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UNIT-Prediction and assessment of impacts on air, water, biota, noise, land, cultural and socio-economic environment

Climate

Alteration of local microclimate due to modification on the proportion of latent and sensible heat of radiation in deforested premises (IP 1)

As mentioned in chapter II, the surface of direct disturbance of the project considering the maximum occupation scenario (436 wind turbines maximum) will be 508.51 hectares as permanent surface and 398.72 hectares as temporarily disturbed surface. Considering that the total surface of the property is approximately 30,113 hectares, it is believed that the surface to be permanently cleared and grubbed represents only 1.69% of permanent works and 1.32% of temporary works.

Clearing and grubbing this surface during site preparation will cause the removal of vegetation and, therefore, there will be a modification of latent and sensible heat of radiation in disturbed areas, as well as an increase of the environment dryness. This will cause changes in temperature and humidity content at the site and consequently in the local microclimate. This is considered low impact taking into account that the surface to be cleared encompasses less than 2% of the total surface of the project. It is worth mentioning that after the construction of the wind farm, for all surface that will be temporarily cleared and grubbed a Land Restoration and Conservation Program is to be implemented with the purpose of achieving the regeneration of natural vegetation.


Atmosphere

Reduction in generation of emissions into the atmosphere within the region due to the use of a non-renewable source of energy instead of fossil fuels (IO1)

As for the operation stage, electricity will be generated through harnessing a renewable energy source, thus avoiding generating emissions equivalent to the fuel necessary to generate the same amount of electricity through conventional generating power stations. It is believed that with this project we boost the Guidelines of the Kyoto Protocol, reducing the contribution of greenhouse gas and support the Agreement for Cooperation on Research and Development of Wind Energy Generation Systems.

Emissions of combustion gas and dust (IP 2, IC1, IO2, IA1)

At the area where it is intended to develop the project there is no data on the air quality; however, there are no relevant fix sources of emission of pollutants so the air quality is deemed good. During the activities of site preparation and construction, as well as during the abandonment stage (dismantling and demolition of facilities), the operation of machinery and equipment with internal combustion engines will be necessary, as well as of vehicles for earth moving and materials for construction. The latter will cause an increase in the emissions of combustion gas (Carbon Monoxide, Hydrocarbons, Nitrogen Oxides) and suspended particles (dust) in the Project area

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during working days. It is estimated that the emissions will be temporary and specific, so it is believed that they will not cause relevant impacts on the air quality within the area.

Another type of emissions generated during the construction stage is dust coming from rock blasting and operation of the concrete plant. These emissions are also specific and temporary.

As for the operation and maintenance stage, emissions of combustion gas and suspended particles will also be generated during circulation of vehicles for surveillance tours and due to the use of machinery and equipment during maintenance activities. These emissions are only present when it is necessary to visit the site for any repair or maintenance activity; therefore, they are also considered specific and temporary.


Noise emissions (IP 3, IC2, IO3, IA2).

Within the area where the wind farm will be located, there are currently no noise emissions sources, so the use of heavy machinery, equipment and combustion vehicles during site preparation, construction, operation (maintenance activities) and site abandonment stages will generate noise levels which may disturb workers at the site and fauna living nearby.


The construction stage will entail the highest levels of noise, considering the this is the stage requiring a larger amount of machinery and equipment. Moreover, this is the stage including rock blasting activities, so it is very important to supervise the use of hearing protective equipment during said activities.

As for the operation stage, in general wind turbines generate wide broadband noise as a result of the blades rotation (aerodynamic noise) and of the operation of the mechanism of the generator and the transmission hub within the nacelle (mechanic noise).

Commonly, the amplitude of sound is from 90 to 105 dB at a distance of 40 meters and from 35 to 45 dB at a distance of 300 meters approximately, whereas frequencies are higher than 100 Hz in broadband noise and lower than 100 Hz in low-frequency noise. But it is noteworthy that the noise issue has been reduced considerably with the design of modern turbines, for its design minimizes the aerodynamic effect, and nacelles have sound isolation devices.

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Energy Association "properly designed wind turbines are quiet during operation, and in comparison to the noise of traffic on the road, trains, planes and construction activities, to mention a few, the noise of wind turbines is very low. Outside the closest houses, at least at 300 meters of distance, and sometimes ever more, the sound of a wind turbine generating electricity is likely to be approximately the same level of noise than water flowing at 50-100 meters of distance or the noise of fallen leaves during soft breeze1

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On the other hand, the wind farm is located at a considerable distance from the closest population, which is a small town called San Francisco, at the east border of the project polygon of disturbance, but at a distance of approximately 3 km from the closest wind turbine. To the southwest of the polygon the town Llera de Canales (county seat) is located, but the distance to the nearest wind turbine is more than 4 km. Considering the above mentioned, it is believed that the noise perceived in the limit of the area where the wind farm will be operated is practically imperceptible.

V.2.4.3. Land


Possible erosive processes due to loss of vegetable coverage and changes in its structure (IP 4, IC3,)

As previously mentioned, the surface of direct disturbance of the project considering the maximum occupation scenario (436 wind turbines maximum) will be 508.51 hectares as permanent surface and 398.72 hectares as temporarily disturbed surface. The clearing of these surfaces will modify the land structure due to the removal of vegetable coverage and of surface layers of the land. This removal may expose the land to erosive processes due to wind and rain.

Likewise, construction activities will take place at sites already lacking vegetation, so these activities will also cause erosive processes and changes in the land structure.

It is important to mention that for all surface to be cleared and grubbed a Land Restoration and Conservation Program will be implemented so as to avoid erosion issues to the fullest extent possible. This program considers the temporary storage of the soil fertile layer, and after concluding the preparation and construction activities, it will be reincorporated into the site so as to enable the regeneration of the soil and of natural vegetation.

Land pollution due to wrong management of liquid and solid waste, turbines maintenance activities, as well as possible dripping of hydrocarbons from machinery and equipment (IP 5, IC 4, IO 4, IA 3)

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Most of the equipment or machinery to be used during site preparation and construction will use diesel (loaders, graders, backhoes, excavators, compactors, trenchers, cranes, dump trucks, haul trucks) and it will be purchased at the closest gas stations and transported to the site through the use of pipes. There will be ground tanks for storage in the area of construction offices and storage area of machinery and equipment. Storage tanks should have dikes and all necessary safety devices. All fuel storage areas will be preferably located at a paved site, with trays and trenches for containing spills and applicable safety measures.

During the activities to be developed in all project stages there will be risks of soil pollution. This risk is caused by storage of fuel, as well as by the use of machinery and equipment, possible oil and fluids leaks during the stage of maintenance, and possible dripping of hydrocarbons to the land coming from machinery and equipment in bad conditions. In addition, the wrong management of solid and liquid waste could generate soil pollution, when storing them at sites without the appropriate controls.

During the operation and maintenance stage, the risk will be much lower than for the rest of the stages, because the period of time for maintenance activities would be limited. Actually, the operation of the wind farm does not represent a risk of land pollution.

Modification of geological formations (IP 6, IC 5)


In general, the specific areas where wind turbines are to be located are flat areas; however, there are some areas, mainly areas where there will be rehabilitation and extension of roads, where provisional works will be installed and the topography is slightly irregular; therefore, it will be necessary to make some cuts and leveling. During these activities, as well as during blasting activities, geological formations are modified due mainly to earth moving and readjustment. However, it is estimated that all material removed will be used for filling and leveling, seeking to recover to the extent possible the original topographic conditions.

V.2.4.4. Hydrology

Surface water

Modification of surface hydrological pattern in the area (IP 7, IC 6)

During the stage of site preparation, mainly during clearing, rehabilitation and road extension activities, as well as activities of construction of provisional works, there might be alterations in the patterns of surface run-off, causing modifications in the specific hydrological pattern. In the construction stage, mainly in activities related to blasting activities and all the civil work (infrastructure construction, opening of ditches for wiring, excavations and leveling, etc), the appearance of alterations in run-off patterns is possible

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It is noteworthy that within the project polygonal there is no permanent water body, so the run-off patterns which may be disturbed would only be temporary run-off during heavy rain. It is also important to consider that the rain pattern in the area is very low, hence it is considered that this impact would be of very low magnitude.

During site preparation and construction stages necessary works will take place so as to avoid puddles or other issues due to alteration of the above mentioned patterns. This includes construction of ditches or temporary sewers, as well as extraction of accumulated water in excavated areas, through pumping or any alternative method where necessary.

Said patterns will be regularized to the fullest extent possible after finishing the construction of the wind farm.

Pollution of water bodies due to wrong management of waste and/or spills or leaks of hydrocarbons (IP 8, IC 7, IA 4)

During the different stages of the project there will be volumes of dirt and vegetable waste, as well as all types of domestic and industrial waste which, if not stored or disposed of in areas prepared for that purpose, may be swept to the channels of the closest streams causing modifications in the water quality. In addition, the presence of machinery and equipment may cause accidental dripping and spills of hydrocarbons which may be swept towards such water bodies. It is important to mention that within the polygon there are no permanent water bodies, the only water bodies near the site are those located on the lower section of the borders of the plateaus; however, since the wind turbines will be possibly located on the borders of the plateaus, it is important not to leave aside this possible impact.

With respect to the operation stage and during maintenance and surveillance activities, small volumes of waste will be generated and it is likely to present dripping or spills of oil or fluids, which, although it does not represent a relevant risk, if it is not properly managed and disposed of at proper sites they may cause pollution of water bodies nearby.

Underground hydrology

Decrease of recharge capacity of aquifers (IP 9, IC 8)

The loss of vegetation due to clearing is considered to cause a decrease in the recharge capacity of aquifers. In addition to this, rehabilitation and extension of access roads as well as construction of provisional works will cause the compaction of land reducing the aquifer recharge capacity.


As for the construction stage, the compaction and leveling activity of the land will modify the permeability of the land and, hence the aquifers recharge capacity will be reduced. In addition to

this, the basis of the foundations for each wind turbine as well as the provisional works will cause loss of the permeable surface of the land, thus reducing the aquifers recharge capacity.

It is important to consider that for both the access roads as the foundations of wind turbines and provisional works, it is contemplated that water will run off towards sites with natural soil or towards absorption wells, where water will be infiltrated naturally towards the aquifer.

Increase of recharge capacity of aquifers (IA 5)

For the abandonment stage it is estimated that with the demolition of the basis and foundations of wind turbines, as well as the dismantling of buildings and other paved areas the land will return to

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its original state, thus allowing the growth of natural vegetation and increasing the recharge capacity of aquifers. **Flora**

Loss of vegetable coverage (IP 10)

Clearing and grubbing activities involve permanent removal of vegetation in 508.51 hectares, considering the maximum occupation scenario (436 wind turbines maximum), and temporary removal in 398.72 hectares, considering the worst-case scenario. Approximately 68.93% of the polygon where the project will be located is covered by submontane scrub, 7.81% by deciduous lowland forest, 4.51% by tropical mezquital and 3.35% by low thorny deciduous forest.

Rehabilitation of disturbed areas (IO 5, IA 6)

It is noted that after the construction of the wind farm, a Land Restoration and Conservation Program will be implemented, contemplating land restoration activities for roads used on a provisional basis during previous stages and temporarily disturbed areas which may be rehabilitated. These activities seek to regenerate the land and grow natural vegetation, with special care in avoiding species which roots may damage underground lines of electrical conduction and data wiring (optic fiber).

On the other hand, during the site abandonment stage, the actions necessary for restoration of the land with the consequent growth of natural vegetation in areas disturbed by the project will be carried out; always considering their subsequent use. Through the implementation of these actions it is also intended to maintain the productive capacity for the largest part of the disturbed area, considering that after finishing the project lifespan these premises will return to their original purpose, thus seeking not to affect the owners or family of the same.


Loss of vegetable species individuals listed in NOM-059 (IP 11)

Clearing and grubbing activities involve the removal of some vegetable species which may be listed in NOM-059-SEMARNAT-2010. In particular, in the study area only one species was identified found in the category of "special protection". This species is the (*Beucarnea recurvata*) or commonly called elephant's foot, which is under the classification of endemic and threatened. It should be mentioned that we will consider at all times the vegetable species rescue and relocation activities, according to the Subprogram of Rescue and Relocation of Flora.

V.2.4.6. Terrestrial fauna

Habitat modification and fragmentation (IP 12, IO 6) With the removal of vegetation during clearance of the land, the habitat of fauna species living in the area will be modified, mainly terrestrial fauna. Among the species affected we can find the felines (jaguar, ocelot, linx and oncilla). These felines are territorial animals and generally solitary. Upon the modification of their habitat they will have to move to the surrounding area and take up new territories.

With regards to the impact during the operation stage, it refers essentially to risk of mortality of birds and bats due to collision with turbines, thus affecting their population dynamics, as well as their migratory patterns. Likewise, the possible impact of wind turbines on monarch butterflies was also assessed. In order to assess the impacts on these species, field work and modeling of the

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possible routes of monarch butterflies were carried out, which are presented in Chapter III and a brief summary is presented below.

- Birds and bats


According to several studies performed, in general, mortality of birds due to collision with turbines is irrelevant. Studies carried out in Europe state that the rate of birds dead because of this type of turbines is very low. At offshore stations of 160 MW of Horns Rev, in Denmark, radar measurements show that most birds avoid the park, changing their routes some kilometers before, so as to fly around it and not above it. However, other human activities may have a more sensitive effect; for example, it has been observed that high tension lines are less visible for birds than turbines and may cause a higher rate of mortality.

As for bats, several studies have highlighted the following issues:

- Destruction and disturbance of their foraging habitat, as well as corridors nearby (so their activity area is restricted).
- Damage or destruction of their perching or shelters.
- Increase of the collision risk possibility during flight [the origin is unknown, with hypothesis such as turbulence, lack of hazard perception from rotation of blades, high concentration of bugs around the structure, alteration of their places due to ultrasonic sounds, even when it is known that the sound emission levels of all the new designs of wind turbines tend to follow the same values. It seems that the sound is not the main problem (Danish Wind Industry Association, 2003), however it does infer on their influence].

In order to know and monitor the main ecological parameters such as composition, richness, and abundance of birds and bats prior to the construction stage, and thus have a base line, the services of the Highly Specialized Professional Services Unit of the Instituto de Ecología A.C. (INECOL) were hired to carry out a monitoring campaign. This monitoring campaign began in spring 2013 and will continue throughout the rest of the year. It is important to mention that two SM2BAT (Wildlife Acoustics) detectors are installed at the site, in order to estimate the form in which bats use the air space of the premises and estimate the foraging activity of each species. The main objectives of this campaign are:

- To determine potential resident and migratory birds in the region.
- To monitor resident and migratory birds within the premises where the wind farm is intended to be installed.
- To describe the flight patterns of birds present within the property.
- To determine the migratory flow
- To describe the composition of species of resident and migratory bats through ultra-acoustics detection systems.
- To search for shelters within the wind farm.

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Preliminary results of the monitoring campaign demonstrate that the diversity and species with higher abundance include resident and terrestrial species not flying above the canopy and migratory species flying outside the mesas or at heights above 125 meters.


With respect to migratory birds, it is important to consider that most of them were found flying at heights above 125 meters, therefore it is estimated that the effect of construction of the wind farm on resident birds is likely to be related to the fragmentation of the habitat more than with the operation of the wind turbines.

There is currently no field data on bats. Global results obtained in the monitoring campaign prior to the construction of the farm will be an integrating part of the Environmental Quality Follow-up Program (PSCA). The results set in the Environmental Impact Statement are preliminary and related to the monitoring of birds carried out in spring during March and April.

□ Monarch butterfly (*D. Plexippus*)

Considering that the Project is located in the state of Tamaulipas, two potential distribution models were applied to determine if the Project Area is located in the migratory route of monarch butterflies, for there are currently no sufficient data available to determine so.

According to the results obtained from the models applied, MaxEnt and BIOCLIM, it is considered that within the Project Area it would be expected that the incidence of monarch butterflies during both migrations (spring and autumn) be minimum due to low levels of climatic affinity. Although precipitations agree with the general pattern of the species, this is not the case for the dominant condition of warm temperatures. However, it should be mentioned that the areas adjacent to the SA presenting a certain degree of affinity and adaptation were the Sierra Madre Oriental and Sierra de Tamaulipas representing a series of climatic conditions favorable for the potential distribution during migrations of *D. Plexippus*

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Reincorporation of fauna into the region due to rehabilitation of disturbed areas (IA 7)

Finally, during the site abandonment stage, the impact on the fauna will be beneficial, considering that the rehabilitation of disturbed areas and maintenance of the same would enable that the type of fauna displaced during previous stages may come back to find a place to live in this area .

Displacement of species (IP 13, IC 9, IO 7,)

Species displacement will be the result of most activities of the project, especially clearing and grubbing, blasting activities, and the presence of machinery, equipment and staff on the area during site preparation, construction and maintenance activities. All works will be performed gradually, which will enable species to migrate towards neighboring sites.

On the other hand, during the operation stage, the displacement of species will be due mainly to generation of noise because of the operation of wind turbines and caused by the habitat fragmentation.

Loss of individuals of animal species within any category of NOM-059 (IP 14)

With the removal of vegetable coverage some fauna species could be disturbed, including those listed in NOM-059-SEMARNAT-2010.

101 species of fauna were detected in total, under conservation status as per the NOM-059-SEMARNAT-2010, of which 8 are endangered species, 29 are threatened and 63 under special protection. The group with the highest number of species is birds, followed by reptiles, terrestrial mammals, amphibians and bats (chiroptera).

As part of the activities of the project it has been considered to carry out animal species rescue and relocation activities, through focused displacement and intimidation techniques, according to the Flora and Fauna Rescue and Relocation Subprogram.

Loss of biodiversity in terms of individuals (IP 15)

The removal of vegetable coverage in the areas to be occupied by the different elements of the project directly impairs the biodiversity of the site in terms of individuals both of flora and fauna. On the other hand, it is considered that this impact is mitigable if taking into account the mitigation and compensation measures included in the Flora and Fauna Comprehensive Management Program.


V.2.4.7. Landscape

Modification of original landscape (IP 16, IC 10, IO 8, IA 8)

It is important to mention that the plateaus where the project would be located are at an altitude of 400 m above sea level, so they may be observed both from the highest parts of the Sierra Madre Oriental and the sierra de Tamaulipas, and from their lowest parts. The landscape quality is high because most of the surface is covered by natural vegetation.

The landscape will be disturbed during the site preparation and construction stages, mainly due to clearing, presence of machinery and equipment and construction activities. However, it is estimated that machinery and equipment may not be seen from spots of greater visibility of the project, which would be roads and adjacent paths.

During the operation stage, there will also be a visual impact because of the presence of machinery and equipment during maintenance activities. However, the most notorious visual impact will be the presence of wind turbines, which will be at an approximate height of 180 meters, depending on the technology available during the project development. In order to harness the wind maximum

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potential, wind turbines will be located at the highest areas of the plateaus, and will be visible from considerable distances.

Likewise, during the site abandonment stage, the adverse visual impact will be mainly due to the presence of machinery and equipment during demolition and dismantling of structures.

Next we present some landscape simulations considering some spots where it is estimated that there will be more human presence, corresponding to roads and adjacent paths.