PROJECT DESIGN DOCUMENT FORM
FOR CDM PROJECT ACTIVITIES (F-CDM-PDD)
Version 04.1

PROJECT DESIGN DOCUMENT (PDD)

Title of the project activity	Jepirachi Wind Power Project
Version number of the PDD	9
Completion date of the PDD	3/10/2013 (updated due to renewal of crediting period)
Project participant(s)	**Colombia:** Empresas Públicas de Medellín; **Finland:** Fortum Corporation, Government of Finland - Ministry of Foreign Affairs of Finland; **France:** GDF SUEZ; **Germany:** RWE Power AG; **Japan:** Chubu Electric Power Co., Inc, The Chugoku Electric Power Co., Inc, Kyushu Electric Power Co., Inc, Mitsubishi Corporation, Shikoku Electric Power Co., Inc, Tohoku Electric Power Co., Inc, The Tokyo Electric Power Co., Inc, Japan International Cooperation Agency (JICA), Mitsui & Co., Ltd; **Netherlands:** Electrabel N.V., Netherlands' Ministry of Infrastructure and the Environment (IenM); **Norway:** Norsk Hydro ASA, Government of Norway - Ministry of Foreign Affairs, StatoilHydro ASA; **United Kingdom of Great Britain and Northern Ireland**: BP Alternative Energy International Ltd, Deutsche Bank AG; **Sweden:** Government of Sweden - Swedish Energy Agency. **Bilateral and Multilateral Funds:** International Bank for Reconstruction and Development as Trustee of the Prototype Carbon Fund (PCF)
Host Party(ies)	**Colombia**
Sectoral scope and selected methodology(ies)	1 : Energy industries (renewable - / non-renewable sources)
Estimated amount of annual average GHG emission reductions	25,631 tCO_2e

SECTION A. Description of project activity
A.1. Purpose and general description of project activity
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The project consists of the development of a wind based generation facility with a nominal power capacity rated at 19.5 MW, located in Wayuu Indigenous Territory in the Northeastern region of the Atlantic Colombian coast, within the Municipality of Uribia in the Department of Guajira. Since commissioning in January 2004, and up till the end of 2009, the wind generators had delivered 320,963 MWh to the Colombian National Interconnected System (SIN) under a preferential dispatching scheme.

Electricity delivered to the grid by the project would have otherwise been generated by the operation of grid-connected power plants and by the addition of new generation sources, as reflected in the combined margin (CM) calculations.

The Project contributes to the sustainable development of Colombia in various ways. First, it demonstrates at a commercial level, the potential for wind based generation in the region thereby facilitating future investments to capture the relatively large wind power potential (estimated at over 5 GW). Second, it increases the share of renewable energy in the national grid, thereby contributing to the national private expertise in the installation and operation of such technology. These indirect benefits may stimulate further the development of the renewable option in the Colombian power system. Third, as the project sits in land belonging to a very poor indigenous community, it contributes to the development of this community through the support of community-driven projects financed by a system of transfers and compensation agreed to by the project sponsor.. Finally, the project also contributes to an increase in economic activity during the construction period, injecting $21 million in the Colombian economy.

A.2. Location of project activity
A.2.1. Host Party(ies)
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Colombia

A.2.2. Region/State/Province etc.
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Department of Guajira

A.2.3. City/Town/Community etc.
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Area between Cabo de la Vela and Puerto Bolivar, within municipality of Uribia near Kasiwolin, Arutkajuy and Medialuna Comunities.

A.2.4. Physical/Geographical location
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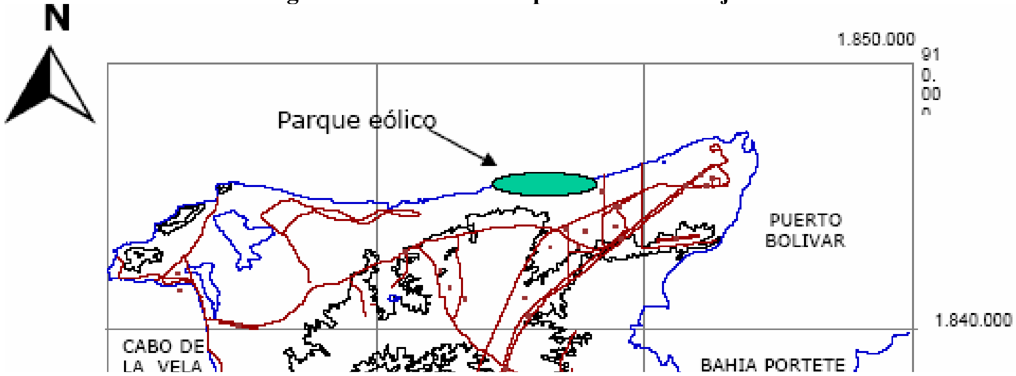
The Wayuu Indigenous Territory covers some 10,675 km^2 which was established through Resolution 015/1984 and amended by Resolution 28/1994 to protect the local indigenous population, and represents 51% of a sparsely populated area of the Department of La Guajira, in Colombia.

Fig. A.2.4. Location of Jepirachi Wind Project



The Project is located in the following geographical coordinates: 12.2472 N latitude – 71.9973 W longitude within the Wayuu Indigenous Territory in the North-eastern region of the Atlantic Colombian coast, in the area between *Cabo de la Vela* and *Puerto Bolivar*, within the region of Uribia in the Department of Guajira. The topographic characteristics of the area provide the necessary conditions to maximize the power generation potential of the wind farm, that is, a regime of high and constant wind.

Otherwise, the area has very low population density, and it is semi-arid with sparse vegetation.

A.3. Technologies and/or measures

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The project contributes to transfer of technology, as it is the first wind power generation facility to operate in Colombia on a commercial basis. All equipment utilized in the Project is proven technology that has been successfully applied in similar projects in other regions of the world. Following a bidding process conducted during the summer of 2003, the nominal power capacity of 19.5 MW is supplied by a total of 15 wind generators with a rated capacity of 1.3 MW each, manufactured by Nordex (N60/1300). Table A.4.3.1 provides all technical information for Jepirachi Wind Turbines. The Project site is connected to the national grid via an 8km standard transmission line.

Table A.3. Technical Characteristics of Wind Turbines for Jepirachi

Rotor 1300 kW	
Type	3-bladed, horizontal axis, upwind
Rotor Diameter	60 m
Swept Area	2828 m^3
RPM	19.2/12.8 RPM
Cut in-cut-out-wind	3-4/25 m/s
Nominal Output at velocity	15 m/s
Design conditions in terms of velocity	70 m/s (IEC)
Lifetime of turbine	20 years
Blades	
Manufacturer	LM Dinamarca
Blade Length	29 m
Material	Glass fibre reinforced plastic/epoxy resin
Lightning Protection	Included, receptor in blade tips
Generator	
Nominal Power	1300/250 kW
Type	Asynchronous, liquid cooled
Synchronous speed	1500 / 1000 r.p.m.
Efficiency at 75% load	96.5%
Control	

Tipo	Micro-processor
Connection	Via soft power controller
Remote communication	Included
Towers	
Type	Tubular (cone-shaped)
Hub heights	60 m
Corrosion Protection	Sandblasted and painted with 250 mg epoxy paint

A.4. Parties and project participants

Party involved (host) indicates a host Party	Private and/or public entity(ies) project participants (as applicable)	Indicate if the Party involved wishes to be considered as project participant (Yes/No)
Colombia (host)	Empresas Públicas de Medellín	No
France	GDF SUEZ	Yes
Finland	Government of Finland - Ministry of Foreign Affairs of Finland; Fortum Corporation	Yes
Germany	RWE Power AG	Yes
Japan	Chubu Electric Power Co. Inc; The Chugoku Electric Power Co. Inc; Kyushu Electric Power Co. Inc.; Mitsubishi Corporation; MIT Carbon Fund Co., Ltd; Tohoku Electric Power Co. Inc.; The Tokyo Electric Power Co. Inc.; Shikoku Electric Power Co. Inc; Japan International Cooperation Agency (JICA); Mitsui & Co. Ltd.	Yes
Netherlands	Netherlands' Ministry of Infrastructure and the Environment (IenM); Electrabel S.A.; Netherlands' Ministry of Economic Affairs, Agriculture and Innovation (EL&I)	Yes
Norway	Government of Norway – Ministry of Foreign Affairs; Norsk Hydro ASA; Statoil ASA	Yes
Sweden	Government of Sweden - Swedish Energy Agency	Yes

United Kingdom of Great Britain and Northern Ireland	Deutsche Bank AG; BP Alternative Energy International Ltd	Yes
Bilateral and Multilateral Funds	Prototype Carbon Fund (PCF) Managing Company: International Bank for Reconstruction and Development (IBRD) as Trustee of the Prototype Carbon Fund (PCF)	Yes

A.5. Public funding of project activity
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This project does not receive public funding nor Official Development Assistance (ODA) or other sources earmarked for development assistance.

SECTION B. Application of selected approved baseline and monitoring methodology
B.1. Reference of methodology
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The ACM0002-version 12.1.0 "Consolidated baseline methodology for grid-connected electricity generation from renewable sources" is chosen as the most relevant to the project activity. This methodology, as applied in this project activity, also refers to the latest approved version of the following Tools: (i) the tool to calculate the emission factor for an electricity system (version 2), and (ii) the tool for the demonstration and assessment of additionality (version 5.2).

B.2. Applicability of methodology
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The consolidated baseline methodology ACM0002 – version 12.1.0 has been chosen because it applies to grid connected renewable power generation project activities. In particular, this methodology is applicable because:

1. The project involves a new power plant at a site where no renewable power plant was operated prior to the implementation of the project activity (greenfield plant),
2. the project activity is grid-connected electricity generation from renewable energy sources,
3. the geographic and system boundaries for the electricity grid are clearly identified and information on the grid characteristics is available, and
4. the proposed project does not involve an on-site switch from fossil fuel to a renewable source.

B.3. Project boundary

	Source	GHGs	Included?	Justification/Explanation
Baseline scenario	CO_2 Emissions coming from electricity generation in fossil fuel fired power plants that are displaced due to the project activity.	CO_2	Yes	Main emission source. The thermal units in the generation grid produce GHG emissions that are avoided when the Project activity enters the grid replacing the thermal units.
		CH_4	No	Minor emission source
		N_2O	No	Minor emission source
Project scenario	The proposed Project	CO_2	No	According to ACM0002 (Version 12.1.0), project emission is zero.
		CH_4	No	
		N_2O	No	

As referred in ACM0002 – version 12.1.0, the project boundary has to be assessed in terms of the emission sources and spatial extent. The GHG accounted for are shown in the table above

• ***Emission sources*:**
Baseline: For the baseline determination, only CO_2 emissions from electricity displaced due to the project are accounted for.
Project: As the project is a wind power Project, it has zero project emissions

• ***Project boundary***:
The spatial extent of project boundary includes the project site and all power plants of the electricity system that the project connects. The project is linked to the Colombian national grid, therefore, all power plants providing electricity to the Colombian grid system are included in the project boundary.

B.4. Establishment and description of baseline scenario
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The baseline scenario in the case of the Jepirachi Wind Power Project is defined by the Electricity delivered to the grid by the project would have otherwise been generated by the operation of grid-connected power plants and by the addition of new generation sources, as reflected in the combined margin (CM) calculations.

The baseline might be described as the most likely scenario of capacity additions and generation private investors and plant operators would choose based on demand projections, investment costs, available technology for capacity expansions and expected price of fuels. Thus, the baseline scenario consists of the current power plants in the relevant system grid for the project boundary (which is the Colombian National Grid System) and the projected capacity expansion as it occurs in the absence of the generation of this CDM project. Specifically in the absence of the Jepirachi Wind Power Project, the same level of demand for electricity would be met by the combined production of plants in the Colombian National Grid System and by the addition of new generation sources, and therefore the estimations of the baseline emissions are based on the combined margin (CM) calculations as described in section B.6.

Therefore, the baseline scenario for the Project is the continuing operation of the existing and future power plants, necessary to meet the actual electricity demand, without the Jepirachi Wind Power electricity generation. In the project scenario the same electricity demand is met with the power dispatched in the base

load by the project, displacing the generation from existing power plants and future power developments. Because the project uses renewable sources to produce electricity, there are no additional emissions from the project activity and the emissions reductions are generated by the displaced generation.

The relevant spatial extent of the Jepirachi Wind Power Project boundary is the Colombian National Grid System, SIN. Therefore, the baseline scenario is one where the electricity that could be supplied by the project to the network would have to be generated by other plants currently connected to the network and by new plants added to the System, based on different kind of fuels. Both aspects are depicted in the Combined Margin, calculated as described in the "Tool to calculate the emission factor for an electricity system" (Version 2).

At the start of the second and third crediting period project proponents have to address two issues:

- Assess the continued validity of the baseline (as per Annexure[1] to the procedures for renewal of the crediting period, Annex 11, Ver 05, EB46); and
- Update the baseline, if the current baseline is not valid any more.

In assessing the continued validity of the baseline, a change in the relevant national and/or sectoral regulations between two crediting periods has to be examined at the start of the new crediting period. If at the start of the project activity, the project activity was not mandated by regulations, but at the start of the second or third crediting period regulations are in place that enforce the practice or norms or technologies that are used by the project activity, the new regulation (formulated after the registration of the project activity) has to be examined to determine if it applies to existing plants or not. If the new regulation applies to existing CDM project activities, the baseline has to be reviewed and, if the regulation is binding, the baseline for the project activity should take this into account. This assessment will be undertaken by the verifying DOE.

For updating the baseline at the start of the second and third crediting period, new data available will be used to revise the baseline scenario and emissions. Project participants shall assess and incorporate the impact of new regulations on baseline emissions.

Given that the project activity is the installation of a new grid-connected renewable power plant/unit, the *baseline scenario* is the following:

Electricity delivered to the grid by the project activity would have otherwise been generated by the operation of grid-connected power plants and by the addition of new generation sources, as reflected in the combined margin (CM) calculations described in the "Tool to calculate the emission factor for an electricity system" (Version 2) consisting of the combination of operating margin (OM) and build margin (BM). The relevant spatial extent of the Jepirachi Wind Power Project boundary is the Colombian National Grid System, SIN. As per paragraph 3 of the procedures for renewal of the crediting period of a registered CDM project activity, it does not require a reassessment of the baseline scenario and hence the above mentioned baseline scenario is still applicable for the project activity for the second crediting period.

Validity of the Baseline and its Updating, if not valid

For the second crediting period, the continued validity of the original baseline has been assessed.

According to the "Tool to assess the validity of the original/current baseline and to update the baseline at the renewal of a crediting period", the stepwise procedure was followed to assess the continued validity of the baseline and to update the baseline:

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[1] Tool to assess the validity of the original/current baseline and to update the baseline at the renewal of a crediting period.

Step 1: Assess the validity of the current baseline for the next crediting period

The "Procedures for the renewal of the crediting period of a registered CDM project activity" version 5 approved by the CDM Executive Board requires assessing the impact of new relevant national and/or sectoral policies and circumstances on the baseline.

Step 1.1: Assess compliance of the current baseline with relevant mandatory national and/or sectoral policies

There are no new national and/or sectoral policies that could affect the baseline scenario during the renewal of the crediting period. Renewable energy projects are always dispatched as they have lower costs in the margin, as it was the case for the first crediting period. In the absence of the project activity electricity would still have been partly generated by fossil fuel power plants or by the addition of new fossil fuel power plants connected to the grid, as shown in the Combined Margin calculations for the grid emission factor.

The project complies with the current regulations dealing with renewable sources of power generation. In particular, the project activity is not affected by the body of main regulations current at the moment.

Following is a brief analysis on how the regulatory framework has not been affected with relation to the project activities, in comparison to the baseline situation at the beginning of the first crediting period:

Law/Policy	Key elements/requirements	Was this law/policy valid during initial registration (Y/N)	Are there any relevant changes since then?	How the law/policy affects the baseline
Law 143 of 1994	Establishes the norms and procedures for the generation, interconnection, transmission, distribution, and commercialization of electricity in Colombia.	Yes	No	The Law 143 can be considered as the General Electricity Law, and it still prevails. It does not affect the project.
Resolution 055 of 1994	Regulates general conditions for the electricity market in Colombia	Yes	No	Art. 11 establishes that power generators with capacity lower than 20 MW can always access the interconnected system
Resolution 086 of 1996	Regulates the power generation activities of plants with capacity lower than 20 MW	Yes	No	It sets up conditions for generating and connecting to the grid..
Resolution 039 of 2001	Sets up complementary conditions for power generators with capacity lower than 20 MW	No	-	It sets up conditions for small generators dispatching to the grid, which now can have access to the wholesale market, but within the prevailing price conditions.
Law 697 of 2001	Issued to promote the development and use of rational and efficient sources of energy	No	-	This law is set to promote the use of renewable energy. However, it is not mandatory nor gives subsidies or incentives to projects like Jepirachi.

				Therefore the baseline is not affected.
Resolution 180917 of 2010	Sets out the Action Plan for the Program on the Rational and Efficient Use of Energy and non Conventional sources of Energy (PROURE)	No	-	The resolution establishes priorities for adding new capacity with renewable energy sources. However, it does not generate financial incentives or establishes mandatory generation activities. Therefore the baseline is not affected.

The national electricity market in Colombia is ruled according to the Law 143 of 1994. Through this law the market becomes competitive, and the wholesale competitive market is set according to periodic open power auctions. The law assigns the coordinating and regulatory role to the Commission on Energy and Gas (CREG), and unbundles the provision of transmission and power generation and commercialization services. The only natural monopoly remains in the provision of transmission service, the other services being competitive. The wholesale market is administered at the National Dispatch Center, which belongs to the company in charge of transmission through the national grid.

Small power generators (less than 20 MW) have preferential access to the market, and are always dispatched. Price is the result of demand and supply for private transactions, and of the auction for the wholesale market (safe some charges for securing the minimum generation level). Small generators supplying to the wholesale market have to use the prevailing price at that market. The central dispatch is based on the lower cost to attend daily demand, creating a merit order system. Small generators and low cost, such as Jepirachi's wind power plant, are always dispatching first.

The fundamental elements of the baseline have not changed since the project was first registered, and the market structure, regulatory framework, and functioning remains the same.

Step 1.2: Assess the impact of circumstances

There is no impact of circumstances existing at the time of requesting renewal of the crediting period on the current baseline emissions.

Step 1.3: Assess whether the continuation of the use of current baseline equipment(s) is technically possible

This sub-step is applicable to the project activity since the baseline is the continuation of the current practice, i.e. the electricity would be supplied by the power grid in the absence of the project activity. It is clear that the power grid as an electricity system would maintain its technical possibility for a much longer time than the crediting period of the project activity.

Step 1.4: Assessment of the validity of the data and parameters

There are some parameters, which were determined at the start of the first crediting period and not monitored during the first crediting period, are not valid anymore. So the current baseline was updated for the second crediting period according to the Tool to calculate the emission factor for an electricity system (Version 2). This update includes Grid Emission Factor and all values used in its calculation (including OM and BM). Application of Steps 1.1, 1.2, 1.3 and 1.4 confirmed that the current baseline is valid for the second crediting period but data and parameters needs to be updated. Therefore step 2 is used

Step 2: Update the current baseline and the data and parameters

Step 2.1: Update the current baseline

The baseline emissions for the second crediting period have been updated, without reassessing the baseline scenario, based on the latest approved version of the methodology ACM0002. This update was applied in the context of the sectoral policies and circumstances that are applicable at the time of requesting for renewal of the crediting period, which have not changed as to affect the project dispatch. More details for the updated baseline emissions for the second crediting period can be seen in section B.6.

Step 2.2: Update the data and parameters

As mentioned in step 1.4 above, all parameters regarding the grid emission factor calculation have been updated for this second crediting period. More details can be seen in section B.6 and B.7 (updated monitoring parameters).

B.5. Demonstration of additionality

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To demonstrate that the project activity is additional and therefore not the baseline scenario, *the tool for the demonstration and assessment of additionality, version 5.2* is used. The application of this tool involves the following steps:

Step 0. Preliminary screening of projects started after January 2000 and prior to 31 December 2005

In accordance with the guidance provided in decision 18/CP.9 the Jepirachi Wind Project sought to have the crediting period starting prior to the registration of the project activity. Supporting documentation included:

- The Jepirachi Wind Farm construction was initiated on January 2003 and was commissioned on the 31st January 2004 which falls between 1 January 2000 and the date of registration of a first CDM project activity, which is September 2005. Please refer to Annex 5 (Letter from Mr. Luis Carlos Rubiano announcing the starting date of Jepirachi‟s commercial operation). In this letter, dated October 8/2003, the installation-schedule of the first 10 aerogenerators for December 2003 is confirmed and the starting date of commercial operations is also given as February 2004.

- Empresas Públicas de Medellín (EPM) seriously considered the incentive from the CDM in the decision to proceed with the project activity. This can be confirmed in Annex 6. This Annex presents a series of three sequential documents issued during the process followed by EPM to be able to present the Project as a CDM activity to the Prototype carbon fund (PCF). The following documents confirm EPM‟s consideration of the CDM incentive in the decision to proceed with the project activity: the first document is a letter from EPM to the Colombian Environment Ministry asking to include Jepirachi in the CDM Colombian Ministry Portfolio; the second document is the Letter from the Ministry of Environment of Colombia submitting the Jepirachi Carbon Off-set project to the Prototype Carbon Fund on behalf of EPM. The third document corresponds to the national approval of the project as an eligible activity for the Clean Development Mechanism of the Kyoto Protocol, sent by the Colombian Environment Ministry (MMA) to EPM, dated December 10/2002.

Step 1. Identification of alternatives to the project activity consistent with current laws and regulations

The electric system in Colombia is a competitive sector with national regulations. Although UPME prepares indicative power expansion plans, actual generation and capacity expansion is left to the decisions of the independent power producers.

Sub step 1a. Define alternatives to the project activity

The following alternatives are considered realistic and credible.
1. The proposed project activity is undertaken without being registered as a CDM project activity;
2. The system expansion would occur as defined by UPME; another thermal or big hydro unit would be installed.

The following table lists capacity additions in a "business as usual" scenario as expected by UPME, in its expansion plan published in 2001. Under the business as usual scenario, most capacity additions were to be thermal (gas-based) which offered the lower investment costs and faster entry into operation. Some medium-sized hydro-based units were also tentatively scheduled to enter into the system in the short term. However, no wind energy facilities were being considered in the reference expansion plan.

Table B.5.1. Expected Capacity Additions, Period 2002-2015

Power Plant	Units	Fuel	Capacity	Entrance Date
Colegio	3	Water	50	April 2, 2002
Miel 1	1	Water	125	June 12, 2002
CC-Costa 1	1	Gas	150	January 1, 2006
CC-Costa 2	1	Gas	250	January 1, 2007
CC-Costa 3	1	Gas	250	January 1, 2010
CC-Costa 4	1	Gas	250	January 1, 2012
CC-Costa 5	1	Gas	250	January 1, 2012
Carbon 1	1	Coal	150	January 1, 2012
Carbon 2	1	Coal	150	January 1, 2013
Carbon 3	1	Coal	150	January 1, 2013
Carbon 4	1	Coal	150	January 1, 2014
Carbon 5	1	Coal	150	January 1, 2014
CA-Llanos	1	Gas	215	January 1, 2015

Source, UPME "Evolución del Comportamiento de la Demanda de Energía Eléctrica, 2001"

Sub step 1b. Enforcement of applicable laws and regulations

Power generation is a mature and consolidated sector in Colombia, with a long tradition of environmental regulations and strict sector technical codes. All proposed alternatives including the project comply with all the laws and regulatory requirements for electricity generation in Colombia.

Step 3. Barrier analysis

Barriers analysis was used to demonstrate that the project is additional. In this step, it is determined whether the proposed project activity faces barriers that: a) prevent the implementation of this type of proposed project activity and b) do not prevent the implementation of at least at one of the alternatives.

Sub step 3a. Identify barriers that would prevent the implementation of type of the proposed project activity

• Technological Barriers: Jepirachi was the first Wind farm project in Colombia. For this reason there was a lack of skilled and/or properly trained labour to operate and maintain the technology. No education/training institution in the host country provided the needed skills, leading to equipment disrepair and malfunctioning. There is always a need of bringing international experts for consultation on operation, maintenance and machinery adjustments. Moreover there is a lack of infrastructure for implementation of the technology. Thus the project is additional.

• Barrier due to prevailing practice: As it has been mentioned before, Jepirachi Wind Project was the first commercially operational wind project in Colombia. Thus there was no experience in the country with this type of technology. This particular project is not considered as „common practice" and therefore it is additional.

• Resources uncertainty: Due to the fact that wind is an intermittent source of power, wind energy involves relatively high risk compared with fossil fuel forms of energy or hydro energy. Wind records are sparse and measures are made at standard elevations, very different from the high towers built to house the generator units. There is uncertainty in the wind measuring data and assumptions made during output estimation. By the time of the implementation of the project there were only wind point estimates.

Sub step 3b. Show that the identified barriers would not prevent the implementation of at least one of the alternatives (except the proposed project activity)

As it has been explained in Sub-step 1b, one of the alternatives considered would be to follow UPME indicative Expansion Plans (BAU scenario). UPME expansion plan showed that potential candidates for capacity expansions were mostly thermal options: coal based steam power plants, gas based combined cycle plants (CCGT) and gas based open cycle turbines (OCGT), in addition to hydropower. However, hydropower generation had become a less likely investment option in Colombia for various reasons related to site availability and its effect on costs, environmental and social impacts associated to reservoirs and flooding, and also due to high up-front capital investment. Nevertheless, UPME has developed indicative scenarios for the expansion of the electricity supply industry considering specific assumptions on demand (i.e. medium growth rate), fuel prices (i.e. low price scenarios) and lower than average hydrologic conditions, as well as perceived trends and registered intentions by private and public generators. These have been presented in section A.4.4. The type of technologies presented in UPME Expansion Plan did not face the barriers described in section 3a for Wind Farms in Colombia; therefore Jepirachi Project was considered additional.

Step 4. Common practice analysis

Sub-step 4a. Analyze other activities similar to Jepirachi Wind Project

There were currently no existing wind farms in Colombia or Guajira region other than Jepirachi. Up to the date there were no new wind projects on the planning stage in Colombia. Therefore this sub-step was satisfied.

Sub-step 4b. Discussion of similar options that occur

No similar activities were widely observed in Colombia since Jepirachi was the first commercially operational wind farm in Colombia. Therefore this sub-step is also satisfied, allowing further analysis (step 5).

Step 5. Impact of CDM Registration

The Jepirachi Wind Project presented high uncertainty (wind regime is variable and may change in the future), lack of local experience (new technology for Colombia), few wind records, and wind data

limitations. In addition to this, the expansion planning in Colombia called for an increase in the thermal generation, given the high reliance on uncertain hydroelectric capacity, in order to provide a more secure supply of energy. By selling certified emissions reductions (CERs) from the project activity, the project developer (EPM) would benefit from the additional revenue generated by carbon sales, what would make the project more attractive. In addition, by selling CERs the project promoter would benefit from government incentives for clean production and export sales of CERs. The incentives included, import tax exemption on foreign equipment and accelerated depreciation that amounted approximately to US$ 19 million.

In summary, the CDM would have the following positive impacts on the proposed project:

1) The CER revenue potential will provide extra finance to ensure the financing and investment return of the proposed project.
2) The CER revenue will enable the project owner to carry out additional training activities for staff and construction workers associated with the employment of the new technology.
3) The CER revenue would provide extra finance for maintenance and expert advice required to overcome potential technological challenges.

B.6. Emission reductions
B.6.1. Explanation of methodological choices

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This section describes the procedures and methodology choices followed as per the approved consolidated baseline methodology for grid connected electricity generation projects (ACM0002 – version 12.1.0).

As stated in section B.2, the Consolidated Baseline Methodology ACM0002 version 12.1.0 is applicable to the project and meets the applicability conditions, specifically, (i) the project involves a new power plant at a site where no renewable power plant was operated prior to the implementation of the project activity (greenfield plant), (ii) the project activity is grid-connected electricity generation from renewable energy sources, (iii) the geographic and system boundaries for the electricity grid are clearly identified and information on the grid characteristics is available, and (iv) the proposed project does not involve an on-site switch from fossil fuel to a renewable source.

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Based on ACM0002 version 12.1.0 using the tool to calculate the emission factor for an electricity system (ver 2), the Operating Margin in the project is calculated using method (b) Simple Adjusted Method, and employing the ex-ante vintage option; the Build Margin is also calculated using the ex-ante Option 1. The cohort of power plants used correspond to the set of power capacity additions in the electricity system that comprise 20% of the system generation (in MWh) and that have been built most recently.

The data for calculation of the Operating Margin and Build Margin Emissions Factors are collected from official sources such as the Energy and Mines Planning Unit (UPME) and the National Dispatch Center (CND). CND, operated by XM, is in charge of planning, supervision and control of generation and transmission of the national electricity system. CND also supervises the Regional Dispatch Centers (CRDs) to ensure system‟s coordination and reliability. CND preferentially dispatches the Jepirachi Wind Power Plant. CND registers and stores generation data by the hour in a state of the art database that can be fully accessible through the Internet. Please refer to Annex 3 for detailed data used for calculation of the emission factor.

B.6.2. Data and parameters fixed ex ante

Data / Parameter	**$EG_{m,y}$ and $EG_{k,y}$**
Unit	MWh
Description	Net electricity generated and delivered to the grid by power unit *m* or *k* in year *y*
Source of data	Data recorded, archived and supplied by the Colombian National Dispatch Center, CND
Value(s) applied	It varies by plant and year. CND keeps records of this variable for its users.
Choice of data or Measurement methods and procedures	The data are suitable for the calculation of the National grid emission factor following the " tool to calculate the emission factor for an electricity system" (version 2) Simple adjusted OM: once for each crediting period using the most recent three historical years; 2007-2009 (*ex ante* option) for the second crediting period. BM: For the second and third crediting period, the *ex ante* BM calculation at the start of the second crediting period will be used
Purpose of data	Calculation of baseline emissions
Additional comment	-

Data / Parameter	**$EF_{CO2,i,y}$, $EF_{EL, m, i, y}$, and $EF_{EL, k, i, y}$**
Unit	tCO_2/GJ
Description	Emission factor of fossil fuel type i for power plant m or k in year y
Source of data	IPCC default values at the lower limit of the uncertainty at a 95% confidence interval as provided in table 1.4 of Chapter1 of Vol. 2 (Energy) of the 2006 IPCC Guidelines on National GHG Inventories.
Value(s) applied	Diesel Oil = 72,600 Residual Fuel Oil = 75,500 Natural Gas = 54,300 Subbitouminous Coal = 92,800 Other Bituminous Coal = 89,500
Choice of data or Measurement methods and procedures	The CO_2 emission factor is used to calculate the CO_2 emission coefficients of the power plants in the grid. Step necessary to find the baseline emission of the grid according to the "Tool to calculate the emission factor for an electricity system" (version 2) Simple adjusted OM: once for each crediting period using the most recent three historical years; 2007-2009 (*ex ante* option) for the second crediting period. BM: For the second and third crediting period, the *ex ante* BM calculation at the start of the second crediting period will be used.
Purpose of data	Calculation of baseline emissions
Additional comment	For those power plants with information on the heat rate from XM, it has been calculated the EF following the Tool. For those without information on the heat rate, it has been taken the official values from UPME, which also follow the Tool.

Data / Parameter	$\eta_{m,y}$ and $\eta_{k,y}$
Unit	GJ/MWh
Description	Average net energy conversion efficiency of power unit *m* or *k* in year *y*
Source of data	XM- National Dispatch Center
Value(s) applied	See Annex 3
Choice of data or Measurement methods and procedures	As per the "Tool to calculate the emission factor for an electricity system" (version 2)
Purpose of data	Calculation of baseline emissions
Additional comment	-

Data / Parameter	$\mathbf{EF_{grid, OM,y}}$
Unit	tCO_2/MWh
Description	Operation margin CO_2 emission factor for grid connected power generation in year *y* calculated using the latest version of the "Tool to calculate the emission factor for an electricity system" (version 2)
Source of data	Ex-ante calculations
Value(s) applied	0.4853
Choice of data or Measurement methods and procedures	As per the "Tool to calculate the emission factor for an electricity system" (version 2).
Purpose of data	Calculation of baseline emissions
Additional comment	As per the "Tool to calculate the emission factor for an electricity system" (version 2). This value is calculated ex-ante and will be used throughout the crediting period.

Data / Parameter	$EF_{grid, BM,y}$
Unit	tCO_2/MWh
Description	Build margin CO_2 emission factor for grid connected power generation in year *y* calculated using the latest version of the "Tool to calculate the emission factor for an electricity system" (version 2)
Source of data	Ex-ante calculations
Value(s) applied	0.3206
Choice of data or Measurement methods and procedures	As per the "Tool to calculate the emission factor for an electricity system" (version 2).
Purpose of data	Calculation of baseline emissions
Additional comment	As per the "Tool to calculate the emission factor for an electricity system" (version 2). This value is calculated ex-ante and will be used throughout the crediting period.

Data / Parameter	$EF_{grid, CM,y}$
Unit	$EF_{grid, CM,y}$
Description	Combined margin CO_2 emission factor for grid connected power generation in year y calculated using the latest version of the "Tool to calculate the emission factor for an electricity system" (version 2)
Source of data	Ex-ante calculations
Value(s) applied	0.4441
Choice of data or Measurement methods and procedures	As per the "Tool to calculate the emission factor for an electricity system" (version 2). As suggested by the tool, the relative weight for EFOM and EFBM should be 0.75 and 0.25, respectively as it is a wind power project with intermittent generating and dispatching potential
Purpose of data	Calculation of baseline emissions
Additional comment	As per the "Tool to calculate the emission factor for an electricity system" (version 2). This value is calculated ex-ante and will be used throughout the crediting period.

B.6.3. Ex ante calculation of emission reductions

>>

The procedure for ex-ante calculation of emission reductions due to the Jepirachi Wind Power Project is presented in this section.

Baseline emissions

Baseline emissions include only CO_2 emissions from electricity generation in fossil fuel fired power plants that are displaced due to the project activity. The methodology assumes that all project electricity generation above baseline levels would have been generated by existing grid-connected power plants and the addition of new grid-connected power plants. The baseline emissions are to be calculated as follows:

$$BE_y = EG_{PJ,Y} * EF_{grid,CM,y} \qquad \text{(B.6.3.1)}$$

Where,

BE_y: Baseline emissions in year "y" (tCO_2e)

$EG_{PJ,y}$: Quantity of net electricity generation that is produced and fed into the grid as a result of the implementation of the CDM project activity in year *y* (MWh/yr)

$EF_{grid,CM,y}$: Combined margin CO2 emission factor for grid connected power generation in year y calculated using the latest version of the *"Tool to calculate the emission factor for an electricity system v. 2"* (tCO_2e/MWh) in year "y"

Calculation of $EG_{PJ,y}$

The calculation of $EG_{PJ,y}$ is different for greenfield plants. If the project activity is the installation of a new grid-connected renewable power plant/unit at a site where no renewable power plant was operated prior to the implementation of the project activity, then:

$$EG_{PJ,y} = EG_{facility,y}$$

Where,

$EG_{PJ,y}$ = Quantity of net electricity generation that is produced and fed into the grid as a result of the implementation of the CDM project activity in year *y* (MWh/yr)

$EG_{facility,y}$ = Quantity of net electricity generation supplied by the project plant/unit to the grid in year *y* (MWh/yr)

Project emissions

The proposed CDM project activity is a wind power system that does not generate project GHG emissions according to ACM0002, version 12.1.0 A value of zero emissions is assigned to the project emissions, **$PE_y = 0$.**

Leakage

No leakage emissions are considered. The main emissions potentially giving rise to leakage in the context of electric sector projects are emissions arising due to activities such as power plant construction and upstream emissions from fossil fuel use (e.g. extraction, processing, and transport). These emissions sources are neglected, **$L_y = 0$**.

Emission reductions

Emission reductions are calculated as follows:

$$ER_y = BE_y - PE_y \quad \text{(B. 6.3.2)}$$

Where,

ER_y = Emission reductions in year *y* (t CO_2e/yr)

BE_y = Baseline emissions in year *y* (t CO_2e/yr)

PE_y = Project emissions in year *y* (t CO_2e/yr)

Calculation of the combined margin CO2 emission factor for grid connected power generation

The combined margin CO2 emission factor for grid connected power generation in year *y* is determined using the *"Tool to calculate the emission factor for an electricity system version 2"*. The emission factor is calculated in the following steps:

***Step 1**. Identify the relevant electricity system*

The project will provide electricity to the national grid.

Step 2: Choose whether to include off-grid power plants in the project electricity system (optional)
Project participants may choose between two options to calculate the operating margin and build margin emission factor:

Option I is chosen; Only grid power plants are included in the calculation.

***Step 3**. Select a method to determine the operating margin (OM)*
The calculation of the operating margin emission factor ($EF_{grid, OM,y}$) is based on the *simple adjusted OM*. The data vintage chosen for the calculation is ex-ante, using a 3-year generation-weighted average, based on the most recent data available. In the case of the Jepirachi Wind Power Project, the average of years 2007-2009 was used. As described in detail in annex 3, the National Dispatch Center (CND) and the Mining and Energy Planning Unit at the Ministry of Energy (UPME) provided all data used to calculate the Operating Margin (OM) and Build Margin (BM) emission factors. The recorded generation data for each power plant at hourly intervals for the chosen vintage period was downloaded from the CND web page. Data will be updated for the third crediting period.

***Step 4.** Calculate the operating margin emission factor according to selected method*
The simple adjusted OM emission factor ($EF_{grid, OM-Adj, y}$) is a variation of the simple OM, where the power plants / units (including imports) are separated in low-cost/must-run power sources[2] (k) and other power sources (m). It is calculated based on the net electricity generation of each power unit and an emission factor for each power unit, as follows:

$$EF_{grid,OM-Adj,y} = (1-\lambda_y)\frac{\sum_m EG_{m,y} * EF_{EL,m,y}}{\sum_m EG_{m,y}} + \lambda_y \frac{\sum_k EG_{k,y} * EF_{EL,k,y}}{\sum_k EG_{k,y}} \quad \text{(B.6.3.3)}$$

Where,

$EF_{grid, OM-Adj, y}$ =	Simple adjusted operating margin CO_2 emission factor in year y (tCO_2/MWh)
λ_y =	Factor expressing the percentage of time when low-cost/must-run power units are on the margin in year y
$EG_{m, y}$ =	Net quantity of electricity generated and delivered to the grid by power unit m in year y (MWh)
$EG_{k, y}$ =	Net quantity of electricity generated and delivered to the grid by power unit k in year y (MWh)
$EF_{EL, m, y}$ =	CO_2 emission factor for power unit m in year y (tCO_2/MWh)
$EF_{EL, k, y}$ =	CO_2 emission factor for power unit k in year y (tCO_2/MWh)
m =	All grid power units serving the grid in year y except low-cost/must-run power units
k =	All low-cost/must run grid power units serving the grid in year y
y =	The relevant year as per the data vintage chosen in Step 3

The parameter (λy) is defined as follows:

$$\lambda_y = \frac{\text{Number of hours low} - \text{cost/must} - \text{run sources are on the margin in year y}}{\text{8760 hours per year}}$$

[2] Low-cost/must-run resources are defined as power plants with low marginal generation costs or power plants that are dispatched independently of the daily or seasonal load of the grid. They typically include hydro, geothermal, wind, low-cost biomass, nuclear and solar generation. In the EF calculation, these plants include all hydro, and windmill plants.

Lambda (λy) should be calculated as follows (see figure below):

Step (i) Plot a load duration curve. Collect chronological load data (typically in MW) for each hour of the year y, and sort the load data from the highest to the lowest MW level. Plot MW against 8760 hours in the year, in descending order.

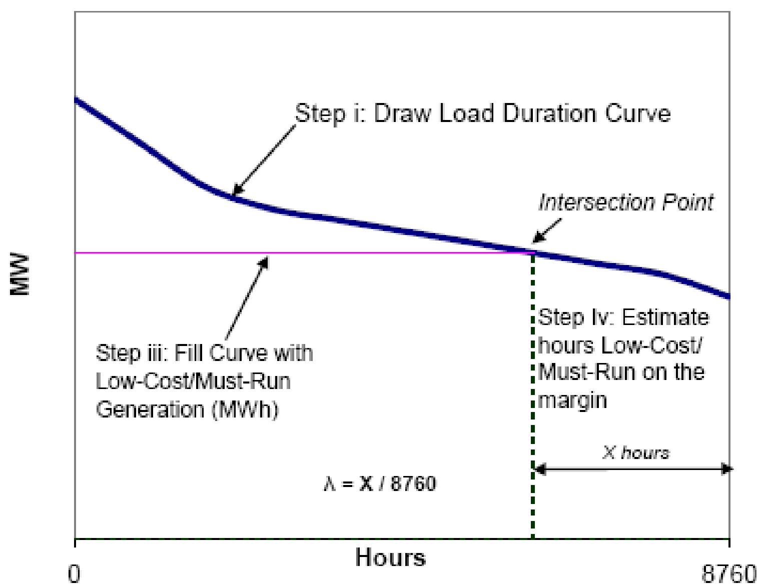
Step (ii) Collect power generation data from each power plant/unit. Calculate the total annual generation (in MWh) from low-cost/must-run power plants/units (i.e. Σk EGk,y).

Step (iii) Fill the load duration curve. Plot a horizontal line across the load duration curve such that the area under the curve (MW times hours) equals the total generation (in MWh) from lowcost/must-run power plants/units (i.e. Σk EGk,y).

Step (iv) Determine the .Number of hours for which low-cost/must-run sources are on the margin in year y. First, locate the intersection of the horizontal line plotted in Step (iii) and the load duration curve plotted in Step (i). The number of hours (out of the total of 8760 hours) to the right of the intersection is the number of hours for which low-cost/must-run sources are on the margin. If the lines do not intersect, then one may conclude that low-cost/must-run sources do not appear on the margin and λ_y is equal to zero.

In determining λy only grid power units are considered.

Fig B.6.3.1. Illustration of lambda calculation for simple adjusted operating margin emission factor



To calculate the CO_2 emission factors **EFEL, m,** y and **EFEL, k,** y of power units *m and k* in year y (tCO_2/MWh), Option A2 was used, as data on electricity generation and the fuel types and the efficiency of the power unit are available. Data on fuel consumption per power units are not available. Following this option, the fuel efficiency of every unit (MBTU/MWh) is converted to TJ/MWh so that the EF (tCO_2/TJ) from IPCC can be used. The following equation is applied:

$$EF_{EL,m,y} = EF_{CO2,i,m,y} * \eta_{m,y} * CONV$$

Where,

$EF_{EL,m,y}$ = CO_2 emission factor of power unit *m* in year *y* (tCO_2/MWh)

$EF_{CO2,m,y}$ =	CO_2 emission factor of fuel type *i* used in power unit *m* in year *y* (tCO_2/TJ) obtained from IPCC[3]
$\eta_{,m,y}$ =	Fuel efficiency of power plant *m* in year y in MBTU/MWh
CONV=	1 MBTU = 0.001055056TJ
i =	Types of fuels used by the unit *m*

The set of emission factors of power unit *n* calculated ex-ante will be reviewed at the beginning of the next crediting period based on the official and publicly available data.

Step 5. *Identify the group of power units to be included in the build margin (BM)*
In terms of vintage of data, option 2 (ex-post) was chosen. This means that for the first crediting period, the BM was calculated based on the most recent information available on units already built for sample group *m*. At the time of PDD submission to the DOE, the sample group of power units *m* used to calculate the build margin consisted of the set of power capacity additions in the electricity system that comprise 20% of the system generation (in MWh) and that were most recent, as this group presented a larger annual generation than the last 5 power units most recently built[4]. Power plant registered as CDM project activities should be excluded from the sample group m. However, if the group of power units, not registered as CDM project activity, identified for estimating the build margin emission factor includes power unit(s) that is(are) built more than 10 years ago then:

(i) Exclude power unit(s) that is (are) built more than 10 years ago from the group; and
(ii) Include grid connected power projects registered as CDM project activities, which are dispatched by dispatching authority to the electricity system.

In this case, excluding the power units built more than 10 years ago, and adding the grid connected CDM project activities, was not enough to account for the 20% of the system generation. Therefore, a couple of plants built at the end of 1998 were added to the m sample.

According to the Tool to calculate emission factor for an electricity system, v.2, for the second crediting period, the build margin emissions factor shall be calculated *ex-ante* based on the most recent information available at the time of validation. In this case, as explained in Annex 3, all power units entering up to the end of 2009, were considered. For the third crediting period, the build margin emission factor calculated for the second crediting period will be used.

Step 6. *Calculation of the Build Margin emission factor*
The build margin emission factor is the generation-weighted average emission factor (tCO_2/MWh) of all power units *m* during the most recent year *y* for which power generation data is available, calculated as follows:

$$EF_{grid,BM,y} = \frac{\sum_m EG_{m,y} * EF_{EL,m,y}}{\sum_m EG_{m,y}} \qquad \text{(B.6.3.5)}$$

Where,

$EF_{grid,BM,y}$ =	Build margin CO_2 emission factor in year y (tCO_2/MWh)
$EG_{m,y}$ =	Net quantity of electricity generated and delivered to the grid by power unit *m* in year *y* (MWh)
$EF_{EL,m,y}$ =	CO_2 emission factor of power unit *m* in year *y* (tCO_2/MWh)
m =	Power units included in the build margin

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3 2006 IPCC Guidelines for National GHG Inventories. Emission factors can be found on the IPCC EF Database at the following link: http://www.ipcc-nggip.iges.or.jp/EFDB/main.php
4 See Annex 3 of the PDD for a complete list of plants built in Colombia and that are most recent.

y = Most recent historical year for which power generation data is available

As indicated by the Tool, the CO_2 emission factor of each power unit m ($EF_{EL, m, y}$) is determined as per the guidance in step 4 (a) for the simple method OM, using option A2(which is based on net electricity generation, the average efficiency of each power unit and the fuel type(s) used in each power unit. This is calculated using for y the most recent historical year for which power generation data is available and using for m the power units included in the build margin. The vintage data set is applied ex-ante, so it will be revised for the next crediting period.

Step 7. Calculate the Combined Margin (CM) emission factor
The combined margin emissions factor is calculated as follows:

$$EF_{grid,CM,y} = EF_{grid,OM,y} * W_{OM} + EF_{grid,BM,y} * W_{BM} \quad \text{(B.6.3.6)}$$

Where,
$EF_{grid,BM,y}$ = Build margin CO_2 emission factor in year y (tCO_2/MWh)
$EF_{grid,OM,y}$ = Operating margin CO_2 emission factor in year y (tCO_2/MWh)
W_{OM} = Weighting of operating margin emissions factor (%)
W_{BM} = Weighting of build margin emissions factor (%)

The weights $\mathbf{W_{OM}}$ and $\mathbf{W_{BM}}$ in equation (B.6.3.6) have been given default value of 0.75 and 0.25, respectively as recommended by the Tool for wind power projects, due to the intermittent and non-dispatchable nature.

The final results of the calculation of the Emission Factor are the following:

$EF_{grid, OM, 2007-2009}$ = 0.4853 tCO_2/MWh
$EF_{grid, BM, 2009}$ = 0.3206 tCO_2/MWh
W_{OM} = 0.75
W_{BM} = 0.25

$EF_{grid, CM, 2009}$ = 0.4441 tCO2/MWh

Note: The data and calculations of the combined margin and of the emission factor are presented in Annex 3 of the PDD.

B.6.4. Summary of ex ante estimates of emission reductions

Year	Baseline emissions ($t\ CO_2e$)	Project emissions ($t\ CO_2e$)	Leakage ($t\ CO_2e$)	Emission reductions ($t\ CO_2e$)
31/01/2011 – 31/12/2011	23,524	0	0	23,524
2012	25,631	0	0	25,631
2013	25,631	0	0	25,631
2014	25,631	0	0	25,631
2015	25,631	0	0	25,631
2016	25,631	0	0	25,631
2017	25,631	0	0	25,631
1/1/2018 – 30/12/2018	2,106	0	0	2,106
Total	179,416	0	0	179,416
Total number of crediting years	7			
Annual average over the crediting period	25,631	0	0	25,631

B.7. Monitoring plan
B.7.1. Data and parameters to be monitored

Data / Parameter	$\mathbf{EG_{PJ,y}} = EG_{facility,y}$
Unit	MWh
Description	Quantity of net electricity supplied by the project plant/unit to the grid in year *y*
Source of data	Data supplied by Empresas Públicas de Medellín for ex-ante calculation, and later by the Colombian National Dispatch Center (CND) for verification purposes. Data supplied by Empresas Públicas de Medellín used for ex-ante calculations.
Value(s) applied	Hourly values reported by CND, which monitors continuously the value of this variable. Annual generation in 2009 was 57,709 MWh
Measurement methods and procedures	Following Colombian regulations the electricity generation from each power plant connected to the grid will be monitored on site using metering equipment located at the commercial frontier, which will be located in the substation at the end of the 115 kV, 0.7 km transmission line connecting Jepirachi wind power system with the national interconnected system. In Colombia, The Measurement Code "*Codigo de Medida*" establishes mandatory high technical standards, procedures for reading, registering and recording activities of electricity transactions performed in the Colombian energy market. This code is part of the CREG"s resolution number 025 of 1995, which is followed for electricity output measurements
Monitoring frequency	Hourly measurement and monthly recording.
QA/QC procedures	All metering devices used to monitor and measure data follow rules that have been summarized in resolution number 025 of 1995, (*Resolución* 025 de 1995) from CREG. This resolution specifies the technical characteristics measurement, telecommunications and back-up equipment to meet installation, testing, certification, operation and maintenance procedures.
Purpose of data	Calculation of baseline emissions
Additional comment	To cross check the metering, the electricity generated will be also measured at the plant substation at 13.8 kV, correcting the measure taking into account the transmission losses, estimated based on the technical specifications of the transmission line. Data will be archived for the crediting period plus 2 years

B.7.2. Sampling plan
>>
N/A

B.7.3. Other elements of monitoring plan
>>
The Monitoring Plan (MP) defines a standard against which to measure Jepirachi Wind Power Project's performance in terms of its greenhouse gas (GHG) emissions and emission reductions that can be monitored and verified in conformity with the modalities and procedures of the Clean Development Mechanism criteria.
The MP can be updated and adjusted to meet operational requirements, provided such modifications are approved by the DOE as in line with the guidelines and procedures of CDM during the initial or periodic verification. In particular, any shifts in the applicable baseline that are identified by following this MP

may lead to such amendments, which may be mandated by the Verifier. Basically the Monitoring Plan consists of three main sections as described in Annex 4 (Please see Annex 4 for the complete MP):

- *Section 2* explains principal assumptions applied in monitoring the GHG performance of the project and in calculating ERs. The section also discusses data sources and assumptions and lays out why the MP is expected to compute ERs in a conservative manner.
- *Section 3* contains instructions regarding operational and monitoring obligations the operator is expected to assume.
- *Section 4* presents the functioning of the MP electronic workbook. The workbook is implemented as Excel spreadsheets and is an integral part of the MP.

Emission reductions in the Monitoring Plan are calculated following steps described in the ACM0002, version 12.1.0. Basically, the following formula is used:

$$\mathbf{ER_y = BE_y - PE_y - L_y}$$

Where,

BE_y =	Baseline emissions due to the displacement of electricity during the year *y* in tonnes of CO_2e in year "y"
PE_y =	Project emissions in year "*y*"
L_y =	Leakage in year "*y*"

In the case of the proposed project, leakage related to transportation of materials and fuel and other up-stream activities are negligible, because higher life cycle emissions would result from the construction and operation of alternative capacity. The life cycle emissions of alternative power generation plants, in particular of fossil fuel power plants, are typically higher than those from wind power plants or hydro/run of river power plants. Therefore, no net leakage can be attributed to the project.

Operational and Management Structure

EPM has formed a multidisciplinary team, coordinated by the Power Operation Manager (*Sub-Gerencia de Operación y Energía*) which has been responsible for monitoring the parameters and will be responsible for recording and analyzing the data. Since the project will be using an Ex-Ante option for the grid emission factor, the only number to monitor for upcoming verifications is the actual electricity dispatched to the grid. This is relatively simple process, as the Colombian interconnected system relies on a highly regulated metering setup, which is required to make payments for electricity possible. This means that for the CDM project the only role for monitoring data is keeping copies of the hourly generation records that the central dispatch center maintains on file.

As per the metering, each of the generating units at Jepirachi is equipped with multi-function electronic metering devices, which register all information that needs to be monitored, such as exported energy, imported energy, power factor, electric tension, electric flow, etc. Such meters will be used for commercial, and maintenance purposes, in addition to the CDM reporting requirements. Before the starting of commercial energy exchanges with the wholesale market system, the equipment needs to be duly certified by authorized entities[5].

The Power Planning Unit keeps a periodical maintenance and calibration program according the codes approved by law, and following recommendations by the equipment providers. Information recorded by the metering equipment is sent every 24 hours to the Commercial Exchange System, operated by the National Dispatch Center. All energy transactions are registered every hour, in the first minute of each hour. EPM transmits every day, the recorded values of the day before. According to that information, the

[5] Following Decree 2269/93.

National Dispatch Center processes the bills and payments for all transactions performed in the wholesale market. All this information is available to the market agents and to the system control authorities.

The metering system at EPM is composed by software and hardware that allows for automatic recording of data collected at the meters. All data for outgoing and incoming energy are measured so that net electricity exports records are kept in file. For verification purposes, the data will be easily available at EPM. In addition, historic records of actual energy supplied to the grid are publicly available at the XM website. For confidentiality purposes, the release of information is made available with a delay of 6 months.

Sources of information for the interconnected grid in Colombia include: (i) the updated operational database of the National Dispatch Centre, CND, in XM ; contact: Ms. Silvia Cossio, tel: +57 (4) 315-7885; and, (ii) UPME ; Mr. Jose Vicente Dulce. Tel: +57 (1) 287-5354 the Planning Unit for the energy sector in the Ministry of Mines and Energy.

Access to CND database is available upon agreement with the CND. The operational data includes: National Energy Demand, Hourly/Daily National Generation by Plants, Hourly/Daily Plant Energy Bid prices, Energy generated to cover constraints, National Hydraulic Generation and Dam water levels among others.

All the information required to estimate the emission reductions associated with the electric interconnected system in Colombia is found in the archives operated of the CND and UPME. The UPME publishes data on its website (http://www.upme.gov.co/Index4.htm) and includes: Indicative Energy and Mines Expansion Plans, Energy and Mines Statistics Bulletins, Analysis of International Electricity Prices and Colombian Electricity Market Magazine. The UPME"s technical capacity has been used to estimate the expected emission reductions through advanced simulation methods, and periodically the estimates of i plant level emission factors based on technical information and chemical analysis of fuels used.

Information collected from stakeholders is subject to the CREG regulation and the National Regulatory Commission for Energy. The internationally accepted measuring standards have been enacted. Audits are implemented to ensure the data quality and access to all stakeholders. Colombia offers very good, accurate and reliable data from its interconnected electric grid.

SECTION C. Duration and crediting period

C.1. Duration of project activity

C.1.1. Start date of project activity

>>

The different units of the project were commissioned between 30/01/2004 and 30/03/2004 and were declared on commercial operation on 19/07/2004.

C.1.2. Expected operational lifetime of project activity

>>

The operational lifetime of the project is estimated as 21 years, as is common for wind power plants.

C.2. Crediting period of project activity

C.2.1. Type of crediting period

>>

Renewable crediting period

C.2.2. Start date of crediting period

>>

The second crediting period comprises the period from 31/01/2011 to 30/01/2018 (both days included).

C.2.3. Length of crediting period
>>
Seven years

SECTION D. Environmental impacts
D.1. Analysis of environmental impacts
>>
Empresas Públicas de Medellín carried out an environmental impact assessment (EIA) including physical, biological, socioeconomic and cultural components. Local communities were consulted throughout the EIA process. The EIA includes detailed mitigation and contingency plans and an outstanding consultation process with local communities. A summary of the findings follows (excerpted from the World Bank Project Appraisal Document). Please see Annex 9 for additional information.

Summary of Findings of Environmental Impact Assessment[6]

Main Potential Environmental Impacts Associated with Wind Power Plants include:
− The resulting impacts from the construction of power transmission lines;
− The opening of new access roads, which can lead to indirect impacts around the project area;
− Increase in noise pollution, depending on the number and model of the turbines and the distance between them, as well as the location of the power plant in relation to existing housing;
− The rotating arms can kill birds, and the negative impact can be especially serious if the windmills are located in the path of migratory birds;
− Impacts on native vegetation and archaeological sites as a result of construction activities for windmill towers, transformers, and access roads; and
− Impacts on the scenic value of the area since wind-power plants are usually located at the top of hills or in open land, both of which make them visible from far away.

Power Transmission Lines
No significant environmental issues related to power lines have been identified. Both the wind farm and the grid connection will be located at least 200 m apart from the coast so as to minimize impacts on birds and their routes. Some collisions of non-marine birds may occur with the wind turbines, but these will be minimized by strategically locating the anchors, the towers and providing a light color to the installations.

Road Construction and Improvement
The Jepirachi Wind Power Project will not include new road construction or major road improvements through natural forests, wetlands, protected areas, or other ecologically sensitive areas. The project site has been chosen so as to minimize the demand for infrastructure access during construction, installation and operation of the project. Impacts during construction works for temporal and no-temporal access roads will not be significant given the topography and other physical characteristics of the project site (e.g. semi desert ecosystem with almost no vegetative cover and no organic content, rain volume is minimal, etc.). From the geo-technical point of view, only a superficial preparation will be needed for cleaning and leveling access works. The EIA indicates that aggregate material would be extracted from the edges of the Apure and Paat Arroyos, and clarify that no material will be extracted from wet streambeds.

[6] Excerpt from Annex 13 of Project Appraisal Document. This document briefly summarizes the findings of the Environmental Impact Assessment for the Jepirachi Wind Power Project.

Noise
New wind technology is significantly less noisy than older technologies. In particular the slow moving blades selected for this unit will reduce noise impacts. In addition, the site is 1.5 km away from the nearest settlement, further masking the noise as part of the background noise prevalent in the area (wind gusts).

Other Complementary Facilities
The EIA has identified the impacts that might be derived from construction activities and has included a program for the prevention and mitigation of these impacts within the Environmental Management Plan. In particular, this program will ensure that contractors follow good construction and environmental practices. As part of the social program, small facilities and civil works will be undertaken, namely refurbishing of school facility, health center, small water storage pits, the set-up of 2-4 m^3/hour desalinization plant and refurbishing of the cemetery. Same procedures will be followed even though the impacts anticipated are negligible.

Compliance with Natural Habitats (OP4.04)
The EIA clarifies that the project will have minimum impact on the natural environment of the area. The project will not be located within existing or officially proposed protected areas. The project‟s impact on local biodiversity will mostly be negligible because relatively so little land will be cleared (and, in the case of bird collisions, project design seeks to minimize any adverse impacts). The anticipated, relatively minor impacts on natural habitats and biodiversity are of three types:

(a) Land clearing: the land to be cleared to install the wind turbines is 6.5 km 2400 m access road, borrow pits, and complementary facilities that totals only 7 ha, of which only 6 ha would remain cleared permanently. The area of the vegetation to be affected by the project is a very tiny fraction of the remaining total of this ecosystem type on the Guajira Peninsula, so the loss is not at all significant.
(b) Construction worker behaviour: To minimize any incidental harm to wildlife during project construction, the Environmental Management Plan specifies that all contractors and construction workers will be prohibited from (i) any hunting, killing or capture of wild animals or herds used by the Wayuu (ii) any cutting, burning or collection of natural vegetation (including cacti) that is not strictly required for project implementation and approved by the supervising engineer in the field and (iii) contamination of waterways with solid or liquid wastes.
(c) Potential bird mortality: From a natural habitats degradation and biodiversity conservation standpoint, the project‟s potentially most serious adverse impact could be bird mortality from wind turbine collisions, or transmission line collisions or electrocutions. These impacts are expected not to be significant due to the following project sitting and design features: (i) the sitting of the windmills will not overlap with normal flight paths of birds found in the area (ii) the wind turbines have a bird-friendly design, with large slow-moving blades, tubular towers (with no attractive bird perches near the blades) that include a plastic device at the top of each one and with a visible colour clearly identified by flying birds (iii) the distance between the transmission line conducting wires will be at least 2.5 m apart to avoid electrocuting any birds of prey (iv) the top power line will be made more visible to flying birds with inexpensive plastic devices.

Cumulative Effects
The project will not increase the environmental load in the area in any significant manner.

Social Aspects
In order to ensure close linkage and harmonization of project activities with the indigenous peoples of the area as well as to ensure respect and integrity of their culture, Empresas Públicas de Medellín designed and implemented a Social Management Plan during the project preparation phase. The main objective of this Plan was to inform, consult and agree with indigenous communities, and local and environmental authorities on the activities developed by Empresas Públicas de Medellín, as well as to carry out the formal consultation required under Colombian law.

Program	Objectives	Project
Information and communication program	1. To inform communities on the project, its characteristics and stages 2. To establish harmonic relationships between communities and the project sponsor 3. To encourage community participation	a) Information, communication and dissemination of the wind project b) Reception and resolution of claims c) Filed visits to follow up the construction process
Employment opportunities program	Improve community income	a) Direct employment (recruitment and hiring) b) Indirect employment (acquisition of raw materials, good and services)
Environmental education program	To promote sustainable development	a) Dissemination of the EMP for employees and communities b) Training on design of environmental projects c) Ethno education projects d) Training on management of reservoir of water e) Training on solid waste disposal f) Training on adequate use of natural resources
Participation and community strengthening program	1. To strengthen communities 2. To facilitate communities" access to financial resources	a) Training on indigenous rights according to Colombian law b) Training on formulation, implementation and assessment of self management projects to access legal transfers and additional PCF benefits
Information and Training for employees program	To respect the cultural characteristics of communities	Training on cultural life of Wayuu people to employees and contractors
Compensation Program	1. To compensate for the use of land and resources 2. To improve the standard of living	a) Water desalinization plant b) Water storage c) School rehabilitation d) Health Center rehabilitation e) Rehabilitation of graveyard
Technology Dissemination Program	To inform and disseminate the advances of the new technology	a) Field visits to the wind power plant b) Dissemination of material on new technology

MANAGEMENT OF ENVIRONMENTAL IMPACTS IN OPERATION

EPM is undertaking a monitoring environmental plan, which involves physical-biotic and social aspects to protect natural resources and to promote a sustainable development. The purpose of the environmental monitoring plan is to verify the results of the environmental management plan and to do corrections if is necessary, in special programs as impact of birds with wind mills or electrics wire conductions, survival of cactus experimental plantation and reestablishment of vegetation, landscape perception, noise impact, job creation and sustainability of compensation actions (houses, desalinization plant).

EPM has developed different actions for his social responsibility for developing areas where the projects are located. They are focused in organizational strengthening for local institutions, such as cultural events, promotion of education actions, health campaigns, and monetary support for the Wayuu Festival and supply of scholar kits and books. EPM supports other projects institutions as rural electrification and aqueduct, for local communities of the wind park.

The project company is aware of his social responsibility and contributes to social programs for benefits in the community. Additionally of the compensations plan for social impact, EPM address 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 consider 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.

D.2. Environmental impact assessment

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The environmental impacts of the project are not considered significant. No environmental licensing was required for Jepirachi Wind Power Park, but the environmental management plan was approved by CORPOGUAJIRA, the Regional Autonomous Corporation of the Guajira, the regional environmental authority. The government endorsed the project with official communication issued by the Ministry of Environment.

SECTION E. Local stakeholder consultation

E.1. Solicitation of comments from local stakeholders

>>

The EIA was conducted under the requirements established in the Decree 1320 of 1998 relative to ethnic minorities and Agreement 169 of 1989 of the International Labor Organization (ILO) that calls for mandatory consultation processes and the participation of indigenous communities during the development of environmental assessments.

Empresas Públicas de Medellín developed an extensive consultation process during the period 1999-2002. This consultation process included national, regional and local governmental institutions concerned with indigenous peoples, and traditional authorities and communities of Rancherías Kasiwolin, Arutkajui and Media Luna. The first consultation regarded the installation of the wind monitoring devices in 1999. The consultation process continued during all the phases of the EIA. The methodology and scope of the EIA was consulted as well as the identification of the impacts and the measures to manage them. Empresas Públicas de Medellín carried out a total of 20 formal consultation meetings with communities and several meetings with governmental institutions. All the consultation meetings with the communities were carried out with translators. The consultation process finalized in June 2002 with an agreement on the Environmental Management Plan, which includes the physical, biological, socioeconomic, and cultural programs described above. The Ministry of Interior, Department of Indigenous Communities Affairs, supervised the consultation process.

No concerns were raised by any other stakeholders when the project was posted on the PCF website.

E.2. Summary of comments received

>>

The main concerns of local groups, authorities and communities, expressed through comments received during the various meetings, were related to the fear of being deceived once again and of losing their lands; these concerns were reiterated throughout the process. In addition, other concerns were raised such as:

• Fear of fencing off the land due to the project, with the loss of their everyday activities
• Fear of the lightning attracted by the climate monitoring stations
• Size of the project
• Negotiation of easements
• Benefit for the municipal government
• Hiring of local workers
• End-use of the power generated by the project
• Company management of operations and benefits
• Fear that it will not be possible to continue cultivating crops
• Death of animals such as goats
• Negative impact on plant life, which is food for the goats
• Negative impact on human health
• Fear that individuals from another region may take advantage of or claim the benefits of the project
• Generation of royalties for the municipal government of Uribia
• Request for money as payment or consideration
• Benefits for the communities during the stage of project operation

E.3. Report on consideration of comments received
>>
All comments received from stakeholders were taken into account through a participation process with communities of the region. There was a consultation process carried out by EPM that was developed through meetings, workshops, and field visits. The first step in this process was the "prior consultation".

This process began with the communities from the *rancherias* and their traditional authorities and enjoyed the support of the environmental authority in the region, CORPOGUAJIRA, which issued the respective environmental licenses, and provided accompaniment in the field as necessary. The main characteristics of this process developed with the Wayúu communities from the area of influence of the project were:

• Consultation on impacts and management measures, interests and expectations of the communities and institutions, by holding workshops, presenting videos, photographs, that would enable the communities to take stock of the impacts of the wind energy project on the environment.
• A process of agreeing on management measures was carried out. Meetings and workshops were held with the communities in which the proposals of the community were considered, especially for managing the impacts related to the transit of vehicles and the possible impact on persons, animals and burial grounds, job creation for the local population, contracting of goods and services, and the definition of compensatory measures aimed at improving the quality of life, particularly as pertains to water, health and education.
• Participation of communities in the environmental studies: The communities participated actively as guides and informants in the basic studies such as: studies of birds, plant life, and soil uses, topography, and aerophotogrammetric restitution, geotechnical studies, archaeological studies and social description.
• Follow-up on agreements and activities derived from the studies and from the process, such as the operation of the stations, the impact on the milieu, expectations mutual implementation of commitments, which made it possible to get feedback on the process, and to improve the interaction with the community. EPM possesses records not only of all comments received by stakeholders but also of the complete process of consultation. Based on comments received, EPM fully carried out an "Execution Plan" where all the comments were introduced. Moreover minutes were taken of each meeting, signed by all persons in attendance, setting forth the information provided about the project, its characteristics, the studies required, doubts, expectations, and fears of the communities; the impacts, needs, and commitments made by the parties. A copy of each of the minutes was provided to communities, the Office of the Major of Uribia, Corpoguajira and the Ministry of Interior.

EPM has a program for communicating and providing information about the project activities to stakeholders, including topics such as employment opportunities, project benefits, and safety aspects.

SECTION F. Approval and authorization

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The letters of approval from Parties for the project activity are available at the time of submitting the PDD to the validating DOE for the renewal of the crediting period.

- - - - -

Appendix 1: Contact information of project participants

Organization name	Empresas Públicas de Medellín
Street/P.O. Box	
Building	
City	Medellín
State/Region	
Postcode	
Country	Colombia
Telephone	
Fax	
E-mail	
Website	
Contact person	
Title	Project Director
Salutation	Mr.
Last name	Del Río
Middle name	
First name	Walter
Department	
Mobile	
Direct fax	+57-54 380 6795
Direct tel.	+57-54 380 2198
Personal e-mail	Walter.Delrio@epm.com.co

Organization name	International Bank for Reconstruction and Development (IBRD) as Trustee of the Prototype Carbon Fund (PCF)
Street/P.O. Box	1818 H Street, NW
Building	MC Building
City	Washington
State/Region	DC
Postcode	20043
Country	United States of America
Telephone	
Fax	
E-mail	Ibrd-carbonfinance@worldbank.org
Website	www.carbonfinance.org
Contact person	
Title	Manager
Salutation	Ms.
Last name	Chassard
Middle name	-
First name	Joelle
Department	CPFCF
Mobile	
Direct fax	+1-202-522 7432
Direct tel.	+1-202-458-1873
Represented by (alternate)	Mr. Tao Wang
Title	
Salutation	Mr.
Last name	Andreu
Middle name	
First name	Jose
Department	CPFCF
Direct Fax	+1-202-522 7432
Direct tel.	+1-202-458-1873
Personal e-mail	ibrd-carbonfinance@worldbank.org

Organization name	Government of Finland- Ministry of Foreign Affairs
Street/P.O. Box	Katajanokanlaituri 3
Building	
City	Helsinki
State/Region	
Postcode	FIN-00161
Country	Finland
Telephone	358-9-160 56033
Fax	358-9-160 56567
E-mail	
Website	
Contact person	Ms. Karoliina Anttonen
Title	Senior Officer
Salutation	
Last name	Anttonen
Middle name	
First name	Karoliina
Department	Unit for International Environment Policy
Mobile	
Direct fax	358-9-160 56033
Direct tel.	358-9-160 56567
Personal e-mail	Karoliina.Anttonen@formin.fi

Organization name	Fortum Corporation
Street/P.O. Box	Fortum, Trading and Industrial Intelligence Keilaniementie 1 POB 100, 00048 FORTUM, Finland
Building	
City	
State/Region	
Postcode	
Country	Finland
Telephone	+358 44 5181 518
Fax	+358 10 45 36650
E-mail	Mans.Holmberg@fortum.com
Website	
Contact person	Holmberg Mans
Title	Head of Environmental Value Trading & Head of Sales Asset Backed Trading
Salutation	Mr.
Last name	Mans
Middle name	
First name	Holmberg
Department	
Mobile	
Direct fax	
Direct tel.	
Personal e-mail	Mans.Holmberg@fortum.com

Organization name	GDF SUEZ
Street/P.O. Box	16, Rue de la Ville L'Evèque 75008
Building	
City	Paris
State/Region	
Postcode	
Country	France
Telephone	+331-57 04 43 72
Fax	+331-57 04 45 05
E-mail	françoise.guichard@gdfsuez.com
Website	
Contact person	Françoise Guichard
Title	
Salutation	Ms.
Last name	Guichard
Middle name	
First name	Françoise
Department	CO2 Strategy. Sustainable Development Division
Mobile	
Direct fax	
Direct tel.	
Personal e-mail	françoise.guichard@gdfsuez.com
Represented by (alternate)	Christine Faure-Fedigan
Title	
Salutation	Ms.
Last name	Faure-Fedigan
Middle name	
First name	Christine
Department	CO2 Strategy. Sustainable Development Division
Mobile	
Direct fax	
Direct tel.	
Personal e-mail	christine.fedigan@gdfsuez.com

Organization name	RWE Power AG
Street/P.O. Box	Huyssenallee 2 D-45128
Building	
City	Essen
State/Region	
Postcode	
Country	Germany
Telephone	
Fax	
E-mail	bodo.einicke@rwe.com
Website	
Contact person	Bodo Einicke
Title	Head of Portfolio Management
Salutation	Mr.
Last name	Einicke
Middle name	
First name	Bodo
Department	
Mobile	
Direct fax	
Direct tel.	
Personal e-mail	bodo.einicke@rwe.com

Organization name	Chubu Electric Power Co., Inc.
Street/P.O. Box	1, Higashishin-cho, Higashi-ku,
Building	
City	Nagoya
State/Region	
Postcode	461-8680
Country	Japan
Telephone	81-52-973-2113
Fax	81-52-973-0590
E-mail	Ishino.Akira@chuden.co.jp
Website	
Contact person	Akira Ishino
Title	
Salutation	
Last name	Ishino
Middle name	
First name	Akira
Department	
Mobile	
Direct fax	
Direct tel.	
Personal e-mail	Ishino.Akira@chuden.co.jp

Organization name	The Chugoku Electric Power Co., Inc.
Street/P.O. Box	4-33, Komachi, Naka-ku
Building	
City	Hiroshima
State/Region	
Postcode	730-8701
Country	Japan
Telephone	+81-82-523-6162
Fax	+81-82-523-6185
E-mail	273393@pnet.energia.co.jp
Website	
Contact person	Masashi Oyama
Title	
Salutation	Mr.
Last name	Oyama
Middle name	Masashi
First name	
Department	Public Relations & Environment Affairs Div.
Mobile	
Direct fax	
Direct tel.	
Personal e-mail	

Organization name	Kyushu Electric Power Company, Inc
Street/P.O. Box	1-82, Watanabe-dori, 2-Chome, Chuo-ku
Building	
City	Fukuoka
State/Region	
Postcode	810-8720
Country	Japan
Telephone	
Fax	
E-mail	Shigehiro_Matsueda@kyuden.co.jp
Website	
Contact person	Shigehiro Matsueda
Title	
Salutation	Mr.
Last name	Matsueda
Middle name	
First name	Shigehiro
Department	
Mobile	
Direct fax	
Direct tel.	
Personal e-mail	Shigehiro_Matsueda@kyuden.co.jp

Organization name	Mitsubishi Corporation
Street/P.O. Box	16-3, Konan 2-chome, Minato-ku
Building	
City	Tokyo
State/Region	
Postcode	108-8228
Country	Japan
Telephone	81-3-3210-4134
Fax	81-3-3210-7708
E-mail	tsuyoshi.nakamura@mitsubishicorp.com
Website	
Contact person	Tsuyoshi Nakamura
Title	General Manager. Planning and Marketing. Emissions Reductions Business Unit
Salutation	Mr.
Last name	Nakamura
Middle name	
First name	Tsuyoshi
Department	
Mobile	
Direct fax	
Direct tel.	
Personal e-mail	tsuyoshi.nakamura@mitsubishicorp.com

Organization name	Shikoku Electric Power Co., Inc.
Street/P.O. Box	2-5 Marunouchi
Building	
City	Takamatsu
State/Region	
Postcode	760-8571
Country	Japan
Telephone	
Fax	+81-87-825-3027
E-mail	yamagata11746@yonden.co.jp
Website	
Contact person	Hiromichi Yamagata
Title	Manager,
Salutation	Mr.
Last name	Yamagata
Middle name	
First name	Hiromichi
Department	Global Warming Solution Group. Environment Affairs Dept. General Planning Division
Mobile	
Direct fax	
Direct tel.	
Personal e-mail	yamagata11746@yonden.co.jp

Organization name	Tohoku Electric Power Co., Inc.
Street/P.O. Box	7-1, Honcho, 1-Chome, Aoba-ku,
Building	
City	Sendai, Miyagi
State/Region	
Postcode	980-8550
Country	Japan
Telephone	81-22-799-6153
Fax	81-22-225-2426
E-mail	w940263@tohoku-epco.co.jp
Website	
Contact person	Yuichi TACHIBANA
Title	
Salutation	Mr.
Last name	TACHIBANA
Middle name	
First name	Yuichi
Department	
Mobile	
Direct fax	
Direct tel.	
Personal e-mail	

Organization name	The Tokyo Electric Power Co., Inc.
Street/P.O. Box	1-3 Uchisaiwai-Cho 1-Chome Chiyoda-ku,
Building	
City	Tokyo
State/Region	
Postcode	100-8560
Country	Japan
Telephone	81 3 4216 6353
Fax	81 3 3504 1570
E-mail	carbonteam@tepco.co.jp
Website	
Contact person	Atsushi Kimura
Title	Group Manager, International Environmental Business Group
Salutation	Mr.
Last name	Kimura
Middle name	
First name	Atsushi
Department	
Mobile	
Direct fax	
Direct tel.	
Personal e-mail	kimura.atsushi@tepco.co.jp

Organization name	Japan International Cooperation Agency (JICA)
Street/P.O. Box	5-25, Niban-cho, Chiyoda-ku
Building	2nd floor, Nibancho Center Building
City	Tokyo
State/Region	
Postcode	102-8012
Country	Japan
Telephone	+81-3-5226-8980
Fax	+81-3-5226-6326
E-mail	Shigiya.Satoshi@jica.go.jp
Website	
Contact person	Satoshi Shigiya
Title	
Salutation	Mr.
Last name	Shigiya
Middle name	
First name	Satoshi
Department	Private Sector Investment Finance Division, Office for Private Sector Partnership
Mobile	
Direct fax	
Direct tel.	
Personal e-mail	Shigiya.Satoshi@jica.go.jp
Represented by (alternate)	Hiromichi Muraoka
Title	
Salutation	Mr.
Last name	Muraoka
Middle name	
First name	Hiromichi
Department	
Mobile	
Direct fax	
Direct tel.	
Personal e-mail	Muraoka.hiromichi@jica.go.jp

Organization name	Mitsui & Co. Ltd.
Street/P.O. Box	2-1 Ohtemachi 1-Chome
Building	
City	Chiyoda-ku
State/Region	Tokyo
Postcode	
Country	Japan
Telephone	81-3-3285-2872
Fax	81-3-3285-9612
E-mail	Troyoso@mitsui.com
Website	
Contact person	Toru Royoso
Title	General Manager
Salutation	Mr
Last name	Royoso
Middle name	
First name	Toru
Department	
Mobile	
Direct fax	
Direct tel.	
Personal e-mail	

Organization name	Electrabel S.A.
Street/P.O. Box	Boulevard du Régent 8, (R1 1002/247) 1000
Building	
City	Brussels
State/Region	
Postcode	
Country	Belgium
Telephone	+32 (0)2 501 57 30
Fax	+32 (0)2 501 59 16
E-mail	Daniel.Rossi@electrabel.com
Website	
Contact person	Daniel Rossi
Title	Environmental Markets Advisor Trading and Portfolio Management Europe
Salutation	Mr.
Last name	Rossi
Middle name	
First name	Daniel
Department	
Mobile	
Direct fax	
Direct tel.	
Personal e-mail	Daniel.Rossi@electrabel.com

Organization name	Netherlands' Ministry of Infrastructure and the Environment (IenM)
Street/P.O. Box	Rijnstraat 8
Building	
City	The Hague
State/Region	
Postcode	2515 XP
Country	The Netherlands
Telephone	0031-70-339.5199
Fax	0031-70-339.1306
E-mail	cdm.dna@minvrom.nl
Website	
Contact person	Ms. Marisa Gerards
Title	Director for International Environmental Affairs
Salutation	Ms.
Last name	Gerards
Middle name	
First name	Marisa
Department	Directorate of International Environmental Affairs
Mobile	
Direct fax	+31-70-339.1306
Direct tel.	+31-70-339.5199
Personal e-mail	cdm.dna@minvrom.nl

Organization name	Netherlands' Ministry of Economic Affairs, Agriculture and Innovation (EL&I)
Street/P.O. Box	Bezuidenhoutseweg 30
Building	
City	Den Haag
State/Region	
Postcode	2500
Country	The Netherlands
Telephone	+31703796328
Fax	+0703797423
E-mail	
Website	
Contact person	Maurits Blanson Henkenmans
Title	
Salutation	Mr.
Last name	Henkeknmans
Middle name	Blanson
First name	Maurits
Department	
Mobile	
Direct fax	
Direct tel.	
Personal e-mail	l.j.m.blansonhenkemans@minez.nl

Organization name	Norsk Hydro ASA
Street/P.O. Box	N-0246 Kjørboveien, Sandvika. N-0246
Building	
City	Oslo
State/Region	
Postcode	
Country	Norway
Telephone	47.22.53.77.36
Fax	47.22.53.90.40
E-mail	liv.rathe@hydro.com
Website	
Contact person	Liv Rathe
Title	Director, Head of Greenhouse Gas Commercial
Salutation	Ms.
Last name	Rathe
Middle name	
First name	Liv
Department	
Mobile	+47 97 68 11 45
Direct fax	
Direct tel.	
Personal e-mail	liv.rathe@hydro.com

Organization name	Government of Norway - Ministry of Foreign Affairs
Street/P.O. Box	7.juni pl./Victoria Terrasse P.O. Box 8114 Dep, NO-0032
Building	
City	Oslo
State/Region	
Postcode	
Country	Norway
Telephone	+ 47 22 24 36 19
Fax	+ 47 22 24 95 80
E-mail	erik.bjornebye@mfa.no
Website	
Contact person	Mr. Eric Bjørnebye
Title	Ambassador/Special Advisor
Salutation	Mr.
Last name	Bjørnebye
Middle name	
First name	Eric
Department	
Mobile	+ 47 95 76 09 56
Direct fax	
Direct tel.	
Personal e-mail	erik.bjornebye@mfa.no

Organization name	Statoil ASA
Street/P.O. Box	
Building	
City	
State/Region	
Postcode	
Country	
Telephone	+47 93050291
Fax	
E-mail	tbe@statoil.com
Website	
Contact person	Thomas B. Egeland
Title	Leader. NG TO PE Emissions
Salutation	Mr.
Last name	Egeland
Middle name	
First name	Thomas
Department	
Mobile	
Direct fax	
Direct tel.	
Personal e-mail	tbe@statoil.com

Organization name	BP Alternative Energy International Ltd.
Street/P.O. Box	1st Floor 1 St James's Square
Building	
City	London
State/Region	
Postcode	SW1Y 4PD
Country	United Kingdom
Telephone	+44 (0) 7771 806 801
Fax	+44 1932 739419 or +44 1932 762382
E-mail	lisa.walker2@uk.bp.com
Website	
Contact person	Lisa Walker
Title	
Salutation	Mrs.
Last name	Walker
Middle name	
First name	Lisa
Department	BP Policy and Long Term Strategy
Mobile	+44 (0) 7771 806 801
Direct fax	
Direct tel.	
Personal e-mail	lisa.walker2@uk.bp.com

Organization name	Deutsche Bank AG
Street/P.O. Box	Winchester House 1 Great Winchester Street
Building	
City	London
State/Region	
Postcode	EC2N 2DB
Country	United Kingdom
Telephone	+44 (0)20 7547 3347
Fax	+44 (0)20 7547 3713
E-mail	martin.lawless@db.com
Website	
Contact person	Martin Lawless
Title	Managing Director Head of Environmental Financial Products Deutsche Bank AG London
Salutation	Mr.
Last name	Lawless
Middle name	
First name	Martin
Department	Environmental Financial Products
Mobile	+44 (0)7979 707379
Direct fax	
Direct tel.	
Personal e-mail	martin.lawless@db.com

Organization name	Government of Sweden – Swedish Energy Agency
Street/P.O. Box	P.O. Box 310, SE-631 04
Building	
City	Eskilstuna
State/Region	
Postcode	
Country	Sweden
Telephone	+46-16-544 20 77
Fax	+46-16-544 20 99
E-mail	beng.bostrom@swedishenergyagency.se
Website	
Contact person	Beng Bostrom
Title	
Salutation	
Last name	Bostrom
Middle name	
First name	Beng
Department	
Mobile	
Direct fax	
Direct tel.	
Personal e-mail	beng.bostrom@swedishenergyagency.se
Represented by (alternate)	Johanna Myrman
Title	Programme Manager
Salutation	Ms.
Last name	Myrman
Middle name	
First name	Johanna
Department	Climate Change Unit
Mobile	
Direct fax	
Direct tel.	
Personal e-mail	Johanna.myrman@swedishenergyagency.se

Appendix 2: Affirmation regarding public funding

N/A. There is no public funding in this project.

Appendix 3: Applicability of selected methodology

Please refer to section B.2.

Appendix 4: Further background information on ex ante calculation of emission reductions

General Data Summary

The National Dispatch Center (CND) and the Mining and Energy Planning Unit at the Ministry of Energy (UPME) facilitated the collection of all necessary information to calculate the Operating Margin (OM) and Build Margin (BM) emission factors. The recorded generation data for each power plant at hourly intervals was downloaded with the help of "neon" system at the CND web page[7].

Data for calculating the Operating Margin emission factor

The method used to calculate the OM is the simple adjusted ex-ante option. The following table summarizes the findings:

	2007	2008	2009
Electricity generation (MWh)	53,665,663	54,432,532	55,939,074
Electricity generation – low cost/must run (MWh)	44,550,547	46,699,344	41,293,041
CO2 emissions – low cost/must run (tCO_2)	0	0	0
Electricity generation – NO low cost/must run (MWh)	9,115,116	7,733,187	14,646,033
CO2 emissions – NO low cost/must run (tCO_2)	5,870,773	5,035,218	9,393,592
Lambda factor	0.2680	0.3319	0.061
Operating Margin Emission Factor (tCO_2/MWh)	0.4714	0.4349	0.6020

The tables shown below present the emissions factors for all power plants connected to the Colombian national grid. These data are used to calculate the $EF_{grid, OM, 2008}$. Table 1 presents the list of power plants operating with natural gas and Table 2 presents power plants operating with coal. Based on this information, the calculated average Operating Margin emissions factor was calculated for 2006-2008, using hourly data for actual generation. (Detailed calculation tables are available as part of the project documentation package and have been provided for validation).

For those power plants with information on the heat rate from XM, it has been calculated the EF following the Tool. For those without information on the heat rate, it has been taken the official values

[7] Neon is a database, which contains close to 35 different variables that are measured and stored by the CND. This information can be accessed at http://sv04.xm.com.co/neonweb/

from UPME, which also follow the Tool. Finally, for Cogenerador Papeles Nacionales, it has been used an average of the gas-fired plant emission factor, given that there was no heat rate available, nor the UPME published a value. Likewise, for the Cogenerador Carmelita it has been used the value that UPME has calculated for other biomass cogenerations.

1. Table.1 Emissions Factor (tCO_2/MWh) for thermal power plants[8]

Plant Name	Fuel	Heat Rate MBTU/MWh	Efficiency TJ/MWh	Fuel EF tCO_2e/TJ	Plant EF (tCO_2e/MWh)
BARRANQUILLA 3	Gas	9.6961	0.0102	54.30	0.5555
BARRANQUILLA 4	Gas	9.9695	0.0105	54.30	0.5711
CENTRAL CARTAGENA 1	Gas	11.1879	0.0118	54.30	0.6409
CENTRAL CARTAGENA 2	Gas	11.0190	0.0116	54.30	0.6313
CENTRAL CARTAGENA 3	Gas	10.9365	0.0115	54.30	0.6265
FLORES 1	Gas	7.7126	0.0081	54.30	0.4419
FLORES 2	Gas	10.4444	0.0110	54.30	0.5984
FLORES 3	Gas	9.6022	0.0101	54.30	0.5501
GUAJIRA 1	Gas	9.8036	0.0103	54.30	0.5616
GUAJIRA 2	Coal (subbitum.)	9.7038	0.0102	92.80	0.9501
MERILECTRICA 1	Gas	9.6010	0.0101	54.30	0.5500
PAIPA 1	Coal (subbitum.)	13.4904	0.0142	92.80	1.3208
PAIPA 2	Coal (subbitum.)	12.2191	0.0129	92.80	1.1964
PAIPA 3	Coal (subbitum.)	12.2715	0.0129	92.80	1.2015
PAIPA 4	Coal (subbitum.)	9.2513	0.0098	92.80	0.9058
PALENQUE 3	Gas	14.3162	0.0151	54.30	0.8202
PROELECTRICA 1	Gas	8.1684	0.0086	54.30	0.4680
PROELECTRICA 2	Gas	8.1684	0.0086	54.30	0.4680
TASAJERO 1	Coal	9.4663	0.0100	92.80	0.9268
TEBSA	Gas	7.3085	0.0077	54.30	0.4187
TERMOCANDELARIA 1	Gas	9.5477	0.0101	54.30	0.5470
TERMOCANDELARIA 2	Gas	9.6806	0.0102	54.30	0.5546
TERMOCENTRO 1 CICLO COMBINADO	Gas	7.0872	0.0075	54.30	0.4060
TERMODORADA 1	Gas	9.7103	0.0102	54.30	0.5563
TERMOEMCALI 1	Gas	6.9735	0.0074	54.30	0.3995
TERMOSIERRA1	Gas	6.6727	0.0070	54.30	0.3823
TERMOVALLE 1	Gas	6.5790	0.0069	54.30	0.3769
TERMOYOPAL 1		Gas		0.8884	
TERMOYOPAL 2	Gas	12.1016	0.0128	54.30	0.6933
ZIPAEMG 2	Coal (other bitum.)	12.7586	0.0135	89.50	1.2048
ZIPAEMG 3	Coal (other bitum.)	9.6027	0.0101	89.50	0.9068
ZIPAEMG 4	Coal (other bitum.)	9.0118	0.0095	89.50	0.8510
ZIPAEMG 5	Coal (other bitum.)	8.6793	0.0092	89.50	0.8196
TERMOPIEDRAS 1 GENERACION		Coal (other bitum.)		0.8634	

[8] Data according to Heating Rates provided by XM, 2010. For Termoyopal 1, Termopiedras 1 Generacion, Morro 1, 2 and Cimarrón, were used values provided directly by UPME.

MORRO 1	Gas	0.8884
MORRO 2	Gas	0.8884
CIMARRÓN	Gas	0.8077

Table 2 Emissions Factor (tCO_2/MWh) for cogeneration plants[9]

Plant Name	Emission Factor (tCO_2/MWh)
CENTRAL TUMACO - COGENERACION	0.2860
COGEN. INGENIO PROVIDENCIA	0.2860
COGENERACION COLTEJER	1.0276
COGENERADOR BIOAISE	0.8163
COGENERADOR CENTRAL CASTILLA	0.2860
COGENERADOR INCAUCA	0.2860
COGENERADOR INGENIO RIOPAILA	0.2860
COGENERADOR INGENIO RISARALDA	0.2860
COGENERADOR PROENCA	0.2860
COGENERADOR PAPELES NACIONALES	0.5881
COGENERADOR CARMELITA	0.2860

All the data presented in the above tables was provided by XM and UPME and is considered official information.

Data for calculating the Build Margin emission factor

Total Generation during 2009: 55,939.09 GWh
20% of the total generation: 11,187.81 GWh

For the Second Crediting Period, the Build Margin Emission factor was calculated *ex ante*, based on the most recent information available on the plants built or additions to the sample *m* (Option 1 of the "tool to calculate the emission factor for an electricity system.v2") by 2009. These calculations updated the calculations undertaken by UPME for 2008. No significant new generation capacity was added in 2009.

According to the Tool, the sample group of power units m used to calculate the build margin consists of either:
(a) The set of five power units that have been built most recently; or
(b) The set of power capacity additions in the electricity system that comprise 20% of the system generation (in MWh) and that have been built most recently[10].

Project participants should use the set of power units that comprises the larger annual generation. As a general guidance, a power unit is considered to have been built at the date when it started to supply electricity to the grid. Capacity additions from retrofits of power plants should not be included in the calculation of the build margin emission factor. Option (b) was selected as it comprises a larger generation than Option (a).

[9] Source: Calculo del Factor de Emision de CO2 del Sistema Electrico Interconectado Colombiano, Unidad de Planeacion Minero Energetico, Version 2009.3. For Cogenerador Papeles Nacionales, it has been used an average of the gas-fired plant emission factor, given that there was no heat rate available, nor the UPME published a value. Likewise, for the Cogenerador Carmelita it has been used the value that UPME has calculated for other biomass cogenerations.
[10] If 20% falls on part capacity of a unit, that unit is fully included in the calculation.

Power plant registered as CDM project activities should be excluded from the sample group m. However, if the group of power units, not registered as CDM project activity, identified for estimating the build margin emission factor includes power unit(s) that is (are) built more than 10 years ago then:
(i) Exclude power unit(s) that is (are) built more than 10 years ago from the group; and
(ii) Include grid connected power projects registered as CDM project activities, which are dispatched by dispatching authority to the electricity system.

In this case, excluding the power units built more than 10 years ago, and adding the grid connected CDM project activities, was not enough to account for the 20% of the system generation. Therefore, a couple of plants built at the end of 1998 were added to the m sample. The table below shows the plants included in the m sample.

Plant Name	**Year commissioned**	**Generation 2009 (MWh)**	**Accumulated Generation (MWh)**
MENOR COCONUCO 2	2009	14,952	14,952
MENOR INZA	2009	3,911	18,863
COGENERADOR PAPELES NACIONALES	2009	16	18,879
COGENERADOR ING CARMELITA	2009	313	19,192
CARTAGENA REPOTENCIACION	2008	160,077	179,269
AGUA FRESCA 1 (CDM)	2008	53,628	232,897
MENOR MORRO 2	2007	98,129	331,026
MENOR REMEDIOS	2007	3,720	334,746
LA CASCADA ABEJORRAL 1	2007	3,586	338,332
MENOR CIMARRON	2007	70,188	408,520
MENOR AMALFI	2007	5,129	413,649
MENOR URRAO	2007	5,193	418,842
MENOR MORRO 1	2007	150,043	568,885
MENOR SAN JOSE DE LA MONTAÑA	2007	2,932	571,817
COGEN. TUMACO	2007	606	572,423
LA CASCADA (Antioquia) CDM	2007	15,257	587,680
COGEN. COLTEJER	2006	2,150	589,830
MENOR CALDERAS	2006	83,488	673,318
SANTA ANA (CDM)	2005	29,027	702,345
TERMOYOPAL 1	2005	158,310	860,655
MENOR LA JUNCA	2005	86,693	947,348
MENOR LA VUELTA (CDM)	2004	61,926	1,009,274
MENOR CEMENTOS DEL NARE	2004	38,366	1,047,640
COGEN. CENTRAL CASTILLA	2004	5,566	1,053,206
COGEN. INGENIO RIOPAILA	2004	5,243	1,058,449
TERMOYOPAL 2	2004	229,579	1,288,028
MENOR LA HERRADURA (CDM)	2004	127,361	1,415,389
MENOR TEQUENDAMA	2004	88,022	1,503,411
MERILECTRICA	2004	70,654	1,574,065
MENOR JEPIRACHI (CDM)	2004	57,709	1,631,774
MENOR EL LIMONAR	2003	58,175	1,689,949
MENOR LA TINTA	2003	63,451	1,753,400
MENOR SAN JOSE	2003	1,653	1,755,053
MENOR CHARQUITO	2003	38,814	1,793,867
COGEN. INGENIO RISARALDA	2003	7,766	1,801,633
MENOR PROVIDENCIA	2003	5,037	1,806,670
MIEL	2002	1,420,425	3,227,095
MENOR SONSON	2002	44,163	3,271,258
MENOR SUEVA	2002	28,897	3,300,155
MENOR EL BOSQUE	2002	13,224	3,313,379
MENOR PATICO LA CABRERA	2002	4,648	3,318,027
MENOR PUENTE GUILLERMO	2001	5,738	3,323,765
PORCE II	2001	1,766,776	5,090,541
TERMO SIERRA 1	2001	1,004,466	6,095,007

TERMOCENTRO 1	2000	564,561	6,659,568
TERMOCANDELARIA 2	2000	235,256	6,894,824
URRA	2000	1,160,903	8,055,727
TERMOCANDELARIA 1	2000	293,571	8,349,298
MENOR RIO PIEDRAS	2000	125,795	8,475,093
MENOR TERMOPIEDRAS	2000	0	8,475,093
TERMOEMCALI	1999	204,402	8,679,495
PAIPA 4	1999	968,564	9,648,059
MENOR PAJARITO	1999	21,739	9,669,798
RUMOR	1999	10,823	9,680,621
TERMOVALLE I	1998	454,661	10,135,282
TEBSA	1998	4,991,882	15,127,164
TOTAL		**15,127,164**	

Source: XM, National Dispatch Center, 2010

Appendix 5: Further background information on monitoring plan

The monitoring plan is described under four sections.

1. The Monitoring Plan
1.1 Purpose of the monitoring plan
The Monitoring Plan (MP) of the project describes the systematic surveillance of the project's performance by measuring and recording indicators relevant to the project or activity operation. The Monitoring Plan forms basis for the verification and assessment of the emission reductions (ER) achieved. It also provides guidance to verify the project's conformity with all relevant regulatory criteria.
The MP is a part of the project design document and defines the standards with which the performance of the Jepirachi Wind Power Project in terms of the greenhouse gas (GHG) reductions will be monitored and verified. The MP builds on information collected in the baseline study. The MP will be an integral part of the contractual agreement between the Prototype Carbon Fund (PCF) and EPM.

The MP establishes a credible and transparent data collection, measurement, recording and management methods required for verification and certification of the ERs and other project outcomes. The MP ensures environmental integrity and accuracy of crediting actual ERs to be accounted. The MP can be updated and adjusted to meet the operational requirements, provided such modifications are found relevant by the DOE during verification and subsequently approved by the Executive Board (EB). In particular, any change in the variables pertaining to emission reductions may lead to such amendments.

1.2 Use of the MP by the Project Operator
The MP is a working document that identifies the key project performance indicators and sets out the procedures for tracking, monitoring, calculating and verifying the impacts of the project, in particular with respect to the project's ERs. This MP must be used by the project operator when planning and implementing the project and during the projects operation. Adherence to the instructions in the MP is necessary for the project operator to successfully measure and track the project impacts and prepare for the periodic audit and verification required to certify the achieved ERs. The MP is thus the basis for the production and delivery of ERs to the PCF or other buyers.

Specifically, the MP provides the instructions for:
- establishing and maintaining the appropriate monitoring system including spreadsheets for the calculation of ERs
- implementing the necessary measurement and management of the project operations;
- preparing for the independent, third party verification and audit.

1.3 Structure of the MP

The MP document contains the following parts:
- *Section 2* explains concepts and principle assumptions applied in monitoring the GHG performance of the project and in calculating ERs. The section also discusses data sources and assumption and lays out why the MP is expected to compute ERs in a conservative manner.
- *Section 3* contains instructions regarding operational and monitoring obligations the operator is expected to assume.
- *Section 4* presents the functioning of the MP electronic workbook. The workbook is implemented as Excel spreadsheets and is an integral part of the MP.

2. Concepts and principal assumptions

The MP builds on the baseline study. The methodology in the MP is guided by the need and limitation of measuring project performance indicators and calculating ERs in an efficient and transparent way.

2.1 Emission Reductions from the Jepirachi Wind Power Project

The Jepirachi Wind Power Project consists of a wind power plant with 19.5 MW located in the Guajira desert (an area of consistent and high winds) The project is located in Wayuu Indian Territory in the Northeastern region of the Atlantic Colombian coast, in the area between Cabo de la Vela and Puerto Bolivar, within the region of Uribia in the Department of Guajira. In terms of geodesic coordinates the site is located 12.2472 N latitude, 71.9973 W longitude, 5 Km west from Puerto Bolivar, an area of sparse population.

In the absence of the Jepirachi Wind Power Project, the same level of demand for electricity would be met by the combined production of plants in the SIN, thus emitting GHG. Generation pricing and merit order dispatch in the Colombian power sector are based on "energy price bidding" by generators for a day ahead based on estimated hourly demand. “Minor plants” (10-20 MW) have the right to participate in the pool and benefit from pool services under a preferential dispatching option (e.g. spinning reserve). In essence, such plants can access the electricity market by selling all their available output at the wholesale market price ("precio de bolsa"), which includes a "capacity payment" component (as a floor price for the bids), and are exempt from penalties on non-delivery of electricity. Since the Jepirachi Wind Power Project qualifies as a minor plant, it will preferentially dispatch its energy in the merit order, and will displace those generating units that are programmed for dispatching according to their bids.

2.2 Geographic and System Boundaries for the MP

As referred in ACM0002 version12.1.0 the project boundary has to be assessed in terms of the emission sources and spatial extent.
• Emission sources: Jepirachi Project presents zero emissions, since it is a Wind Project. For the baseline determination only CO2 emissions from electricity displaced due to the project are accounted for.
• Spatial extent: The spatial extent of Jepirachi Project boundary includes the project site and all power plants connected physically to the electricity system Jepirachi is connected to. The Colombian grid is a national grid, connected to Jepirachi through a 0.7 km long line. Therefore, all power plants providing electricity to the Colombian grid system are included in the project boundary.

2.3 Time Boundary and Baseline Review Protocol

The project has opted for a 7 – year renewable crediting period (for a maximum of two additional crediting periods). Therefore, baseline review will be undertaken at the end of each crediting period.

2.4 Calculating Emission Reductions

The emission reductions from the project result from the electricity from the Jepirachi Wind Power Project displacing power generated by thermal plants (coal or simple cycle or combined cycle gas) in the Interconnected System. The calculation of the emission reductions follows the guidance outlined in the ACM0002 (version 12.1.0 - "Consolidated baseline methodology for grid-connected electricity generation from renewable sources". The steps needed to calculate the emissions reduction are summarized below.

Determine the net yearly project electricity output for the period under verification from the NEON (the official database of the CDN), which can be accessed from the website, www5.ISA.com.co /neonweb[11] *The output is available in MWh or KWh.*

⇩

Use the ex-ante combined emission factor calculated as explained in this PDD.

⇩

Multiply the actual electricity output produced by the project by the Combined emission factor for the Colombian interconnected electricity grid

⇩

Total CERs generated by the project for the period is calculated as

ERy= BEy-PEy-Ly

Where PEy are the project emissions in year y and Ly refers to leakage in year y as defined in the methodology ACM0002 (ver.10-"Consolidated baseline methodology for grid-connected electricity generation from renewable sources"), *both are equal to zero (0).*

3. Operational and Monitoring Obligations

The operator of the Jepirachi Wind Power Project will need to fulfill operational and data collection obligations in order to produce greenhouse gas emissions reductions and to ensure that sufficient information is available to calculate the ERs in a transparent manner and to allow for a successful verification of the ERs.

3.1 Operational Obligations

The operational obligations of EPM are to ensure that all reasonable steps to maximize the generation of energy from the Jepirachi Wind Project are taken thereby maximizing the GHG emissions reductions.

3.2 Data Requirements and Project Database

The data required for the MP is in line with the kind of information collected by an electricity utility. The data used in this MP will be collected by EPM and comes from the following sources:

- **National Dispatch Centre (CND)** Web-page, http://sv04.xm.com.co/neonweb/. Access to CND database is available on internet, and data on actual MWh generated by Jepirachi Wind Power system can be easily obtained. For updating calculations for the second crediting period,

[11] Once in this page, access to the Database is granted after supplying valid user ID and password.

information available at the CND will be used on hourly generation, split by low cost/must run and other plants.

- **Energy and Mines Planning Unit (UPME)** publishes most of its data on its website (www.upme.gov.co) and includes: Reference Energy and Mine Expansion Plans, Energy and Mine Statistics Bulletins, International Analysis of Electricity Prices, Colombian Electricity Market Magazine, among others. The UPME is in charge of presenting the Indicative Expansion Plan for the energy sector, as well as support the requirement for information from the ministry and stakeholders. The technical capacity of the UPME to support the implementation of advanced simulation methods, generation of data on plant level emission factors and chemical analysis of fuels used in the country has been taken into account. UPME‟s information on entry into operation of new plants will be used to update calculations for the build margin emission factor.

4. The Jepirachi Wind Power Project Workbook

Basically, the MP electronic workbook will consist of a database to compile, specifically for the CDM project, all effectively dispatched kwh. The workbook will aggregate the data onto different timeframes: (i) daily; (ii) monthly; and (iii) yearly. Also, for verification purposes, the data will be equally organized in annual reports, taking the First Crediting Starting Date as the first day of the year. The workbook will multiply the aggregate yearly kWh by the ex-ante Grid emission factor in order to obtain the yearly emission reductions number required at verification.

4.1. Quality Assurance and Quality Control
Stringent international standards will be used to assure the quality of the information used. ICONTEC, the Colombian normative institution, certified the following management systems: the Quality Management System under ISO 9001, version 2008, the Environmental Management system under ISO 14001, version 2004, and Occupational Health and Safety Management System under OHSAS 18001, version 2007. All EPM‟s operating power plants are part of these management systems. The QMS of the Jepirachi Wind Power Project will be part of the same quality system, with the objective of being certified using ISO 9001 within two years after its commissioning, as it is stipulated in Colombian regulations (*Resolución CREG No. 005/09*) . As the enforcement of these standards is very well established no additional QA/QC action is required. The electric metering system is calibrated every two years.

4.2 Measuring Net Electricity Generation (EGy)
Measurement of Electricity Generation by EPM: Electricity generation is hourly measured in EPM by electronic electricity meters. This information is backed up by the Informatics Unit of EPM trough the Grandes Clientes de Energía database (“Large Energy Consumers”) on a daily basis through the SQL Server.

To ensure reliability, there are three main and three backup energy meters, located in panel TM 1 at the substation of energy in the area of the Wind Park. They were installed and calibrated in December of 2005 and last calibration was made on March on 2008, and no deviations were detected. Although ION meters do not require calibration, only verification of their accuracy, the meters are calibrated every two years depending on the registration of tendencies variations (error, standard variation), affected by to the working conditions. It is achieved by Laboratory of Calibration (Laboratorio de Calibración de equipos de medida de energía y gas), a special department of the Energy Distribution Business Unit that sets up all the meters.

Calibration tasks follow national standards and are in accordance with the calibration instructive specified in Colombian standard NTC 4856 for electricity metering devices. EPM has adopted its own procedure based on the Colombian technical norm NTC-ISO-IEC 17025 and NTC 4856, under the so-called “Instructive to perform on-site electricity meter proofs with a pattern metering device” (DIS-EM-LE-IN-009-01). This procedure is carried out to verify that the meters are working properly with the

corresponding accuracy. They are also checked for alarms. The patterns used to calibrate the electricity meters in-situ could be any of the following:

- Portable Standard MTE Nº 16, 17, 18 (accuracy 0.05) for on site
- Calibration.
- Calibration Bench LANDIS TALOGYR 6061 for calibration at EPM
- Laboratory.
- Calibration Bench ZERA ED 6816 for calibration at EPM laboratory

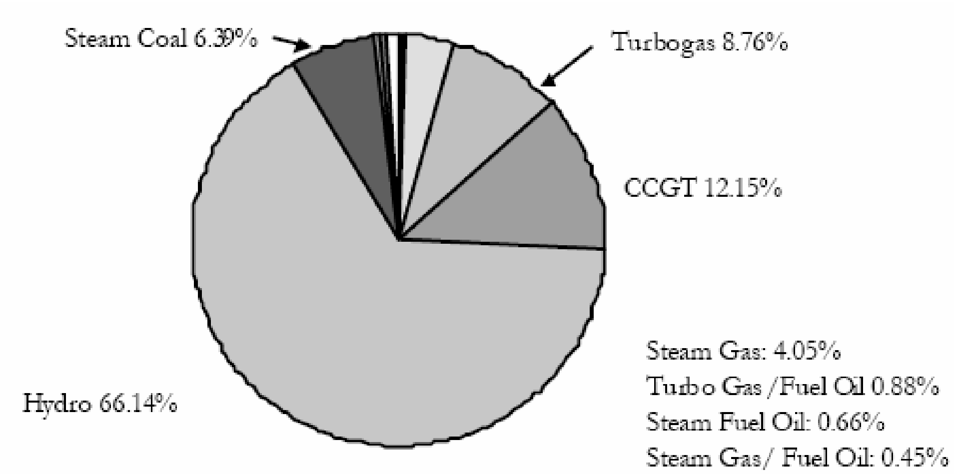
The accreditation of the laboratory is achieved by Superintendencia de Industria y Comercio de Colombia. All informs of calibration and certifications, the readings and data are kept in the headquarters of EPM in Medellin. The data of power generation of Neon database is daily backed by Subdirección Tecnología de Informacion trough the Unidad informatica Generación, which politics of quality, safety and reliability.

NATIONAL AND SECTORAL CIRCUMSTANCES

The following description of the national and sectoral circumstances of Colombia‟s renewable energy projects during the early 2000 is still valid as national circumstances have not changed significantly. The description is also applicable to the Jepirachi Wind Project, which planning goes back to the year 2002.

National and sectoral circumstances: The total net installed capacity of the Colombian National Interconnected System (SIN) in 2001 was 13.2 GW. Most of this installed capacity is hydro-based (about 66%) reflecting the country‟s high dependence on hydropower. Figure A.5.1 summarizes the power mix by source and technology.

Figure A.5.1 Installed Capacity of the Colombian Electricity Sector by Technology Composition during 2001



Source "Unidad de Planeación Minero Energética, Plan de Expansión de Referencia 2001"

Since 1980 the Colombian Electricity Supply System (ESI) has maintained a hydroelectric share in the range 55-75% and a thermal composition in the range 25 to 45%. This is reflected in the Figures A.5.2. and A.5.3 which presents the updated information by 2008.

Figure A.5.2 Generating contribution by thermal and hydro

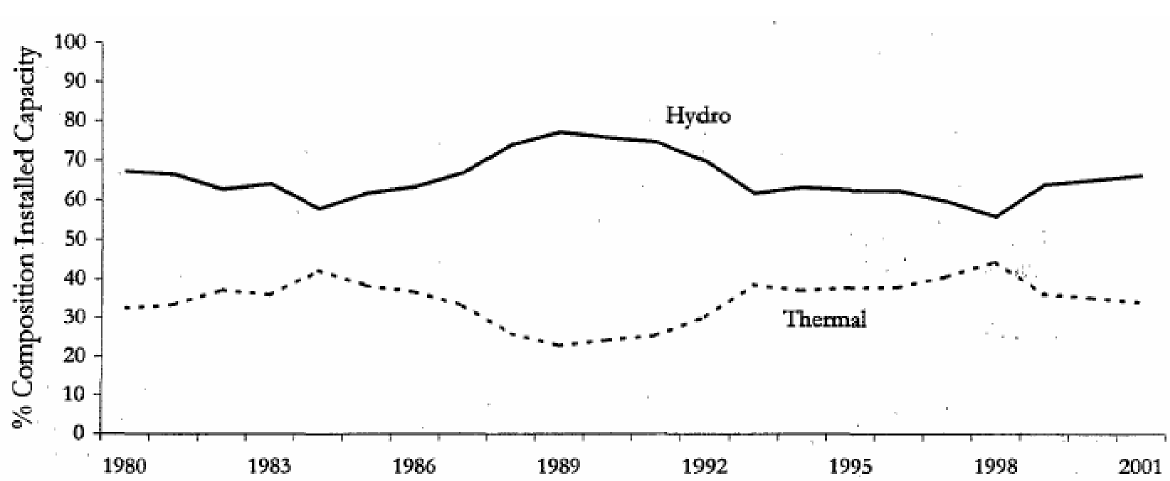
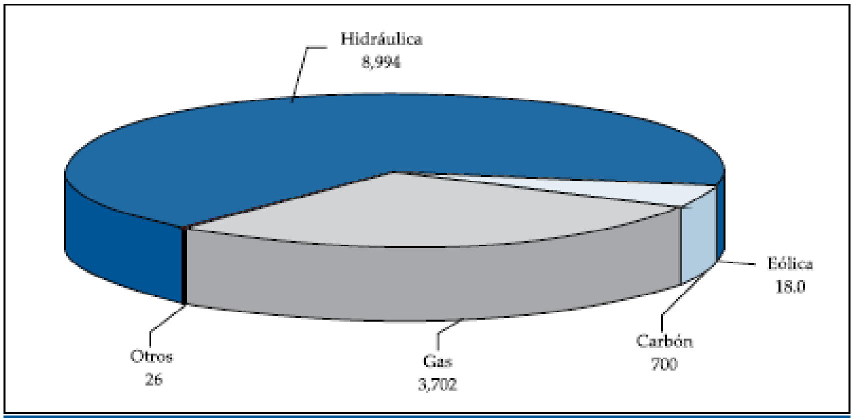


Figure A.5.3 Generating Power by Technology (updated)



Gráfica 2-7 Capacidad efectiva por tecnología en MW

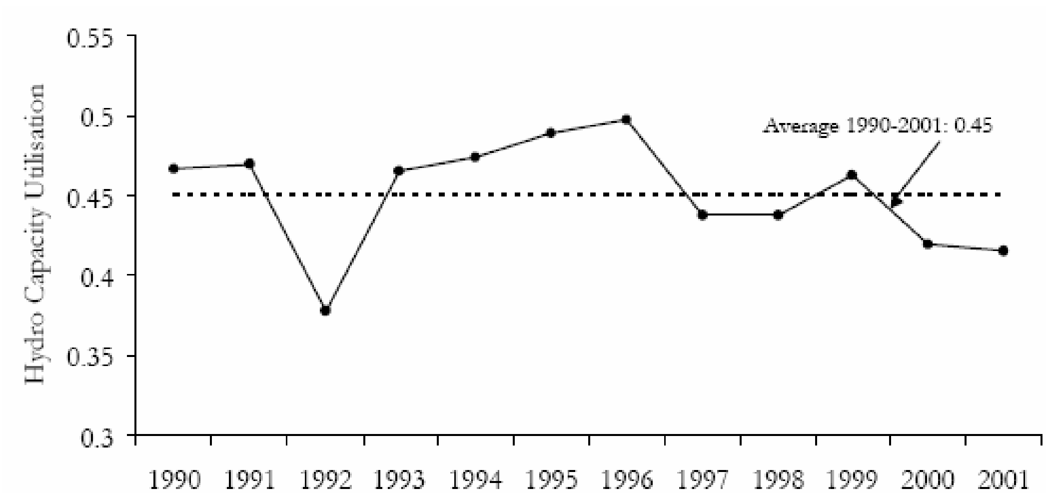
Fuente: XM

After severe droughts, registered during the 1990s (i.e. 1992, 1997), that caused power shortages with associated forced rationing, the system has encouraged the development of more thermal generation capacity, specifically with the intention of increasing capacity and enhancing the system"s reliability. The increase in thermal share of the SIN has also been the indirect result of the withdrawal of the public sector from large investments and the reluctance of private generators to enter the hydroelectric generation and associated environmental and social requirements. A similar situation has taken place in 2009, with the El Niño climatic event. Therefore, future additions to the power mix are anticipated to be thermal-based. While this responds to the need for flexibility and robustness of the system, the increase in thermal share contributes to the gradual increase of GHG emissions by the sector and the release of local pollutants (such as NOx and, SOx particulates and volatile hydrocarbons, which have been linked to health issues in exposed populations).

Hydro Availability and its Effects on the Supply/Demand Ratio of the power sector

In the period 1990-2001, five dry years, including the drought of 1992 due to El Niño phenomenon affected the electricity supply. This led efforts to diversify the sources of power, focusing on the expansion of thermal generation capacity. Figure A.5.4 shows the utilization capacity of hydroelectric plants in the system during this period. Hydro utilization capacity could be defined as the percentage of the actual Hydro capacity in use over the maximum available Hydro capacity.

Figure A.5.4 Utilization of Hydroelectric Generation Capacity in Colombia during 1990 - 2001



Source, Data from the Unidad de Planeación Minero Energética (UPME), International Energy Data

Market forces in Colombia strongly favor thermal power over renewable energy, resulting in a trend of increased carbon emissions per generated kWh. A greater number of private initiatives favoring thermal power projects are likely to be developed in the short term as they are faster to implement and more competitive than renewable energy projects in terms of capital costs.

Taken together, the factors presented above have resulted in a greater share of thermal energy in the SIN, and this trend is expected to continue as per the indicative expansion plan. Given its small size (80 MW) relative to the net installed capacity of the SIN (13,200 MW), the Project has no effect on the planned expansion of the SIN.

The main sources of information for the interconnected grid are: (i) the updated operational database, managed by the National Dispatch Centre, CND, in XM; and, (ii) UPME, planning unit for the energy sector under the Ministry of Mines and Energy, serving as the technical secretariat for energy planning in the country. All the data goes through quality control checks of the official entities. In this way it can be assured that the data is reliable. Information from all stakeholders in the interconnected system is subjected to regulation by the CREG, the national regulatory commission for energy and gas. A well-developed, high quality, internationally accepted measuring standards have been enacted. Audits are commonplace to ensure the quality of the data, plus multiple interest groups have access to the data, as the transactions can only use the official data. QA/QC methods are regularly enforced. Colombia offers very good, accurate and reliable data from its interconnected electric grid.

Reductions of emissions: The wind project is a non-GHG emitting electricity generation technology option. In the absence of the Jepirachi Wind Project, the same level of demand for electricity would be met by the combined production of plants in the SIN, thus emitting higher GHG. Generation pricing and merit order dispatch in the Colombian power sector are based on "energy price bidding" of the generators for a day ahead based on estimated hourly demand. "Clean plants producing renewable energy" have the right to participate in the pool and benefit from pool services under a preferential dispatching option (e.g. spinning reserve). In essence, such plants can access the electricity market by selling all their available output at the wholesale market price ("precio de bolsa"), which includes a "capacity payment" component (as a floor price for the bids), and are exempt from penalties on non-delivery of electricity. Since the Jepirachi Wind Project qualifies as a renewable energy project producing clean energy, it will

preferentially dispatch its energy in the merit order, and will displace those generating units that are programmed for dispatching according to their bids. The total estimated emission reductions to be achieved by the project are approximately 350,000 tons of CO_2 over 14 years (by year 2025).

Baseline scenario: The baseline scenario was constructed following the approved consolidated methodology, ACM0002 – Version 12.1.0 The methodology states that for project activities that do not modify or retrofit an existing electricity generation facility, as it is the case of the Jepiracho Wind Project, the baseline scenario is defined as: *Electricity delivered to the grid by the project would have otherwise been generated by the operation of grid-connected power plants and by the addition of new generation sources, as reflected in the combined margin (CM) calculations described below*. According to this approach the future scenario can be described as a combined analysis of the existing grid, its operation and recent additions. To complement the suggested analysis this section presents the information required to estimate the building margin. It also introduces the expansion plans that were defined by the Government of Colombia through the UPME.

The Government of Colombia envisioned the electric power expansion path based on three main considerations: (i) those projects already approved and under construction; (ii) project included for implementation in the near future; and, (iii) analysis of the demand growth and least costs expansion of the interconnected grid base on already included power plants. The results are summarized in Table A.1.1.

Table A.1.1 presents the plausible power expansion scenarios contemplated by the UPME. Notice that 67% of the potential additions to the interconnected grid are hydropower plants, while 32.6% are thermal units for short term scenarios. However, hydropower generation has become a less likely investment option in Colombia for various reasons related to site availability and high up-front capital investment and environmental and social impacts of reservoirs and flooding. Nevertheless, UPME has developed indicative scenarios for the expansion of the electricity supply considering specific assumptions on demand (i.e. medium growth rate), fuel prices (i.e. low price scenarios) and lower than average hydrological conditions, as well as perceived trends and registered intentions of private and public generators.

For the **short-term scenarios,** UPME concluded that **Scenario** 2 would be the most probable option given the assumptions considered, especially with regards to retirement of plants, and the fact that scenarios 1 and 4 exhibited low levels of reliability regarding security of supply relative to Scenarios 2 and 4.

UPME concludes that given the assumptions on demand and fuel prices, the system will probably only add gas-based generation in the period 2006-2010 (shown as **Scenario 1 for Long Term Expansion).** It is important to note that lower than average hydrological conditions were assumed for the four scenarios described above. Under scenarios of average hydrologic conditions, the installation of new hydroelectric plants would not occur.

DETERMINATION OF THE DISPATCH ORDER IN THE COLOMBIAN POWER SECTOR

Generation pricing and merit order dispatch in the Colombian power sector are based on energy “price bidding" by generators for a day ahead estimated hourly demand.

Generating units are then programmed for dispatch according to their bids, from the cheapest to the most expensive (the merit order), to supply the demand. The price (bid offer) of the last unit to be dispatched (the one at the margin) defines the "marginal price" of generation. In a strictly "spot price" dispatch, usually (but not always) the bids reflect the operational costs of energy production (the variable costs;

comprising mainly fuel and operational costs), and not investment-related costs. Operation decisions for existing plants (whose investment costs are already sunk) are based exclusively on its short-term variable costs. Hence, the dispatch merit order is determined by the variable costs of the various alternatives. In this case, the Project, with its insignificant variable cost, will displace the most expensive alternative at the margin.
Under normal circumstances (when supply is sufficient to cover demand), clearly spot/marginal price is not sufficient to recoup investments for the plant at the margin. For the plants not at the margin, the, marginal price they receive for their generation is greater than their own variable production costs, therefore they can recover part of their investment cost.

In some power pricing systems, a "capacity payment" has been established to deal with the problem of recovering investments, and therefore having a better price signal for investing in new plants (other method favored by economists is to freely allow for much higher prices during periods of tight supply - periods of very limited reserve or when shortages are expected - so that generators could make sufficient revenue during these periods to compensate for investments. This method increases the price volatility of the spot market). In Colombia, a proxy for capacity payment has been implemented, in a limited and ad-hoc way, through the establishment of a "floor price" in the wholesale power market (no generator could bid below this price). The regulator (CREG) establishes this floor price.

Appendix 6: Summary of post registration changes

The following changes have been incorporated into version 9 of the PDD as post registration changes:

- Technical specifications of the turbines in Section A.3 (i.e. rpm of the rotor, blade's manufacturer, synchronous speed of the generator, cut in-cut-out-wind, blades' material and towers' height),
- Calibration frequency in Section 4.2 of Appendix 5 has been updated to make it consistent with frequency in Section 4.1 of the same Appendix.
- The name of the project participant in Section B.7.1 has been updated to Empresas Publicas de Medellin.

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History of the document

Version	Date	Nature of revision
04.1	11 April 2012	Editorial revision to change version 02 line in history box from Annex 06 to Annex 06b.
04.0	EB 66 13 March 2012	Revision required to ensure consistency with the "Guidelines for completing the project design document form for CDM project activities" (EB 66, Annex 8).
03	EB 25, Annex 15 26 July 2006	
02	EB 14, Annex 06b 14 June 2004	
01	EB 05, Paragraph 12 03 August 2002	Initial adoption.
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