



Final Report

Mid Size Sustainable Energy Financing Facility (MidSEFF)

Usak Wind Power Plant: Non Technical Summary (NTS)

January 2012

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European Bank for Reconstruction and Development

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The European Bank for Reconstruction and Development (EBRD) launched in January 2011 a financing facility aimed at scaling up Renewable Energy and Energy Efficiency investments in Turkey, to increase the country's energy savings and decrease its carbon emissions. The Turkish Mid Size Sustainable Energy Financing Facility (MidSEFF) launched by the EBRD with support from the European Investment Bank (EIB) and European Commission (source of the Technical Cooperation funds) will provide a total of EUR 900 million in loans through 5 Turkish banks for on-lending to private sector borrowers.

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Project Name: Usak WPP - Non Technical Summary (NTS)				Controlled Copy	
Rev. N.	Date	Description Amendment	Edited by	Revised by	Approved by
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1. Project Description

The project location is Aegean Region, Usak province, Banaz district, Beylikorman, Kaylakkiran, Avlan, Guney ridges, Eyupcami hill, Santdagi location. The wind farm area is at an elevation ranging between 1,100 m and 1,400 m above sea level and its surroundings are agricultural lands with single trees of irregular height and density.

The wind measurements analysis has been carried out by the German-based company DEWI according to the MCP process (Measure, Correlate and Predict), which is a standard in wind energy industry. The overall process of wind data analysis undertaken by DEWI is considered adequate by the MidSEFF Team.

The data at the basis of the electricity calculation are wind measurements collected from two calibrated anemometers installed at the site (Usak 1 and 2). Data were recorded at a height of 50 m (Usak 1) and 60 m (Usak 2) during 24.5 months and 9 months, respectively. The average wind speed resulted in 5.4 m/s for the former and 6.6 m/s for the latter.

The short-term measuring data have then been correlated with meteorological long-term data to find reliable sources for filling gaps and long-term correction of the measured wind statistics.

DEWI checked data of fourteen meteorological stations and different sets of the Reanalysis data, but most of them have shown poor correlation with the site measurements.

Data from Afyonkarahisar station have been used to fill data gaps of site measurements and to extend the measurement period of one of the two anemometers to one full year. Only one Reanalysis data set has been evaluated reliable and has been used by DEWI for long-term correction. The so obtained wind statistic is therefore valid for a period of 11 years and the average wind speed results 5.5 and 6.9 m/s for Usak 1 and Usak 2 respectively.

For what concerns the plant, a total of 6 different configurations have been analyzed in DEWI's report, considering different turbines. The chosen configuration consists of 36 Sinovel turbines with a nominal power of 1.5 MWe each and a hub height of 80 meters. A theoretical power (Figure 1-1) curve of the selected turbines has been provided for the standard air density of 1.225 kg/m³ and then recalculated by DEWI for the air density at the site.

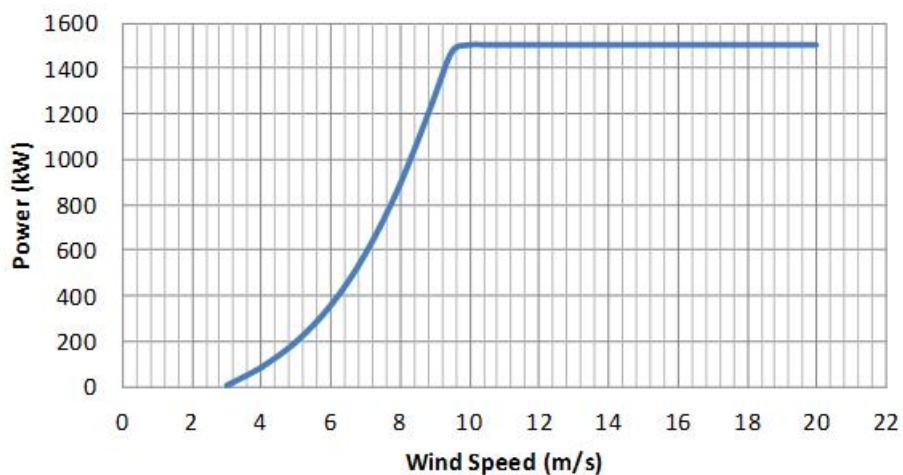


Figure 1-1: Theoretical power curve of SL1500/89 at standard air density (1.225 kg/m³)

In general terms the layout is suitable for the prevailing wind directions (NNE and S) at the site. Regarding the inter-turbine distances, it has been noted that, even if the minimum distance of 3 rotor diameters is respected everywhere, about a quarter of turbines aligned along the prevailing wind directions is spaced by just 5 rotor diameters. This leads to consistent wake losses (more than 8%) and to high turbulence intensity which could in turn induce high stress on turbines.

Usak WPP will be connected to the national electricity grid through the existing 6 km transmission line passing through the wind farm. A new line, 154 kV, single circuit 2 X 1,272 MCM will be added to the existing 6 km overhead transmission line to connect Uşak WPP to Uşak TM-Afyon-I TM Transformer Station. The related grid connection agreement has been provided by the Project sponsor.

Other project information such as details of access to the site and to the specific wind turbines, details of the civil works to be performed for connections, design of turbines foundations, geotechnical studies and ground surveys have not been provided to the MidSEFF team.

For what concerns the project schedule, the Company’s expectation is to close all the works within 9 months. Despite the poor knowledge of ground conditions and the lack of foundations design, the MidSEFF team considers the time schedule tight, but feasible.

The Energy Output Calculation has been performed by DEWI using a CFD code named Phoenix 3.4. This software has been utilized to extrapolate the wind data from the two anemometers to the various turbine positions and to the height of the hub (horizontal and vertical extrapolation). For this purpose, the orographic model of the territory has been used. After this, wake losses due to the mutual interference of turbines have been computed. The results of this calculation are considered by the MidSEFF Team consistent with the modelled wind farm.

In the subsequent calculation step, systematic energy losses (such as availability, maintenance, etc.) have been considered. Also these efficiencies are considered adequate and consistent with the project.

Finally, DEWI has taken into account the uncertainties, both in wind speed and energy. The analysis does not neglect any standard source of uncertainty and the selected values have been found generally satisfactory. Nevertheless the MidSEFF team reviewed some of these values and recalculated the exceedance probability curve. The results for P50, P75 and P90 are shown in Table 1-1.

Table 1-1: Exceedance probability table

Exceedance Probability	Annual Energy Production [GWh/year]	
	DEWI Report	MidSEFF estimation
P50	153.1	153.1
P75	137.2	135.1
P90	122.9	119

It is worth to mention that the financial plan submitted by the developer for the project uses as P75 the conservative value of 130 GWh/year. For the same reason of conservativeness, the P75 value adopted for all the calculations developed in this REUP has been maintained at 130 GWh/year.



Figure 1-2: Views of project area



Figure 1-3: Views of project area



Figure 1-4: Views of project area

2. Environmental and Social Baseline

2.1 Environmental Description of the Project Area

The plant location is a rural area and not valuable for agricultural and natural view. On the basis of the information provided by the sponsor, confirmed during the site visit, the area is not highly valuable under naturalistic viewpoint. Most of the generators appear to be located in a stony and scarcely vegetated soil, mainly vegetated by brushwood. The total area related to the project is 920 he, but only 18.4 he will be physically used by facilities. The agricultural area is 290 he and only 4.5 he will be occupied actually, the other part (290-4.5 = 285.5) will easily be used for farming also after the project will be operating. No forestry area in the project site but some small trees and brushes. The turbines will be placed where no tree-cutting will be needed.

On the basis of the information provided by the sponsor (confirmed during the site visit), the area is not highly valuable under naturalistic viewpoint. All generators appear to be located in a stony and scarcely vegetated soil, mainly vegetated by maquis.

According to Project Information File and site visit, the project area belongs to the Treasury of Turkey and private owners. The privately owned area is wheat and barley farming field and the Treasury part is not used area mainly consisting of a few maquis and brushwood. The Agricultural Area Usage Permit was received from the Ministry of Agricultural and complementary part is going to be received during construction

No residential areas in the project areas nor in the proximities: the village of Büyükoturak is located more than 500 m far away from the nearest wind turbine; but project area uses the lands of 4 different villages namely Büyükoturak, Paşacık, Karaköse and Çiftlik

The information provided highlights that the characteristic of the soil and its actual use make it not so valuable. The economic displacement is not a critical aspect.

Considering the project location, the impacts on flora and fauna are not to be considered as a potentially critical aspect apart from the impacts on bird life which needs a particular deep analysis.

Considering the type of project, a dedicated study has been partially implemented about presence of the birds and birds migration routes in the wider region of the project. In western Anatolia, there is only one main bird migration route and three ancillary routes. According to the provided information, primary and secondary migration routes appear to be sufficiently far from the WPP area.

2.2 Social Condition of the Project Area

Generally speaking the plant location area is in a natural status with no particular evidence of human structures and infrastructures, only a some small road runs along the existing farming areas. No residential areas in the project area nor in the proximities are present: the nearest settlement, Büyükoturak, is located more than 0.5 km far away from the wind turbines. Other villages in the surroundings are: Paşacık, Karaköse and Çiftlik. The main economic activities of these villagers are farming (barley and wheat) and animal breeding (sheep).



Figure 2-1: Büyükoturak Village

3. Social and Environmental Impact

Main typologies of WPP related impacts are:

- impacts on the environment and nuisance to local people during construction activities;
- impacts on biota and especially on birdlife (during operation);
- impacts on landscape (during operation);
- noise impact (during operation);
- land use.

Other typical related issues are:

- water usage and discharge;
- waste production,

Further statement is dedicated to working conditions.

The documents submitted by Sponsor show that no limits of the law will be exceeded for any considered environmental component. The following paragraphs show how the environmental and social problems, related to the expansion of the plant, are addressed. In Table 3-1 some technical data about project impacts are showed.

Table 3-1: Impact Quantification

COMPONENT	IMPACT	QUANTIFICATION
Land use	<u>Different use of the land</u>	Mainly forestry. Agricultural and Private lands also involved.
Water	<u>Utilization and Discharge</u>	1.5 m ³ /day for construction, 0.3 m ³ /day for operation
Waste	<u>Production of solid waste</u>	1.34 kg/person/day (10 workers for construction, 2 worker for operation)
	<u>Excavation waste</u>	6,720 m ³
Birds	<u>Collision with turbines</u>	No presence of migratory routes, no evidence of birds communities
Emissions	<u>Noise</u>	Construction phase <70dBA (law limit) Operational phase: No disturbance for the nearest receptors (45 dBA for 200 m, the nearest settlement is 0.45 km away)
	<u>Particulate</u>	< 1.5 kg/h (law limit)

3.1 Impacts on Biota and Birdlife

The baselines studies showed that no valuable habitats/species are present in the area, so that no relevant impacts are expected. Considering the kind of project, a deeper analysis was devoted to birdlife, because birds' collision with the turbines could be a problem in case of the proximity with some migratory or ancillary routes. A dedicated study about the presence of birds and migratory routes has been partially implemented by the sponsor: the study confirms that the project location is far from migration routes so that no relevant issues related to birds' collision is expected.

3.2 Landscape

The impact on landscape due to the presence of the wind generator is quite a typical issue considering the location of this kind of plants (usually on the crests of hills) and the dimensions of each tower.

The site visit confirmed that the project area is visible from great distances, especially in particular weather conditions; in any case the sight of the plant is not so impressive or intrusive in visual path from the surrounding villages.

3.3 Land use

In order to utilize agricultural fields in the project for non-agricultural purposes, in compliance with sanctions in "Soil Conservation and Land Use Law" No. 5403 enacted as issued in Official Gazette 25880 dated 19.07.2005 required permits come from Uşak Provincial Directorate of Agriculture and/or Ministry of Rural Affairs. The client has taken a formal answer from the local authority for agricultural fields usage in 2009.

For the private lands the sponsor's intention is to purchase these lands or acquire passage rights from the owners; in case of some difficult to agree with owners, the sponsor has obtained the right to expropriate these areas through Energy Market Regulatory Authority (EPDK) according to Expropriation Law No. 4650, Electricity Market Law No. 4628 and law No. 5496.

3.4 Water

There should be household water waste both during construction and operation phase. This is generally employees' daily waste. The pollution is biological and physical. A study on the PIR shows that it is acceptable limits and will be managed according the Water Pollution Control Regulation.

3.5 Waste

The residential type solid waste produced by staff to be employed during field preparation/construction phases of the project and operation will be collected and kept in covered trash bins located at several locations within the field to be used as construction site. Solid waste collected as such will be disposed by being sent to Banaz Municipality solid waste collection system on regular basis.

Lump iron, steel, sheet metal and iron, packaging materials and similar solid waste will emerge during field preparation and construction phases of the project and the amount cannot be predicted since it will vary. Waste material will be collected as scrap to be stored at a suitable location within the project area, possible solid waste will be recycled to be reused or handed to licensed recycling companies. Waste not viable for recycling will be disposed by being sent to Banaz Municipality solid waste disposal site.

There will not be any hazardous waste emerging during the field preparation and construction phases of the project in compliance to "Directive on Controlling Hazardous Waste Materials".

Employees will be warned about the prohibition on dumping all solid wastes (like waste food etc) to emerge during the field preparation, construction and operation phases of the project into seas, lakes, streets and similar recipient environment as mentioned in "Directive on Controlling Solid Wastes".

The excavated material collected due to construction works will be temporarily stored around the excavated area dumped by shovels and buckets. After the excavation and concrete laying processes, stored excavated material will be used at filling material. Remaining parts will be used in environmental arrangements, landscape works and road preparation.

3.6 Emissions: Particulate and Noise

3.6.1 Particulate Emissions

During construction phase emissions to atmosphere have been assessed referring to dusting caused by construction activities.

The estimated overall dust emission to atmosphere is lower than the dust generation limit regulated by the Air Pollution Due to Industrial Facilities Control Regulation (1.5 kg/h). Therefore no dust modeling is found to be necessary to perform.

To minimize impacts on air quality by the project, the following precautions will be taken:

- setting a speed limit for vehicles moving inside the project area;
- covering the truck dampers while loaded.

3.6.2 Noise Emissions

The noise emission for the construction phase has been assessed considering the yard's equipment, obtaining noise level against distance from the yard's area and comparing the generated level to directive limit values; it's to point out that total noise level approximately 100 m away from the yard is observed to be below Lday 63.8 dBA limit.

Noise emissions are expected during operation due to turbines working. A study within the Project Information Report shows that it is acceptable level for the nearest settlements.

3.7 Working Conditions

Provided documents and notes by the project sponsor state that construction and operation activities will be executed in line with the existing legislations, namely: "Regulation of Occupational Safety and Health" and "Regulation of Occupational Safety and Health In Constructive Works".

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