

Wind power plants: effects and environmental impacts in the northeast coast of México

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Summary

The northeast coast of Mexico (Tamaulipas State) has ideal conditions, both physical and land use, to build and install wind-electric plants. However, these types of facilities have a number of environmental impacts that should be identified and studied prior to implementation. Three environmental impact assessments were performed for this area. The results of the studies show a minimum number of environmental impacts, most of them with a low significance, which indicate that the use of wind energy is one of the main solutions to support the reduction of climate change effects.

Introduction

The energy generation by wind power plants has many benefits: it does not produce toxic gases, does not contribute to the climate change or to acid rain, does not generate hazardous wastes, but some wasted oils, and has high energy efficiency given that each Kw/h of electricity generated from wind in place of carbon avoids the generation of 0,60 Kg of CO₂, 1,33 gr of SO₂, and 1,67 gr of NO_x inter alia

The importance of this industry has been increasing over the last 15 years. According to the secretary of energy , Mexico (2007), the global installed wind turbine capacity in the world has been growing quickly between 1996 and 2006 (up to 11 times), from 6,100 MW to 74,223 MW. Thus within the generated capacity at the global level, Germany has first place with 27.8% of the total (20,622 MW), Spain is second with 15.6 (11,615 MW), then the United States with 15.6% (11,603 MW), India with 8.4% (6,270 MW), Denmark with 4.2% (3,136 MW) and China with 3.5% (2,604 MW), while Mexico stands at position 28 with 0.1% (88 MW).)¹.

Also, the global wind energy sector has already developed a major technological effort, which sets production costs values as a real solution in the short term for electricity generation in Mexico, as in European countries.

Within the document "Global vision of the wind power energy", by Green Peace organization and the Global Council for Wind Power Energy², establishes a target that more than a third of the energy consumed in the world will be provide by wind power energy by the year 2025. In this frame work Mexico has begun an ambitious program to build wind power plants, studying two main zones at the northeast cost (Tamaulipas State) and Tehuantepec Itsmo (Oaxaca state). This document is a brief of the impact assessment of three different studies held in the north cost of the Mexican Gulf, including the municipals of Reynosa, San Fernando and Matamoros near the US border, all within the Hydrological Burgos Basin.

Physical and biological zone aspects.

The Burgos basin area comprises 208,586 km², including totally or partially the States of Coahuila, Nuevo León, and Tamaulipas. In this last state, the projects will be undertaken in the municipalities of San Fernando, Reynosa and Matamoros with a

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population over 1.1 million in 2010. The study area is a space unit with relative uniformity in its main environmental components: soil, surface hydrology (absence of a clear pattern) and biotic cover of flora. It is therefore a anthropogenic macro ecosystem, consisting of an area that integrates a coastal plain of little (no more than 10 M) elevation, with few areas of flooding,

With reference to the ecological regions located at the northeast coast of Mexico where the projects will be held, can be mention the protected natural area called Laguna Madre and other one named Rio Bravo Delta, both of them important because of their biodiversity , mainly bird species.

In this area the main natural renewable resource is the wind³. The process of wind generation starts with cold fronts aimed to the South and the route of these wind currents is constrained by topographical accidents. When these cold fronts occur in the Gulf of Mexico, its influence in the environmental system area is evident with sustained wind speeds of 20 to 30 m/s (almost 100 km/h). These average records, determining the dominance of the distribution of wind speed, identifying the dominant speed is 5 to 6 m/s, which is adequate to the project needs.

In general terms the areas proposed for projects are highly impacted by human activities and are basically formed by two types of plant association: herbaceous halophilic vegetation and thorny scrub, except in areas with the cultivation of sorghum, (Rzedowski 1978)⁴. The field work performed results in a low incidence of the presence of wild vegetation, almost all individuals identified and observed correspond to copies generically known as "weeds" mainly type secondary, resistant to human activities, with herbaceous Halophyte species and vegetation of thorny scrub. In the literature^[3], 60 species of thorny bushes are registered, of which 13 species were observed in the area of projects. A high degree of disturbance of ecosystems, both in the literature consulted and the field comments, is present.⁵

In the Laguna Madre and Río Bravo Delta regions share the space more than 450 species of birds, aquatic, terrestrial and semi, that makes the 15% of the total migratory birds which each year arrive to Mexico from Canada and the United States of America, looking for shelter, feeding and nesting in winter. Furthermore of 144 permanent species of resident birds, 2.7% are endemic in Mexico. Outstanding the duck red head (*Aythya americana*), of which records in the region are up to 36% of the world's population, and in the zone exists the only breeding colony of White Pelican (*Pelecanus erythrorhynchos*) in coastal environments of Mexico, as well as 100,000 shorebirds that represent the highest concentration in the country, as well as ducks and Canadian goose which reach their southern end of distribution. Peterson, T.R. 2002)⁶

One of the main biological functions of the region, is to serve as a natural corridor for migratory water birds, that results in the high percentage (59%) of migration birds with respect of the avifauna records in the area, and to the values of the resident birds (38%); that are flying in the Gulf, that makes this zone one the most important of the continent for prey birds.

Methodology for impact assessment

The methodology was based on Mexico regulations for environmental impact assessment that establishes 3 different steps (identification, valuation and description of environmental impacts), including the use of check lists and matrices that describe the attributes of each impact. Specifically, the methodological development considered the following parameters for each impact: character, duration, extent, intensity, synergy, reversibility and mitigability; for both direct and indirect impacts. The first phase developed was the elaboration of a specific list of environmental factors and the project impact agents or components (Modak. 1997)⁹ (Canter 1977)⁸.

For the evaluation of environmental impacts, we used the methodology known as Leopold matrix (1971)⁹, which was modified to match with the particular features of each project component. This matrix was developed based on the results of the check list and the table that included a double entry with the interactions environment-project, choosing those environmental factors that may be impacted, qualify them according to the parameters, on a scale from 1 up to 4. The score was awarded based on pre-established criteria matrix.

As a second step in order to determine the impact magnitude regarding the surface or affected volume, permanence and intensity, the following equation was used to determine the magnitude level.

$$\text{Magnitude} = \left[\frac{E + D + I}{12} \right] S$$

Where:

E = impact extension

D = Impact time

I = impact strength

S = synergy

12 = is the sum of the maximum values of E, D and I

In order with the assessment criteria, the possible values established in the equation means that the domain of the magnitude variable (M) could be from 0.25 up 2. All the impacts, according to their value were classified inside three different categories high, medium and low.

These values were matched with the critical ecosystem environmental factors aimed to determine the significance of the impact as well and only those considered impacts of high significance were selected.

Results of studies in impact assessment terms

It is important to note that it was detected in the analysis carried out all of the impacts, the implementation of these projects will produce on average close to 90 impacts in each project, of which 67 are expected of low magnitude, 20 media significance and 3 of high significance, primarily related to the impact that the operation of wind turbines will have on avian wildlife and processes of mobility of species.

It is obvious that the operation phase generates the greatest number of potential significant impacts, which could affect biotic resources (birds) on their way through this geographical space, some of which are under a regime of protection, so it is clear that the result of this negative effect can translate into the modification of the behavior patterns of these vertebrates. While the rest of impacts refer to the use of the soil, with its effects on the processes of the inert environment, soil and given that these actions imply a major alteration to the current environment.

Under this framework and within the expected impacts, it is possible that a negative disorder of the mobility of the terrestrial species, by disassembled occupancy as a result of the presence of people and machinery; While it's a reversible effect which will only impact the affected area, its cumulative effect caused by agricultural operations to increase synergies which translates to scare off wildlife.

It is estimated that the movement produced by the excavations generates visual pollution. Although the placement of the ground product of excavations will have negative effects, this impact will be temporary.

On the other hand, foundations of the towers for wind turbines are conducive to the erosion of the soil. The modification of the natural vegetation, even in the case of agricultural land, will have negative effects on the characteristics of the soil, including the loss of some of its nutrients. The establishment of foundations for concrete of

permanent character in the sites of placement of wind turbines will also affect the vertical drainage of the soil. Although the vegetation is of low biological value, being of a recoverable component, the effect of placing wind turbines reaches significance given the general disruption that is recorded in the area

Wind turbines are high structures that need to operate in an exposed site, enabling them to make the best use of the prevailing wind. This means that they will be visible from relatively distant areas if we take into account the topography of the area. If this has a detrimental effect or not, is a highly subjective matter. While some people express concern about the adverse effect that wind turbines have on the beauty of the landscape, others view them as gracefully and elegant or as symbols of a better and cleaner future

It is important to mention that the aerodynamic design of the wind turbines will substantially reduce the noise levels, but still expected impacts by activity, which can have negative effects on the patterns of behavior of the species.

Birds can be affected by the development of wind energy, due to losses in habitat, disturbance in the areas of food and breeding and for injuries or deaths caused by the blades of the rotor in motion the presence of wind turbines may affect negatively on the mobility of species, particularly birds. Although the rotation between 6 and 16 rpm of the blades allows foresee that this negative effect will be the simple fact that collisions of them, especially at night can register of accidental character, prints a character of significance to the impact if it is the fact that the project area is located to one side of the natural area protected Laguna Madre and Río Bravo Delta and is located in part of the migratory route of some species of birds, of which a part. Some species are under some protection status, so there may be some negative impact on the number of individuals of migratory species

The vegetation lost, as it has happened in most of the wind power facilities in many parts of the world, will lead to alterations in the behavior patterns of the fauna in the area, mainly birds which will gradually modifying their transit routes. In summary: Of the 14 identified significant impacts, only 4 affect environmental reporting considerations of the biotic resources of the area without reaching levels that endanger the status and conservation of them and that could impact in changing their behavior patterns.

Conclusions

Wind turbine installation in this area is environmentally viable because it does not promote or increase the ecosystem fragmentation, nor does it exceed the carrying capacity of the air basin in this area, given that the natural resource that will be used as raw material is air and the project will not be above its rate of renewal.

The installation of wind turbines does not cause significant changes in the trend of environmental development of negative character that occurs in the environmental system in this area and even in the case of a project of occupation, the space that will affect, in relation to the size of the area of the development is minimal (just the 0.97% of the total projects surface).

The projects, even though they are located in the area adjacent to the protected natural area of Laguna Madre and Río Bravo Delta, will not generate significant impacts to the presence of migratory birds in the area, although this aspect should be studied in greater depth. One of the main recommendations of the impact assessment studies is to conduct further research in this matter.

It is important to mention the social benefits of the project that promote the use of clean alternatives to oil for the generation of electricity, which will result in a reduction in the emission of greenhouse gases. Also it is expected to have a positive impact on the area population through the creation of jobs.

The land ownership in this zone, most of them in private hands, makes it easier to promote and build these kinds of projects, which does not occur in the region of the Mexican isthmus (Oaxaca state) in which the majority of the land is communal.

As a general conclusion it will be noted that these kinds of projects do not further fragment the ecosystem, but they could bring some damages in the wildlife, especially birds, that need to be studied in a long term analysis. That was the principal recommendation held to the project promoters, because there were not studies of this item and today the discussions of the wind farm possible effects goes on without a final resolution

One limit to the private energy production in México is the local legal system that does not allow the electric power sale by individuals, and can only be done through the Government enterprise of electricity.

References

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