

ENVIRONMENTAL IMPACT ASSESSMENT FOR WIND ENERGY POWER PLANT, GABAL EL ZEET, SUEZ GULF , IN EGYPT

By

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Abstract

Introduction: Harnessing power from the wind is one of the cleanest and most sustainable ways to generate electricity as it produces no toxic pollution or global warming emissions. Despite its vast potential, there are a variety of environmental impacts associated with wind power generation that should be recognized and mitigated. Environmental Impact assessment (EIA) is a tool for decision-makers to identify potential environmental impacts of proposed projects, to evaluate alternative approaches, and to design and incorporate appropriate prevention, mitigation, management and monitoring measures. **Aim of the work:** the study aim at assessing the environmental impact of the project of wind energy power plant, Gabal El Zeet, Suez Gulf , in Egypt. **Material and Method:** Environmental assessment of wind direction and intensity, turbine power, noise, electromagnetic waves and vibration is performed. **Results and Discussion:** the study documents the environmental impact parameters including noise, electromagnetic interference, vibration and bird migration. **Recommendations:** the suggested method of mitigation is provided to local authorities to be taken into consideration for the wind energy power plant, Gabal El Zeet. **Key words:** Gabal El Zeet, Suez Gulf, Environmental Impact Assessment, Wind Energy, Power Plant.

Background

Wind energy is a recent addition to the energy mix in most areas, and regulation of wind energy is evolving rapidly. Wind power is viewed by many specialized scientists to be one of the prime technologies for meeting the attempt to curb CO₂ emissions. Generation of electricity by wind energy has the potential to reduce environmental impacts caused by use of fossil fuels to generate electricity because, unlike fossil fuels, wind energy does not generate atmospheric contaminants or thermal pollution, thus being attractive to many governments, organizations, and individuals. However, in order to implement wind energy projects, planning permission is required. For the majority of wind farm schemes, planning permission will require the presentation of an Environmental Impact Statement (EIS), which identifies the environmental, social and economic impacts of the development. This is used as a decision tool when determining whether planning permission should be considered (<http://www.nap.edu/read/11935/chapter/2#14>).

Environmental impacts of projects' set up electrical power plants:

Environmental effects differ in terms of quantity and quality, also according to the type, time and place. The extent of the impact on the environment depends on the degree of acceptability to the community. Environmental effects may be direct or indirect and may interact together to occur triggering secondary effects that may be more dangerous than the initial impact. It might have negative, positive or neutral, short-term or long-term, flipped or not flipped or local, regional or global environmental effects.

Health effects have tabbed to be taken into consideration and may not be clear at the beginning of the project and the possible effects must be predicted. These effects may be direct as a result of exposure to toxic and dangerous processes during the project. These effects may directly harmful to the human body or indirectly such as by transmission of diseases by water, or by a state of malnutrition. The consequent damage to the human being who is considered the backbone of the development of society and the

consequent loss of enormous amount of money for the treatment of pathological conditions should be anticipated.

It is mandatory to point out that during the process of choosing the type of fuel to be used for energy production, negative health effects must be considered and the money spent for managing ill health effects secondary to hazardous fuel used should be added to the bill when calculating the cost per kilo of produced energy.

Aim of the work: This paper will review the environmental Impact Assessment process beside assessing the environmental impact of the project of wind energy power plant, Gabal El Zeet, Suez Gulf , in Egypt, for helping decision maker to know the negative impact of the project aiming at mitigation of the production process.

Material and Method

Study design: It is a cross sectional environmental study

Place of study: Wind energy power plant, Gabal El Zeet, Suez Gulf , in Egypt.

Duration of the study: the study is conducted between October 2014 and February 2016.

Study method: Environmental assessment of wind direction and intensity, turbine power noise, electromagnetic waves and vibration is performed. Documentation of the technical specification of the wind turbine used at the study site. Previous study of bird migration were included in our study to fulfill the Environment Impact Assessment (EIA) file. Basic data were collected through communication with the Committee of Renewable Energy, belonging to Ministry of Energy, Egypt.

Environmental Impact Assessment:

Environment Impact Assessment (EIA) means the process of collecting, organizing, analyzing, interpreting and communicating information that is relevant to the consideration of the application. An EIA is a predictive tool, where the likely significant effects of a development, both positive and negative are objectively analyzed. This information is used to determine whether the development should go ahead or not. It is also a mean of drawing, in a systematic way, an assessment of a project's likely significant environmental effects. This

helps to ensure that the importance of the predicted effects, and the scope for reducing them, are properly understood by the public and the relevant competent authority before it makes its decision. An EIA additionally covers, not only natural resources, but also environmental quality and impact on communities, as environmental, social or economic.

The EIA process should enable all of these factors to be given due weight when an application is being determined. An EIA is not only a tool for decision makers, it is also a tool for the designers and developers of a scheme to ensure that they drive maximum benefits from a development (in terms of energy output and environmental enhancement) whilst minimizing local adverse impacts. The EIA process can throw up design measures that sometimes can enhance certain environments. It is therefore important to incorporate EIA at the earliest opportunity in any development (Kipeto Energy Limited Report, 2012).

EIA basics procedures for electrical power plant generation from wind power plant:

1- Ambient air quality study site.

2-Examine the size of the particles, airborne surrounding site.

3-Study of air pollution from the plant modeling.

4-Study of water quality waterways surrounding the site.

5-Study of the surrounding water cooling cycle and the effects on morphology waterways and determine the environmental requirements of the cooling water outlet modeling.

6-Economic impact study - social.

7-Modeling the effects of noise from the station on the different dimensions of them and the noise measuring site.

8-Study the effect of the traffic pressure on the roads surrounding the project site as a result of the establishment of a private station during the period of construction.

9-Geological study of the site comprehensive installation of ground layers and groundwater characteristics and supported with pictures and detailed satellite maps.

10-Examine the ecological environment of the site and a comprehensive land use plant and animal species.

- 11-Ecological study of water in front of the site.
- 12-Study for quantitative risk assessment (QRA).
- 13-Buy-meteorological data from the General Authority for Meteorology.

Consent: A letter of approval from authorized personnel for performing this work was taken.

Data analysis: The data were collected, analyzed, and presented as descriptive data.

Results

Detailed description of the geographical location of the project

The location of the Environmental and social impact assessment (ESIA) AREA can be seen from Fig.1. It is located on the Gulf of Suez, about 150 km north of Hurghada and 10 to 15 km to the west of the Hurghada – Suez Road.



Fig.1 Location of the 300 km² ESIA AREA

Table 1 : Boundary Coordinates of the 200 km2 ESIA AREA (WGS84)

No.	Point name	N	E	No.	Point name	N	E
1	P1	28°12'02.34"N	32°54'53.15"E	14	P14	28°24'0.23"N	32°46'58.31"E
2	P2	28°13'45.8"N	33°00'27.11"E	15	P15	28°24'4.08"N	32°46'5.33"E
3	P3	28°16'50.48"N	32°58'29.55"E	16	P16	28°26'58.82"N	32°46'6.72"E
4	P4	28°17'16.20"N	32°59'6.63"E	17	P17	28°27'1.97"N	32°48'1.54"E
5	P5	28°17'56.79"N	33° 1'15.45"E	18	P18	28°29'59.54"N	32°48'2.35"E
6	P6	28°20'7.68"N	32°59'35.07"E	19	P19	28°29'54.70"N	32°44'59.99"E
7	P7	28°18'43.41"N	32°52'57.34"E	20	P20	28°30'57.18"N	32°44'59.80"E
8	P8	28°19'58.79"N	32°52'58.46"E	21	P21	28°31'1.90"N	32°44'3.49"E
9	P9	28°19'59.06"N	32°51'59.75"E	22	P22	28°38'21.50"N	32°43'42.56"E
10	P10	28°21'0.09"N	32°52'0.23"E	23	P23	28°35'8.00"N	32°42'17.29"E
11	P11	28°20'59.86"N	32°50'28.51"E	24	P24	28°29'47.10"N	32°43'40.10"E
12	P12	28°23'0.92"N	32°50'32.96"E	25	P25	28°22'57.74"N	32°45'59.90"E
13	P13	28°23'0.71"N	32°47'5.73"E	26	P26	28°17'58.54"N	32°47'37.91"E

North: N

East: E

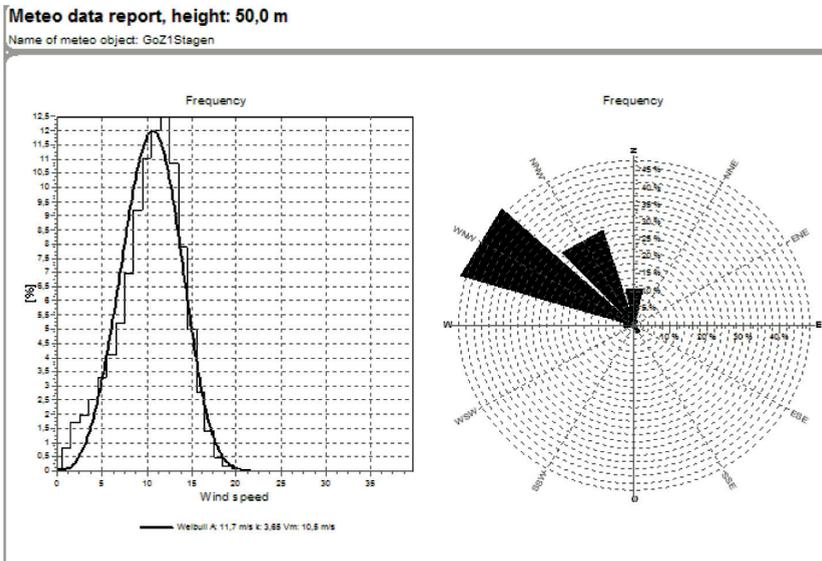


Fig. 2 : Wind speed frequency distribution and wind rose

Table 1 and Fig. 2 show the direction of wind at the project location that is named Banbassatha, This allows proper installation of the units of electricity generation.

Winds are usually not blowing from the sea side. Nevertheless, as the desert grounds have high salt content, the climate is considered to be aggressive.

It is noteworthy that the natural conditions, especially the drastic dry and windy conditions, are very much limiting the biodiversity of the site:

- In exceptionally rainy years, runoff water is being collected in low parts, what may lead to the growth of

some plants. However, these plants are subjected to long dry periods leading to their death.

- The high wind velocity in the site plays an important role in the severe erosion of the soil. The ground surface in the site is mainly covered by compact layer of pebbles and gravels. These represent desert armour, which prevents the permeation of rain water or spilled water to the subsoil. The high wind velocity removes the seeds and other prop gules. So, the chance for seeds to germinate and establish themselves is very poor.

Technical specifications for wind turbines used in the project:

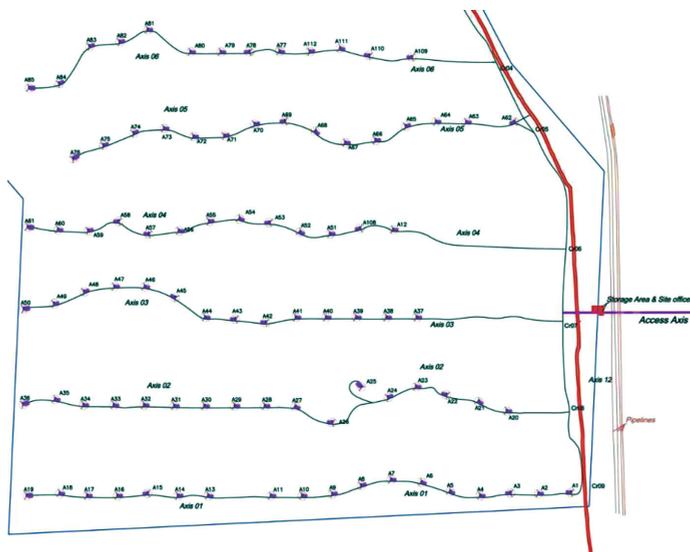


Fig. 3: Typical Arrangement of a Wind Farm including Cabling

Figure 3 shows the location of wind turbines, internal roads and cables.

Wind turbines with unit capacities of about 1.5 to 2.5 MW, rotor diameters of 70 to 90 m and max tip heights of 80 to 120 m are likely to be selected. Other typical features of such a project are the wind turbine foundations of about 2 to 3 m depth and a surface of up to 15 x 15 m² in case of a large turbine (2 to 2.5 MW), wind turbines with tubular towers with diameters of up to 4.5 m at the footing and maximum blade tip heights of about 120 m, allowing wind turbine unit capacities of up to about 2.5 Mega Watt (MW). The wind farm internal grid consists of cable trenches and small electrical kiosks next to each wind turbine comprising of ring main station and possibly as well transformer and/or controller stations, if the latter will not be integrated into the turbines.

The transfer method of electric power that is generated from the project site

The wind power collected by the medium tension (MT) cable grid has to be evacuated via a new 500 kilo Volt (KV) trans- mission line to be built. Accordingly, two or three central 220 kV substation at a central location of the 200 km² area are considered for evacuation of the wind power to

the nearby 500/220 kV. Moreover, at this stage of project preparation it is assumed that service areas (for control and maintenance including spare part and tools stock) will be built at the border of the area adjacent to a 220 kV substation and the asphalt road or in Ras Gharib, with access to the low tension (LT) network.

Birds Migration

Other environmental drawback is manifested as bird migration.

The ecological and ornithological merits of a site are surveyed prior to development, with a Phase 1 Habitat survey in the first instance. A level of value is established against which to measure impact, on the basis of designations, rarity, sensitivity and ecological significance. Habitats and species are identified, and birds are surveyed at nesting, breeding, over wintering and migration times (Drewill & Langston 2006).

The main objectives of the bird migration study (ornithological investigation) were:

- To collect baseline data on migrating birds (mainly soaring and gliding species migrating during the day)
- To describe migration patterns of

relevant species in a quantitative way

- To identify and assess possible impacts regarding development of wind power within the ESIA Area and finally, if necessary to recommend migration measures in order to minimize possible conflicts. Therefore, standardized daytime field observations were done between August 22nd and October 25th 2012 (autumn migration) as well as between March 01st and May 16th 2013 (spring migration), totaling to about 696 and 801 hours of observation in autumn and in spring, respectively. The general study design was similar to that used during an ornithological investigation carried out southwest of Ras Gharib in 2010 and 2011. Observations were done from eight observation sites (A to H) which were located at distances of about 10

km (Fig. 4). Observations focused on species that can be regarded as especially vulnerable to collision strikes or other negative impacts caused by wind turbines: these are mainly large birds (first of all, birds of prey, storks and pelicans) that principally migrate by soaring and gliding during daytime.

The standard data set which covers all birds migrating at distances of up to 2.5 km to each observation site was analyzed with regards to:

- Bird number, flock size and species composition
- Spatial, seasonal and daily distribution of bird migration, flight altitude
- Migratory activity in relation to wind speed and direction.
- Migratory activity in context of the result of previous studies;



Fig. 4: Locations of the eight observation sites (A to H) within the ESIA AREA in autumn 2012 (orange) and spring 2013 (blue) (circles indicate a radius of 2.5 km around each observation site)

Table 2: Number of recorded birds, proportion (%) of the flyway population of the most numerous species recorded in spring 2013 within the project area

Species	Scientific name	Number	Percent fly-way population
White Stork	<i>Ciconia ciconia</i>	112,729	15.0 - 25.1
Great White Pelican	<i>Pelecanus onocrotalus</i>	3,065	4.4
Black Stork	<i>Ciconia nigra</i>	1,240	3.1
European Honey Buzzard	<i>Pernis apivorus</i>	20,550	2.1
Black Kite	<i>Milvus migrans</i>	2,239	1.7
Egyptian Vulture	<i>Neophron percnopterus</i>	116	2.6
Short-toed Snake Eagle	<i>Circaetus gallicus</i>	426	4.9
Steppe Buzzard	<i>Buteo buteo vulpinus</i>	24,867	2.0
Greater Spotted Eagle	<i>Aquila clanga</i>	62	2.8
Steppe Eagle	<i>Aquila nipalensis</i>	3,795	10.1
Booted Eagle	<i>Aquila pennata</i>	156	3.1
Common Crane	<i>Grus grus</i>	1,160	2.3

The data on the flyway population sizes are taken from Leshem & Yom-Tov (1996) and Hilgerton (2009) .

Noise, Electromagnetic Interferences and Vibrations

- **Noise**

Noise from a wind turbine is predicted from manufacturer's information on source sound pressure levels based on a reference wind speed at a certain height above the ground (usually 10m). From a single wind turbine this is usually between 90 and 100 dB(A). At 40m, this translates

to a sound pressure level of 50-60 dB(A), which is about the same level as conversational speech. A number of attenuating factors e.g. atmospheric absorption and barrier attenuation are then added. The sound pressure level has the advantage of being an objective yet a handy measure of sound intensity, but it has the drawback that it is far from being an accurate measure of what is actually perceived (ETSU .,1997a).

Table 3: The Law 4/1994, executive regulations, require maintaining the following critical ambient noise levels at day (7 am to 6 pm) and night times (6 pm to 7 am):

Receptor	Day dB (A)	Night dB (A)
Industrial areas (heavy industries)	70	60
Commercial & downtown	65	55
Mixed Residential, commercial, small industrial	60	50
Residential areas in cities	55	45

The following receptors inside and in the surroundings of the project boundaries were identified and assigned to the relevant receptor cluster, whereby the Ras Gharib settlement is far away from the wind farm as shown in Table (4):

Table (4): the Ras Gharib settlement around the wind farm:

Receptor	Noise limit cluster	Noise limit dB (A)
Explosives storage about 200 m to the north of the Ras Gharib – Nile Valley road	Mixed Residential, commercial, small industrial, if manned	50
Ras Gharib (about 6 km away from the nearest area point)	Residential areas in cities	45

If noise levels were above the recommended levels, mitigation will involve reducing turbine numbers, moving turbines away from sensitive properties, or adapting the turbine specification (e.g. adding baffles and acoustic insulation to generator housing). A change of turbine manufacturer can also help sometimes.

- **Electromagnetic Interferences**

Wind turbines could potentially cause electromagnetic interference with aviation radar and telecommunication systems (e.g. microwave, television, and radio). This interference could be caused by three main mechanisms, namely near-field effects, diffraction, and reflection or scattering. The nature of the potential impacts depends primarily on the location of the wind turbine relative to the transmitter and receiver,

characteristics of the rotor blades, signal frequency receiver, characteristics, and radio wave propagation characteristics in the local atmosphere (Burrall, 2004). Effects include blocking or scattering of signals. Scattering of signal may affect domestic TV. Any blocking or scattering of signals is considered significant and requires mitigation measures. Assessment of line of site radio and microwave signals transmitted through the site by consultation with various users of EM transmissions. For mitigation procedures, moving turbines or rerouting electromagnetic signals are both established mitigation measures. For TV receptors an installation or modification of a local repeater station or cable connection can alleviate impacts (Scottish Natural Heritage, 2005).

A military radar is operated at a distance of 3 km from the south-eastern border of the ESIA AREA. As the area was already cleared by the Ministry of Defense before being assigned for.

- **Vibrations**

Vibrations may result from wind turbine operation. However, wind turbines working under regular conditions with the blades correctly balanced and the main shaft correctly adjusted show very little vibration. The propagation of the vibration is dampened by the foundation body and there is very little transmission into the underground, especially in case of a non-rocky under-ground like in most of the part of the subject project area. Thus, vibration effects will not be measurable in the underground already nearby the wind turbines. Moreover, vibrations or very low-frequency “infrasound” produced by wind turbines are the same as those produced by vehicular traffic and home appliances and are similar to the beating frequency of people’s hearts. Such “infra-sounds” are not special and convey no special risk factors (Institute of Ecology and Environmental Management, 2006).

Final Mitigation and Design:

Following the mentioned environmental assessment, the design of the wind-farm is amended and a final assessment made of all the assessments.

Studying the impacts and how is a Planning Decision made?

The decision making authorities must take into account the results of all of the impact assessment presented in the EIS, including local impacts and the wider, global impacts. The decisions must be placed against some considerations such as National Energy Policy and Planning Policy Statements.

Weighing up these parameters is a difficult process and often depends on who is on the decision making panel and who is objecting party.

Conclusions and recommendations:

The environmental benefits of wind-energy development, mainly reductions in atmospheric pollutants, are enjoyed at wide spatial scales. Balancing negative and positive environmental and socioeconomic impacts of wind energy; and incorporating public opinions into the review process. Regulatory agencies should adopt and routinely use an evaluation guide in their reviews of wind-energy projects.

Some pointers emerging:

- EIA can be used as a design tool as well as decision tool
- It can aid maximizing output whilst minimizing negative environmental impact
- EIA requires objectivity (though some assessments).
- Ensure adequate information is available for decision makers

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