CDM/JI Feasibility Studies

Wind Power Electricity Generation in Slovakia

Summary

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Mizuho Information & Research Institute, Inc.

Contents

1 Description of the project

1.1 Description of the project

This whole project does the wind power generation of total 90.75MW in the west of The Slovak Republic. The wind parks of the project are located at two local spots.

Table 1 Description of Project A

Item	Index or Specification	Note
Business operator	COMPANY A	
Type of wind turbine	V100, 2.75 MW	Manufacturer：Vestas
Number of installed wind turbines	16	Total 44 MW
Distance to the power grid	5.0 km	An electrical substation equipment of 22/110kV will be newly constructed as the connection to the grid.
Annual average wind speed	6.4 m/s	
Expected power generation	About 90,000 MWh	Potential of annual power generation
Start of operation	In the middle of 2008	

Table 2 Description of project B

Item	Index or Specification	Note
Business operator	COMPANY A	
Type of wind turbine	V100, 2.75MW	Manufacturer：Vestas
Number of installed wind turbines	17	Total 46.75 MW
Distance to the power grid	5.0 km	Necessary to construct a new electrical substation of 22/110 kV as the connection to the grid.
Annual average wind speed	6.1 m/s	
Expected power generation	About 88,000 MWh	Potential of annual power generation
Start of operation	In the middle of 2008	

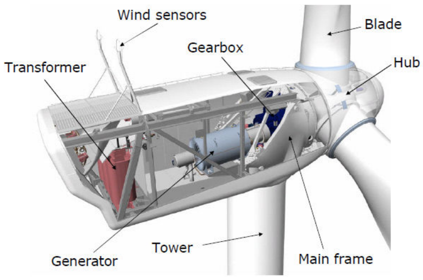
1.2 Location of the project sites

A picture taken near one site is presented as Figure 1. Wind turbines are planned to be installed in line over the hill shown far away in the picture. At present, this area appears as flat grasslands without any constructions.

Fig. 1 Present condition of the project site

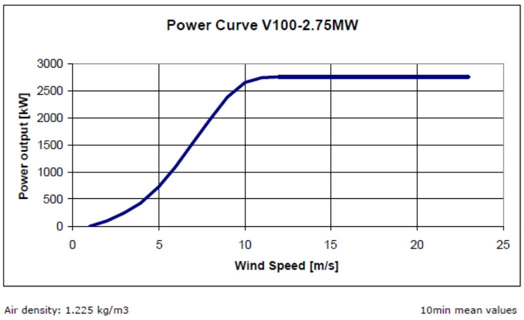
1.3 Wind power technology introduced to the project

V100 series 2.75MW, a new product from Vestas company, will be introduced to this project. The V100-2.75MW is capable to generate electricity with every wind direction . The rated speed of rotor can be changed within the range of 60% based on the OptiSpeed technology that Vestas Co. has developed. As a result, it can even harness the force of wind gust, then the potential of annual power generation has been improved comparing to Vestas' previous products. Moreover, a low peak load contributes to reduce mechanical wear and cracks on the gear, the wings, and the tower. In addition, its lower rotational speed leads noise-reduction respectably.



Source：http://www.exportinitiative.de/media/article006029/2_J.%20Clausen_VESTAS.pdf

Fig. 2 Internal structure outline of V100-2.75MW



Source：http://www.exportinitiative.de/media/article006029/2_J.%20Clausen_VESTAS.pdf

Fig. 3 Power curve of V100-2.75MW

Table 3 Performance examination results of V100-2.75MW

Wind speed（m/s）	5	6	7	8	8.5
Power generation（MWh）	3903	6114	8342	10393	11319

Source：http://www.exportinitiative.de/media/article006029/2_J.%20Clausen_VESTAS.pdf

2 Baseline scenario

This project is a wind power generation project, and brings out neither immediate GHG emissions nor the reductions from the project itself. On the other hand, the electric power generated by the project will be connected and transmitted through the power grid, thereafter; it comes to reduce certain emissions from other fossil fuel power plants over the grid in the country.

As a baseline methodology that can be applied to this type of project, in CDM, the specific baseline methodology ACM0002 has been established, substituting for certain amount of electricity power over the grid by power generation utilized various renewable energies including wind power to reduce CO2 emissions.

However, at this investigation stage for the above project, it was decided to calculate baseline referring to the methodology that government of Netherlands (Ministry of Economic Affairs of the Netherlands) had once developed. The government of Netherlands have been examining and developing theirown baseline methodology for Central and Eastern Europe since before, then executing actual Joint Implementation (JI) projects upon the methodology.

It is assumed that adopting the methodology already realized shall indicate smaller risk for this investigation in consideration of Slovak geographic environment in the same Eastern European region.

However, updated results of available data are applied here since the original data within above mentioned methodology came from 2000.

2.1 Outline of calculation process

Concretely, the average emission factor at baseline scenario is calculated by the following process;

1) To calculate the average emission factor A of natural gas and oil thermal power plants
2) To calculate the average emission factor B of other fossil fuel thermal power plants (i.e. coal, etc.)

However, when power generation by CHP is included in above 1) and 2), the average emission factor will be calculated, evaluating the remaining amount after all energy inputs to CHP minus the estimated energy amount spend for heat generation as the energy used for power generation. The estimated energy amount for heat generation is calculated as the produced heat energy divided by 0.9.

3) To calculate the ratio C of thermal power generation with natural gas and oil to the total power generation with all types of fossil fuel
4) To calculate the ratio D of other power generation, excluding those with natural gas and oil, to the total power generation with all types of fossil fuel
5) To calculate $C_{corrected}$ (= 1.5×C) for weighting as marginal power supply
6) To calculate $D_{corrected}$ (= D－0.5×C) for weighting as marginal power supply
7) To calculate baseline emission factor X ($X = A \times C_{corrected} + B \times D_{corrected}$) by applying the above relevant values.
8) To forecast a future baseline emission factor Z, applying a method of least squares on the past factor X in a particular year.

2.2 Data sources and results of the calculation

Energy supply data utilized for the above calculation of baseline emission factor is from IEA statistics. As a result, emissions factors of each fuel type is shown in Table 3 – Table 6.

Table 3 Emission factors on the power grid (2001)

Emission Factor (kg-CO2/kWh)	Coal	Crude Oil	Petroleum	Gas		Oil&Gas
for Electricity Plants	1.120			0.569		0.569
for Elec. Of CHP	1.268		0.416	0.852		0.754
for Total	1.117		0.331	0.755		0.669

Table 4 Emission factors on the power grid (2002)

Emission Factor (kg-CO2/kWh)	Coal	Crude Oil	Petroleum	Gas		Oil&Gas
for Electricity Plants	1.118					0.000
for Elec. Of CHP	0.924		0.330	0.668		0.595
for Total	0.981		0.325	0.668		0.593

Table 5 Emission factors on the power grid (2003)

Emission Factor (kg-CO2/kWh)	Coal	Crude Oil	Petroleum	Gas		Oil&Gas
for Electricity Plants	1.364					0.000
for Elec. Of CHP	1.185		0.499	0.714		0.666
for Total	1.210		0.492	0.714		0.664

Table 6 Emission factors on the power grid (2004)

Emission Factor (kg-CO2/kWh)	Coal	Crude Oil	Petroleum	Gas		Oil&Gas
for Electricity Plants	1.428					
for Elec. Of CHP	1.136		0.430	0.690		0.629
for Total	1.177		0.430	0.690		0.629

Table 7 is presented as a summary of all specific factors derived through the calculation process and the resultant baseline emission factors on the power grid. The conclusive emission factors on the power grid are shown at the bottom of the table as values for 2008-2012.

The time-series emission factors (2001-2004) and baseline emission factors on the power grid (2008-2012) are illustrated in Figure 5.

Table 7 Results of baseline emission factors on the grid

	2008	2009	2010	2011	2012
Emission Factor (kg-CO2/kWh)	0.8543	0.8551	0.8559	0.8567	0.8575

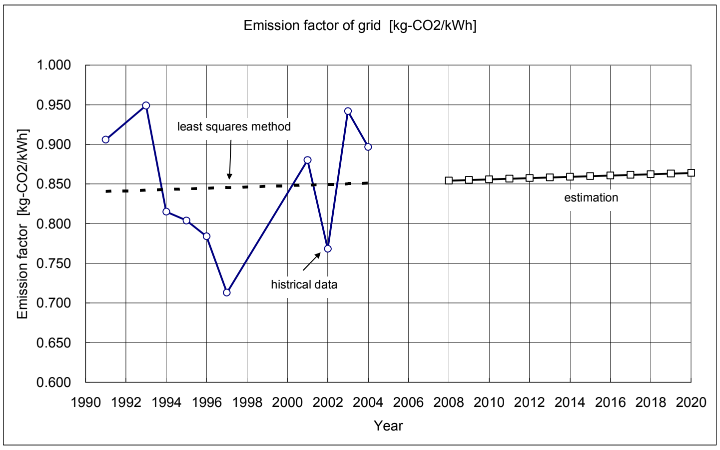


Fig. 4 Calculated baseline emission factors

3 Monitoring plan and methodology

3.1 Purpose of monitoring plan

Monitoring plan is designed for managing and reporting all amount of green house gas emission reductions related to the relevant project. In monitoring, it is required to ensure that the project performance will appear as high as planned and the emission reduction credit will be actually identified.

A responsible person of the project implementation must response to the inspection requirement of reporting the emission reductions with his proper data evaluation, measurements and traceability of enough reliability, transparency and accuracy. These observations and monitoring systems will be needed to confirm project's effectiveness as a part of verification or certification by selected verifier(s). This process can also prove the actual reductions of CO2 emissions and give the fair credibility to emission credit buyers.

The unique GHG emission for wind generation as this project is the emissions from fossil fuel power plants located on the power grid over the area. The pivotal point in this case is if the implementation of proposed project could actually reduce a certain amount of these emissions.

Therefore, the crucial monitoring items are;

1) Amount of power generation from the project

2) Emission factor on the power grid (including transmission loss).

Specially, above 1) the amount of power generation from the project is defined as the important key at monitoring. About the emission factor on the power grid, it was already calculated as the baseline emission factor of this project. In case of executing this project as JI, monitoring might not be necessary since the period of ERU issuance is relatively short - only for 5 years. On the other hand, if implementing it as “Project-backed AAU” trading project, annual monitoring for emission factors might be needed from the viewpoint of conservative emission factor management since the reduction even after 2013 will be possibly added as the Late credit.

COMPANY A, the implementation body of this project, will utilize this monitoring plan as their guidance for monitoring the fulfillment of project’s emission reductions. This plan may be revised as per the requests of Slovak validator(s) or verifier(s) to ensure more suitable reliability, transparency and conservativeness for the practical environment assessment and the estimation of emission reduction amount.

3.2 Monitoring methodology

In this project, power generation by wind turbines and the necessary data for calculation of emission factor on the grid will be monitored.

3.2.1 Monitoring the amount of power generation

To prove the accuracy of calculated power generation, monitoring process should be conducted by the responsible person of the project. In practice of selling some generated power to a local distribution company, the amount of electricity transmission for concerned period is determined after when two meters, placed by each of the project operator and the distribution company at a grid connection point (a substation), are verified with the same metered records.

For the monitoring of this project, as same, a meter at a substation will be used. The meter is readable with a remote operation through telecommunication lines. Monthly data from meter is processed to be documentations and stored ensuring verifier’s convenient access, and all metered records have to be maintained for further demands of an inspection organization.

3.2.2 Monitoring necessary data for calculation of emission factor on the power grid

Data for calculation of baseline emission factor on the power grid in Slovakia will be monitoring. As described in “1.2 Baseline scenario”, power generation and fossil fuel consumption on the entire grid is calculated referring IEA statistics of ENERGY BALANCES OF OECD COUNTRIES and ENERGY STATISTICS OF OECD COUNTRIES. For this reason, above two statistical resources are positioned as the basic data for monitoring.

3.2.3 Data management system

The data management system provides information for continuous data collecting and recording during the monitoring period. The relevant and successive data recording is the most fundamental among all monitoring works. If the successive data cannot be archived in the precise and effective ways, there will be no appropriate validation for emission reductions by implementing a project. Hereafter describes the way of data management for records related to the project.

COMPANY A has complete responsibility for monitoring GHG emission reductions. Procedures of tracing the information from primary data sources towards the calculation of final data should be explained in the written documents.

To realize enough accessibility for verifier(s) to any data related this wind power generation projects, project-related documents and monitoring results are formatted as indexes, all hardcopies are stored by engineering division at the responsible body of the project (the operating company of wind power generation) and their copies are also stored as backup.

3.2.4 Determination of the monitoring result

Determination of the monitoring result for a wind power generation project is mandatory as required to all CDM projects. It is unknown at this point how the validation procedures will be for the coming validation of a JI project like this project (specially the JI based on Track 1 procedures).

However, if the same level of CDM validation is required, it is foreseen that the validation takes place semiannually or quarterly and an independent organization validates the evidence of emission reductions as described and expected in the PDD.

3.2.5 Responsibilities for the determination

The responsibilities of COMPANY A for determination are following;

- To contract with the verifier to achieve the agreement for validation activity schedule during crediting period, based on the requests of the emission-right buyer and the Ministry of Environment in Slovak Republic as a competent authority (or JISC, if necessary)
- To cooperate to the verifier, by providing all necessary information, etc., for a smoother validation process
- As the responsible person for project implementation, to cooperate completely to the verifier, to educate staff, to be available for any interviews and to response sincerely to all the questions from IE.
- To assign staff responsible for monitoring and validating, to be also responsible for all the process of monitoring and validating and to act as the contact window for the verifier.

4 Project period and crediting period

4.1 Project period

Start of the project is currently planned at the middle of 2009. The present technology enables to run wind power generation equipments for up to 20 years. COMPANY A sets the project period as for 20 years; hence, the closing of project is scheduled in 2027.

4.2 Crediting period

Crediting period will be different if this project is implemented as JI or “Project-backed AAU” trading project.

4.2.1 For the JI project

If implemented as JI project, the period of ERU issuance will be for 5 years from January 1st, 2008 to December 31st, 2012. Accordingly, the crediting period for this project will be from the middle of 2009 to the end of 2012.

4.2.2 For the "Project-backed AAU" trading project

AAU will be issued according to the amount of GHG emission reductions by the project implementation. Under the Kyoto Protocol, because AAU is designed as the credit for 5 years from 2008 to 2012, the transfer period would be for the same 5 years of the first commitment period as in the above JI case.

However, among the ways of defining emission reductions, there are so-called Early credit or Late credit as to be additional transfer amounts onto the reductions during the first commitment period, by calculating reduction amount in/before 2007, or expected amount in/after 2013.

In this project, too, an application of these credits may arise according to future negotiations since Ministry of Environment in Slovak Republic once spoke, at the meeting with Mizuho Information & Research Institute, Inc., that it would be possible to calculate Late credit to be added as bonus. In view of this, the crediting period as the calculation period for emission reductions, will be from the middle of 2008 to 2012 plus α.

5 Calculation of GHG emission reductions

5.1 How to calculate GHG emission reductions

This project is a wind power generation business, without bringing out neither direct nor indirect GHG emissions from the project itself. The type of GHG is only CO2. For that reason, the amount of GHG emission reduction is calculated as;

$$ER_{GHG} = EF_{GRID} \cdot Elec_{PROJECT}$$

ER_{GHG} : amount of annual GHG emission reductions

EF_{GRID} : baseline emission factor including transmission loss

$Elec_{PROJECT}$: power generation by wind power

5.2 Calculation of emission reductions

The expected power generation and GHG emission reductions at project A and project B project are presented in Table 8 and Table 9.

Table 8 Amount of power generation and emission reductions at project A

	5 years total	2008	2009	2010	2011	2012
Emission Factor (t-CO2/MWh)		0.85	0.86	0.86	0.86	0.86
Electricity generation (MWh)	314,874	0	44,982	89,964	89,964	89,964
Emission reductions (t-CO2)	269,681	0	38,464	77,000	77,072	77,144

Table 9 Amount of power generation and emission reductions at project B

	5 years total	2008	2009	2010	2011	2012
Emission Factor (t-CO2/MWh)		0.85	0.86	0.86	0.86	0.86
Electricity generation (MWh)	309,251	0	44,179	88,358	88,358	88,358
Emission reductions (t-CO2)	264,865	0	37,777	75,625	75,696	75,767

The total amount of GHG emission reductions from these two sites is presented in Table 10.

Table 10 Total amount of GHG emission reductions for both sites

	5 years total	2008	2009	2010	2011	2012
Baseline emissions (t-CO2)	534,545	0	76,241	152,625	152,768	152,911

As examined above, the total amount of GHG emission reduction for both of project A and project B project (the total for the first commitment period) is estimated to 534,545 tones of CO_2 equivalent.

6 Information related to environment assessment

Environmental assessment has been performed by the COMPANY A since the beginning of 2006, and as soon as completed as a report, a next process will be undertaken for final approval by the signature of the director of a bureau which specializes in environmental assessment in Ministry of the Environment. "Noise", "Impact on scenery", and "Impact on birds" are the three important issues in the environmental assessment which requires the approval regarding wind power generation business. In the present circumstances, it is understood that it has gone extremely well the explanation to the public meetings, local governments, etc. General reactions are positive due to the potential increase of job opportunities and the subsidy to the local governments of the power generation sites. A person in charge at COMPANY A, however, made a comment that it possibly becomes a most difficult point to pass the above bureau in Ministry of the Environment since its current director is rigid to a large extent.

7 Others

7.1 Other indirect impacts

Other indirect impacts are not considered to exist at this point.

7.2 Stakeholders' comments

COMPANY A, the business operator is making a collection of stakeholders' opinions and responding to them regarding to its wind power generation business itself. At this stage, mostly favorable opinions are received from each stakeholder.