop sustainable strategies for the use of fossil fuels and REs, as it is provided in the current Law of the Sustainable Use of Energy, and the Law on the Use of Renewable Energy and Financing of the Energy Transition.