

**JEPIRACHI WIND POWER PROJECT
LA GUAJIRA, COLOMBIA**

CDM REGISTRATION REFERENCE NUMBER 00194

MONITORING REPORT NUMBER 2



MONITORIG PERIOD

August 1/2006 to December 31/2007

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INTRODUCTION

This is the second Monitoring Report for the Emission Reduction (ERs) generated by the Jepirachi Wind Park, a CDM project (registration number 00194, of April 1, 2006), for producing renewable energy covering the second monitoring period (August 1 to December 31 of 2006) and the third monitoring period (January 1 to December 31 of 2007), for 19.223 tons CO₂ reduced.¹

The first monitoring report was prepared in November 2006, and was verified by Det Norske Veritas, in December 2006, for 48000 tons of emission reductions of the period between January 2004 to July 2006, which were sold to PROTOTYPE CARBON FUND (PCF) as verified emissions reductions (VER); the certified emission reductions (CER) were issued by UNCCC in May 2008.

With the implementation of this project, EMPRESAS PUBLICAS DE MEDELLIN (EPM) sells electricity to the national grid, avoiding the dispatch of same amount of energy produced by fossil fuelled thermal plants to the grid. By that, the project avoids CO₂ emissions, and contributes to the regional sustainable development.

The project participants of the project are EPM as owner, developer and operator of the Wind Park, and the INTERNATIONAL BANK FOR RECONSTRUCTION AND DEVELOPMENT as trustee of the PROTOTYPE CARBON FUND (PCF) of the WORLD BANK (WB) as buyer of the emissions reductions (ER).

The wind park Jepirachi is located in a desert area inhabited by the Wayuu indigenous communities, at La Guajira Department, north of Colombia. The technical parameters of are:

- Total nominal power 19,5 MW
- Number of windmills: 15
- Power by each windmill: 1,3 MW
- Minimum speed for generation: 4 m/s
- Nominal speed for windmills: 15 m /s
- Average Speed of wind (h=50 m) 9,25 m/s
- Diameter of blades: 60 m
- High of Powers: 60 m

Connection to the National Transmission System is done trough a transmission line of 110 kV between Cuestecitas y Puerto Bolivar Energy Substations.

¹ According to the amendment to the Emissions Reduction Purchase Agreement (ERPA; November 2007) between PFC and EPM the verification period is from January 1 to December 31 of each year.

The different units of the project were commissioned between January and March, 2004 and were declared on commercial operation of July of same year. The project has been completed as planned and described in the PDD.

1. METHODOLOGY

The base line methodology and monitoring developed and adopted by EPM for The projects, correspond to the “Consolidated baseline methodology for grid-connected electricity generation from renewable sources” ACM0002, option c). This option accounts for CDM large extent power generation projects (greater than 15 MW) as designed by the CDM Executive Board. This results from an internal analysis of the sector, and became a country methodology for its application within the Colombian electric sector.

In order to estimate the baseline emission factor (EF), by which CO₂ emission reductions are calculated for a CDM project, the methodology ACM0002 is based in the estimation of two variables: the operating margin emission factor and the build margin emission factor. In the estimation of the baseline emission factor, two factors have the same weigh.

The data used for the estimations is taken of the NEON data bases of the National Dispatch Centre (CND), by which it was possible to access the National Grid-connected electricity System (SIN). These are the official source data related with offering and power generation plants connected to the CND.

Operating Margin Emission Factor:

The consolidated methodology ACCM002 to estimate the operating margin emission factor has to estimate “ $365 \times 24 = 8760$ ” calculations, corresponding to all hours per year. For each hour, an REAL dispatch of the Colombian electric system has to be built (as required in the methodology), which is different to the ideal dispatch performed by the system’s operator, since there is no public data regarding the order in which plants are dispatched in the REAL system. Thus, to comply with the ACM0002 methodology, this dispatch has to be built. This procedure is performed by taking all data for each hour and day of the respective year and take into account the generators offerings, availability, system’s demand, etc.

In order to calculate this factor, the methodology assumes that a CDM generation project displaces the electric power generated by a set of plants that are dispatched due to high offering prices. Basically, plants taken into account are those which generation comprises 10% at the end of the dispatch order, that is to

say, as per CO₂ emissions per power generation unit. This emission factor is obtained for each hour of project operation.

The Build Margin Emission Factor

It is based on the assumption that the CDM projects would replace or delay the installation of the new capacity. The methodology assumes that the recently operating plants that have been introduced in the system are representative of the capacity additions that would eventually be replaced or delayed by the CDM project activity. In the case of Colombia, the build margin emission factor is estimated on the set of plants more recently built, that together produce 20% of the power demanded for the study year.

The system's actual generation is available as entry data. These data are submitted by the CND. This value is used to calculate the 20% generation, which would be taken into account for the calculation. The UNIDAD PLANEACION MINERO ENERGETICA (UPME) submits data including the projects' entry date. These projects are chronologically organized starting from the most recent plant in operation to the former one.

The first plant is then assigned its actual generation as submitted by the CND, by using the actual operation data of the plant. The same proceedings are followed with the rest of the plants until completing the system's 20% actual generation. Plant generations included in the 20% of the system's actual generation are multiplied by their respective emission factor. If the factor is zero, it means it is a hydraulic plant. Emissions related to each plant within the 20% margin are obtained with this multiplication.

Emissions related to plants in the 20% threshold of the system's actual generation, are summed up. Finally, the build margin emission factor results from dividing the sum in the 20% threshold of the system's actual generation

The build margin is ex post defined since the power generation in Colombia is very variable, and difficult to predict, and using a ex ante factor can produce the estimation of lower reduction emissions.

Baseline Emission Factor

The baseline emission factor results from taking the average of the operating and build margin emission factors, for which the relative weights are assumed to be

equal (0.5). To find the yearly total emissions, this factor is multiplied by the project's yearly generation.

2. EMISSIONS REDUCTION CALCULATION

The calculation formula for the Emissions reductions of CO₂ generated by the project according to the consolidated methodology ACM002 c option, for power generation projects connected to the grid. It considers:

$\text{Net CO}_2 \text{ emissions avoided (Ton CO}_2\text{e)} = \text{Net generation during period (MWh)} * \text{Factor emission (Ton CO}_2\text{e/MWh)}$

2.1 Calculation of the emission factor for baseline from August 1 to December 31/2006

According to the methodology the emission factor for baseline calculated for Jepirachi Wind Park is: 0.3251 Ton CO₂/MWh:

Emission Factor of the Operating margin (EF_{OM})

Ton CO₂ for the operation margin: 6.760.79 tCO₂.
Power Generation 20,339.08 MWh

$$EF_{OM} = 6,760.79 / 20,339.08 = 0.3324 \text{ tCO}_2/\text{MWh}$$

Emission Factor for the Build margin (EF_{BM})

$$EF_{BM} = 0.3177 \text{ tCO}_2/\text{MWh}$$

Emission Factor for Baseline

$$EF = 0.5 * EF_{OM} + 0.5 * EF_{BM} = (0.5)*(0.3324) + (0.5)*(0.3177) = \mathbf{0.3251 \text{ tCO}_2/\text{MWh}}$$

2.2 Calculation of the emission factor for baseline from January 1 to December 31/2007

Emission Factor for Jepirachi Wind Park is: 0.2528 Ton CO₂/MWh:

Emission Factor of the Operating margin (EF_{OM})

Ton CO₂ for the operation margin: 10.643.6 tCO₂.
Power Generation: 49,890.9 MWh.

$$EF_{OM} = 10,643.6/49,890.9 = 0.2133 \text{ tCO}_2/\text{MWh}$$

Emission Factor for the Build margin (EF_{BM})

$$EF_{BM} = 0.2923 \text{ tCO}_2/\text{MWh}$$

Emission Factor for Baseline (FE)

$$EF = 0.5 * EF_{OM} + 0.5 * EF_{BM}$$

$$EF = (0.5)*(0.2133) + (0.5)*(0.2923) = \mathbf{0.2528 \text{ tCO}_2/\text{MWh}}$$

3. POWER GENERATION OF THE WIND PARK JEPÍRACHI AND DISPATCHED ENERGY TO THE GRID IN THE MONITORING PERIOD

Power generation data for emissions reduction is taken of Centro Nacional de Despacho (CND) which provides data hour by hour and day by day for all plants of the energy market in Colombia. A monthly summary of power generation is presented in Table 1:

TABLE 1. Power Generation Turing the monitoring Power

YEAR	2006 Real Power generation KWh	2007 Real Power generation KWh
ATENEA DATA BASE		
JANUARY		5,426.56
FEBRUARY		5,031.54
MARCH		5,762.33
APRIL		4,826.73
MAY		4,020.58
JUNE		3,947.72
JULY		6,150.27
AUGUST	6,197.96	3,770.90
SEPTEMBER	4,783.49	3,173.95
OCTOBER	2,289.70	1,005.64
NOVEMBER	2,992.36	3,245.17
DECEMBER	4,075.57	3,529.59
TOTAL	20,339.08	49,890.97

4. DATA MONITORING

The validated monitoring plan has been made operational by EPM, but the calculation method for emissions reduction indicated in the Project Design Document (PDD) and in the monitoring protocol (June 30.2002) was modified in order to use the methodology ACM 0002 which considers the analysis of the dispatch and the calculation of the hourly emission factor of base line of the system as a weighing of consolidated emissions factors for operation and build.

The monitoring is based on continuous metering of electricity production, and according to the monitoring plan it was monitored the electricity output on site using measurement equipment at the substation (interconnection facility to the grid).

To ensure reliability, there are three main and three backup meters for power, located in panel TM 1 at the substation of energy in the area of the Wind Park and there area energy meters for the auxiliaries equipments of the park. The equipment is calibrated once a year by Laboratorio de Calibración de equipos de Medida de Energía y Gas (a special team of the Energy Distribution business in EPM). Last calibration was made on 4 of March of 2008, and no deviations were detected (see Annex 1 for certifications).

All informs of calibration and certifications, the readings and data are kept in the headquarters of EPM in Medellin and in the area of the Wind Park, in the binnacle. This shows the operative conditions of the wind park, with two main objectives:

Daily registration of power energy, trough 3 different Excel Sheet files:

- Sheet Number 1: shows power generation day by day, the average wind speed for 24 hours, available energy of the day and daily plant factor.
- Sheet Number 2: shows the tables with monthly accumulated power, and a graphic with bars to compare monthly power generation.
- Sheet Number 3: to register the average wind speed each day , hour by hour (with average registration of 10 minutes)

The data is accumulated 2004 and consolidated up to year 2008; power and is inquired through software ION SET UP in a especial personal computer located in the energy substation In the wind park area

Daily and hour registration of different events as such unavailability because of failures of the interconnection grid, or in the Jepirachi Wind Park, due to windmills preventive maintenances.

The EPM's laboratory of measurements is accredited for energy and quality norms, and is the just one accredited in Colombia for doing in situ calibrations.

The monitoring of the generated power is done through the software ION SET UP. Equipo de Medición, (an especial team at Distribution business in EPM) examines every day all the meters of the generation plants, including Jepirachi Wind Park. The data is sent to Administradora de Intercambios Comerciales (ASIC). The transmission of the data is done through a satellite system, directly engaged by EPM, using the software BM 90. If an eventual failure occurs, there are other alternative means, such as: i) A tower for cellular phones calls, wit a additional tower at Puerto Bolivar (a seaport for coal exporting near Jepirachi Wind Park) ii) a public telephone card system with satellite communication.

The information on the energy supplied to the grid is uploaded to the official database (NEON - [www5.ISA.com.co /neonweb](http://www5.ISA.com.co/neonweb)) by the Centro Nacional de Despacho (CND);

therefore it is no necessary to process, to complete or to correct the generation data by EPM. Then it is taken from NEON data base of ASIC which is the final version for commercial uses (files with TFF extension). Administrador del Sistema de Intercambios Comerciales (ASIC) is a special division of CND, in Expertos en Mercados company (XM), charged of the registration of energy frontiers (measurements system for energy consumption), long term contracts for power supply, liquidation, invoicing, collect and pay the contracts of energy in the exchange market between power generators and dealers; maintenance of the information system and software required for all necessary tasks for adequate performance of commercial interchange system.

5. EMISSIONS REDUCTION GENERATED IN THE MONITORING PERIOD

According to the formula in section 2, the calculation emission reductions amount to 19.223 ton CO₂ e .The calculated emissions reduction for this project are presented separately for each of the periods.

5.1 Monitoring Period from August 1 to December 31/2006

$$\text{Ton CO}_2 = \text{EF} \cdot \text{GEN} = 0.3251 \text{ Ton CO}_2/\text{MWh} \times 20,339.08 \text{ MWh} = 6,611.22 \text{ ton CO}_2\text{f}$$

$$\text{TOTAL} = 6,611.22 \text{ Ton CO}_2$$

5.2 Monitoring Period from January 1 to December 31/2007

$$\text{Ton CO}_2 = \text{EF} \cdot \text{GEN} = 0.2528 \text{ Ton CO}_2/\text{MWh} \times 49,890.9 \text{ MWh} = 12,612 \text{ ton CO}_2$$

$$\text{TOTAL} = 12,612 \text{ Ton CO}_2$$

TABLE 2 Emission reductions for the Jepirachi Wind Park

CALCULATION OF ERs		MONITORING PERIODS		
Description	Unit	From August 1 to December 31/2006	From January 1 to December 31/2007	Total
Metered Electricity Supply	MWh	20,339.08	49,890.9	
Baseline Emission Factor	tCO ₂ e/Mwh	0.3251	0.2528	
Emissions Reduction	tCO ₂ e	6,611.22	12,612	19.223

No Fossil Fuels have been used during the monitoring period; therefore, according to the PDD, no leakage calculation is required.

6. SUSTAINABILITY- ECONOMIC AND SOCIAL WELL BEING

The project company is aware of his social responsibility and has contributed to social programs for benefits in the community. Furthermore of the compensations plan for social impacts, in the agreement signing with the Prototype Carbon Fund for the reduction of emissions it was defined that EPM extra revenues for each equivalent ton reduced, with a exclusive destination to projects and programs that contribute in an effective way to the local development of the communities and institutions and for improving quality life of the population in the project area. This is included in The Community and Institutional Strength Plan (PFIC), with specific indicators for social, cultural, economic institutional and organization issues and focused in self management process. A complete report about the progress of this plan an its indicators is presented in Annex 2

For purpose of monitoring and verification, different units of measurements were defined for each of the goals and indicators of sustainable development. The monitoring activities cover three periods of seven years each one. The objective is to ensure the full accomplishment by EPM of all commitments and to confirm the effectiveness of the social programs and actions for improving the quality of life and the institutional and community strengthening.

Since some of the initial indicators agreed with The World Bank could not be directly controlled and monitored by EPM, it was necessary to agree on new social indicators. These new indicators begin to be reported for this period. The validated indicators are: direct beneficiaries of the project, indirect beneficiaries of the project, new generated jobs, implemented programs and institutional participants. These are quantitative indicators and have an annual revision.

In 2006 and 2007, EPM addressed his activities toward the join and participation of local and regional governmental agencies for developing social programs in order to improve the quality of life of the indigenous communities in the influence area of the Jepirachi Wind Park. In addition, EPM considered the participation of the communities leaders and authorities in different events and situations such as meetings for program coordination, institutional agreements, and joint definition of projects, based in communitarian self management. Those projects are:

- Training on techniques for production and marketing of the Wayuu handcrafts at Medialuna sector in Uribia Municipality: The objective is to train a total of 50 craftsmen at Kasiwolin, Arutkajuy and Medialuna villages, in aspects as weave techniques, quality control, traditional designs, color combination, and final presentation.

- Assistance for 56 families at Medialuna village in Uribia Municipality: The program covers nutritional and health care, and different projects related to basic infrastructure and sanitation, training and development of productive projects.

In addition to these inter-institutional programs, EPM supported different activities for community strengthening, such as cultural events, promotion of education actions, health campaigns, monetary support for the Wayuu Festival and supply of scholar kits and books.

The results for the social indicators are:

- Direct beneficiaries: 120 persons
- Indirect beneficiaries: 120 persons
- Jobs generated: 26
- Programs achieved: 2
- Government Agencies implicated (6): SENA, Municipio de Uribia, Universidad de la Guajira, Instituto Colombiano de Bienestar Familiar, and Empresas Públicas de Medellin.
- Private Agencies implicated: Fundación Indígena Ana Watta Kai

7. ROLES AND RESPONSIBILITIES

In the energy generation business at EPM, there are several areas in charge of the CDM activities, depending on the phase of the project (Planning, Building, Operation and Marketing). As Jepirachi Wind Park is in commercial operation since 2004, the main CDM activities are related to development actions included in the Monitoring Plan, and in the Project Design Document (PDD), in especial the requirements for monitoring, verification of the emission reductions, and some programs for environmental management and monitoring.

Área Planeación Generación: is the contact with the buyer and the verifier of the CERS. It is aligned with different areas of the EPM in order to prepare the monitoring report and facilitate the verification audit.

Subgerencia Ambiental Generación: is responsible of monitoring the environmental and social indicators at Wind Park Area.

Area Gestion Regulatoria Generación: support the application of the methodology, supervises the calculation of the emission reduction and has an integrated knowledge of the functioning of the dispatch in the Colombian electric system.

Subgerencia Comercial Generación: consults the database of energy and makes the calculations about the real dispatch, and summarize the power generation data.

Subgerencia Operación Generación: operates the wind park. It is in charge of metering the energy, the transmission of the data, and support to the following of the environmental and social indicators for monitoring report.

Equipo de Medida. Distribución de Energía: receives the energy data and transmits it to ASIC; calibration of the meters.

In the Annex 3 is presented the organizational Chart and areas of EPM that participate in the monitoring and verification of the emissions reductions at Jepirachi, as well as the persons who are directly involved.

8. ANNEXS

1. Certifications of energy meters calibration installed at the Substation in the Wind Park Jepirachi
2. Report of the monitoring to the agreement between Empresas Publicas de Medellin and the World Bank about Plan de Fortalecimiento Institucional y comunitario: periods August 2006 to December 2007
3. Organization Chart and people working at Jepirachi CDM