MONITORING REPORT FORM (CDM-MR) *
Version 01 - in effect as of: 28/09/2010

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* as contained within the document entitled "Guidelines for completing the monitoring report form (CDM-MR)" (EB 54 meeting report, annex 34).

MONITORING REPORT
Version 01 16/12/2011

Chacabuquito Hydroelectric Power Project
Project 1052
Monitoring Period 2 (02/05/2007 - 30/06/2009)

SECTION A. General description of the project activity

A.1. Brief description of the project activity: >>

>> The Chacabuquito Hydroelectric Power Project consists of a run-of-river power plant of 30 MW installed capacity that utilizes the waters of the Aconcagua river. The purpose of the project is to generate zero emission energy to be injected in the Central Interconnected System (SIC), the main Chilean grid[1], using the hydrological sources and displacing the use of fossil fuels. It produces an average net annual generation of 170 GWh (with a 0.65 plant load factor, which is obtained through the division of net annual generation by the power plant installed capacity and total amount of hours of the year). The project connects to the 5th Region's at a 110 KV sub-system within the Central Interconnected System (SIC) and energy is delivered to industrial and residential consumers in the area. In addition, it is important to note that the plant does not consider a dam.

This plant is in cascade with two other upstream existent plants, Los Quilos and Aconcagua, which have been successfully operated since 1939 and 1994 respectively. In addition, there is a fourth project of similar characteristics on the same river, being also submitted under carbon bonds financing. The project is being developed by Hidroeléctrica Guardia Vieja (HGV), a subsidiary of Grupo Matte.

The project uses well-proven technologies for run-of-river power generation. The design consists of a diversion weir, a system of channels and tunnels, a penstock and a powerhouse with four turbine- generator kits. In addition, the project construction costs are about US$ 37.0 million including contingencies but without financing charges. Of this, US$ 34.0 million corresponds to the cost associated with the hydro electric plant and related equipment and US$ 3.0 million is required for the expansion of the current transmission lines that connects Los Quilos and Aconcagua plants.

This project contributes to sustainable development in Chile through:

- Use of local renewable energy resources (small hydro) to displace coal and natural gas thermal power generation in the SIC.
- Increased commercial activity through clean and renewable source of power.
- Employment generation in the 5th Region where the project is located.

The total amount of emission reductions during this second monitoring period is 185,117 tonnes of CO_2e.

A.2. Project Participants

>>

Name of Party involved ((host) indicates a host Party)	Private and/or public entity(ies) project participants (as applicable)	Kindly indicate if the Party involved wishes to be considered as project participant

[1] In Chile are four interconnected electric systems, Great North Interconnected System (SING), Central Interconnected System (SIC), Aysén Electric System and Magallanes Electric System. The SIC supplies more than 75% of the Chilean installed capacity.

		(Yes/No)
Chile (Host)	• Hidroeléctrica Guardia Vieja S.A.	No
Sweden	• Government of Sweden – Swedish Energy Agency	Yes
France	• GDF Suez	No
Netherlands	• Electrabel S.A.; Netherlands' Ministry of Infrastructure and the Environment (IenM) ; Netherlands' Ministry of Economic Affairs; Agriculture and Innovation (EL&I) ; Deutsche Bank AG	Yes
Norway	• Government of Norway – Ministry of Foreign Affairs; Norsk Hydro ASA; Statoil ASA	Yes
Canada	• Government of Canada – Ministry of Foreign Affairs and International Trade	Yes
Finland	• Government of Finland – Ministry of Foreign Affairs; Fortum Corporation	Yes
Japan	• Chubu Electric Power Co., Inc.; The Chugoku Electric Power Co., Inc.; Japan International Cooperation Agency (JICA); Kyushu Electric Power Co., Inc.; MIT Carbon Fund Co., Ltd. (MIT) ; Mitsubishi Corporation; Shikoku Electric Power Co., Inc.; Tohoku Electric Power Co. Inc.; The Tokyo Electric Power Co., Inc.	No

A.3. Location of the project activity:

>> The project is located near to Los Andes, city placed 100 km north from Santiago (capital of the country). The hydro power plant is located in a small valley surrounded by mountains (Aconcagua Valley). The Chacabuquito plant is in cascade with two existing upstream hydropower plants (Aconcagua of 81 MW and Los Quilos of 39 MW). The location of the project activity is illustrated in Figure A.1.

Project coordinates:

32º51'12.35" S - 70º30'22.21" W

Figure A.1a: Chacabuquito Project Location Geographic position

Figure A.1b: Chacabuquito Project Location. Road Map

Figure A.1c: Chacabuquito Hydroelectric Power Project Location. Satellite Panoramic View

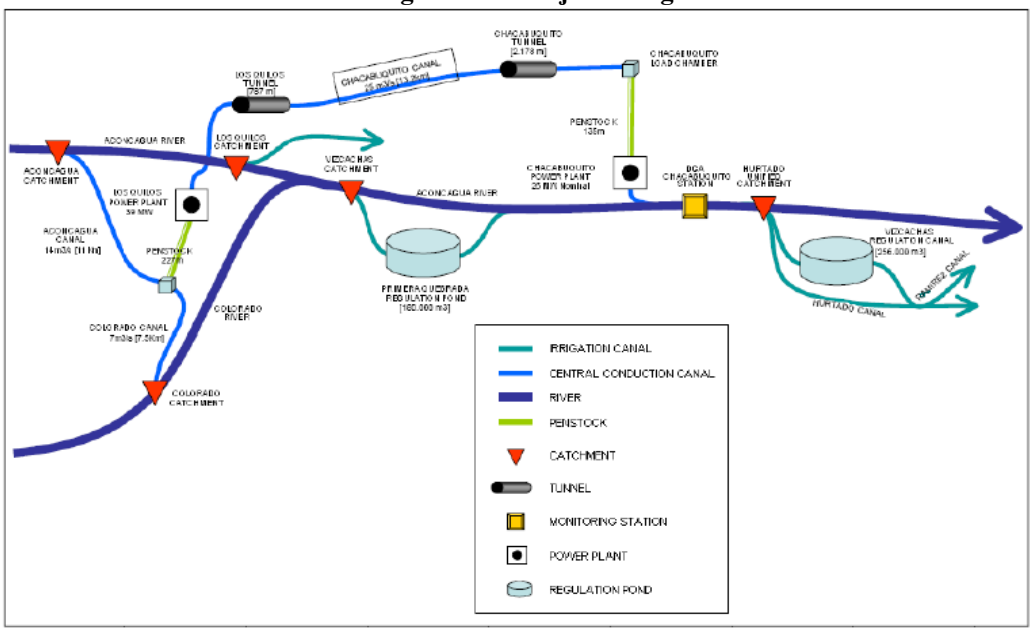
A.4. Technical description of the project

>> The Chacabuquito Hydroelectric Power Project uses a simple layout and well proven technologies in Chile and worldwide and used in other HGV power plants. It consists of a diversion weir, a system of channels (11 km) and tunnels (3 km), a pressure penstock, water fall of 137 m (134.58 m net water fall), a powerhouse and a high voltage line, and upgrade of existing transmission system. HGV has demonstrated a successful experience of construction, setting up and operating similar plants. Figure A.2 shows the project design.

Table A.1.: Turbines and Generators description

Turbines					
Number	**Type**	**Manufacturer**	**Net fall**	**Nominal Power**	**Serial Number**
4	Vertical Francis	VA Tech Hydro	134.58 m	6534 kW	1 1956 2 1957 3 1958 4 1959
Generators					
Number	**Model/Type**	**Manufacturer**	**Year**	**Rating Power**	**Serial Number**
4	DIG 171m/10	AVK	2001	8020 kVA	1 8324653A202 2 8324653A102 3 8324653B202 4 8324653B102

Figure A.2: Project Design



Canals and tunnels and the penstock will take the 21.5 m^3/sec from the Los Quilos plant through a series of canals and tunnels over a distance of approximately 10 km to a 440 m long and 137 meter head penstock (134.58 meter net head penstock) to the 30 MW Chacabuquito power house. From the power house, the 21.5 m^3/sec will be discharged back to the Rio Aconcagua at Chacabuquito to meet the project's water right requirement to supply 18 m^3/sec to a downstream existing hydro plant and to satisfy irrigation users.

A.5. Title, reference and version of the baseline and monitoring methodology applied to the project activity:

>> AM0026 (v.2): "Baseline Methodology for zero-emissions grid-connected electricity generation from renewable sources in Chile or in countries with merit order based dispatch grid".

>> ACM0002 (v.6): "Consolidated methodology for grid-connected electricity generation from renewable sources"

A.6. Registration date of the project activity:

>> 7th of July 2007.

A.7. Crediting period of the project activity and related information (start date and choice of crediting period):

>> 1st of July 2002 – 30th of June 2009 (Renewable)

A.8. Name of person(s)/entity(ies) responsible:

>> **Project Participant**:
Hidroeléctrica Guardia Vieja S.A.

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SECTION B. Implementation of the project activity

B.1. Implementation status of the project activity

The project activity starting date is the 1st of July 2002.

During the second monitoring period Chacabuquito power plant has continuously operated, with some exceptions regarding the special events that are detailed in the table below. However, it is worth to mention that none of the following events are considered as a serious situation, and most of them are part of the normal events faced by power plants like Chacabuquito:

Unit	Start Time	Start Date	End Time	End date	Type event
Year 2007					
U1	9:02	07-06-2007	13:50	07-06-2007	Scheduled maintenance
U1	8:05	26-06-2007	14:20	26-06-2007	Scheduled maintenance
U1	5:35	04-08-2007	23:36	04-08-2007	Scheduled maintenance
U1	8:20	08-08-2007	17:29	08-08-2007	Scheduled maintenance
U1	7:02	14-11-2007	17:10	14-11-2007	Scheduled maintenance
U1	8:04	21-11-2007	22:47	21-11-2007	Scheduled repair
U2	5:35	04-08-2007	23:36	04-08-2007	Scheduled detention
U2	8:32	09-08-2007	14:43	09-08-2007	Scheduled repair
U2	8:48	10-08-2007	17:10	10-08-2007	Scheduled repair
U2	8:01	26-09-2007	19:08	26-09-2007	Scheduled maintenance
U2	7:00	27-09-2007	18:29	27-09-2007	Scheduled detention
U2	7:46	28-09-2007	19:28	28-09-2007	Scheduled detention
U2	7:03	15-11-2007	17:20	15-11-2007	Failure
U3	5:35	04-08-2007	23:36	04-08-2007	Scheduled detention
U3	8:14	20-11-2007	17:30	20-11-2007	Failure
U4	8:25	03-07-2007	13:45	09-07-2007	Scheduled maintenance
U4	5:35	04-08-2007	23:36	04-08-2007	Scheduled detention
U4	14:11	29-09-2007	15:52	29-09-2007	Scheduled repair
U4	6:15	30-09-2007	19:40	01-10-2007	Failure
U4	9:46	09-10-2007	13:08	09-10-2007	Failure
U4	7:12	13-11-2007	17:15	13-11-2007	Failure
U4	10:45	23-11-2007	11:25	23-11-2007	Failure
U4			17:48	01-07-2009	Detention for lack of water
Year 2008					
Central	20:18	21-05-2008	6:00	22-05-2008	Failure
Central	19:00	21-05-2008	20:18	21-05-2008	Failure
Central	5:03	31-05-2008	22:00	31-05-2008	Scheduled detention
Central	1:23	16-08-2008	1:36	16-08-2008	Failure
Central	16:09	12-12-2008	17:08	12-12-2008	Failure
Central	5:08	13-12-2008	23:55	13-12-2008	Scheduled detention
U1	21:38	20-01-2008	17:30	22-01-2008	Failure
U1	9:52	01-02-2008	10:10	01-02-2008	Failure
U1	17:01	22-07-2008	12:44	23-07-2008	Failure
U1	11:34	27-09-2008	13:30	27-09-2008	Scheduled repair
U1	8:47	01-11-2008	12:30	01-11-2008	Failure
U1	12:15	19-12-2008	12:50	19-12-2008	Failure

U2	8:34	31-07-2008	18:00	31-07-2008	Scheduled inspection
U2	9:32	04-08-2008	16:40	04-08-2008	Scheduled inspection
Year 2009					
U2	19:20	23-01-2009	19:30	23-01-2009	Failure
U2	13:50	26-01-2009	16:50	26-01-2009	Failure
U2	7:54	28-01-2009	10:30	28-01-2009	Scheduled repair
U1	6:48	26-02-2009	6:59	26-02-2009	Scheduled detention
U2	2:40	23-04-2009	17:46	23-04-2009	Failure
U2	6:45	04-05-2009	18:40	20-05-2009	Scheduled maintenance
U1	2:27	06-05-2009	17:03	06-05-2009	Detention for lack of water
U1	2:20	07-05-2009	17:08	07-05-2009	Detention for lack of water
U1	2:14	08-05-2009	17:15	08-05-2009	Detention for lack of water
U1	2:08	09-05-2009	16:56	11-05-2009	Detention for lack of water
U4	7:06	11-05-2009	15:40	16-05-2009	Scheduled maintenance
U1	2:02	12-05-2009	17:06	12-05-2009	Detention for lack of water
U1	1:48	13-05-2009	5:15	13-05-2009	Detention for lack of water
U1	2:30	14-05-2009	9:48	14-05-2009	Detention for lack of water
U1	12:58	14-05-2009	17:00	14-05-2009	Detention for lack of water
U1	2:22	15-05-2009	16:47	15-05-2009	Detention for lack of water
U1	2:26	16-05-2009	17:17	18-05-2009	Detention for lack of water
U1	8:19	19-05-2009	17:30	19-05-2009	Detention for lack of water
U1	3:07	20-05-2009	17:06	20-05-2009	Detention for lack of water
U1	1:36	21-05-2009	17:04	22-05-2009	Detention for lack of water
U1	1:20	23-05-2009	17:07	25-05-2009	Detention for lack of water
U3	8:00	25-05-2009	22:45	29-05-2009	Scheduled maintenance
U3	8:00	25-05-2009	22:45	29-05-2009	Scheduled maintenance
U1	1:54	26-05-2009	17:33	26-05-2009	Detention for lack of water
U1	2:50	27-05-2009	16:55	27-05-2009	Detention for lack of water
U1	3:00	28-05-2009	17:01	28-05-2009	Detention for lack of water
U1	3:00	29-05-2009	18:00	29-05-2009	Detention for lack of water
Plant	6:09	30-05-2009	23:30	30-05-2009	Scheduled detention
U1	6:33	30-05-2009	22:58	30-05-2009	Detention for lack of water
U2	2:18	30-05-2009	22:30	30-05-2009	Detention for lack of water
U1	8:15	01-06-2009	16:04	05-06-2009	Scheduled maintenance
U2	1:50	02-06-2009	17:02	02-06-2009	Detention for lack of water
U2	1:42	03-06-2009	17:02	03-06-2009	Detention for lack of water
U2	2:50	04-06-2009	16:42	04-06-2009	Detention for lack of water
U2	2:50	05-06-2009	17:21	05-06-2009	Detention for lack of water
U2	3:27	09-06-2009	17:22	09-06-2009	Detention for lack of water
U2	0:18	10-06-2009	17:04	10-06-2009	Detention for lack of water
U2	3:04	11-06-2009	17:15	11-06-2009	Detention for lack of water
U2	2:03	12-06-2009	16:05	12-06-2009	Detention for lack of water
U2	12:00	13-06-2009	15:13	13-06-2009	Detention for lack of water
U1	9:25	15-06-2009	23:31	19-06-2009	Scheduled maintenance
U2	4:06	23-06-2009	16:35	23-06-2009	Detention for lack of water
U2	3:19	24-06-2009	17:45	24-06-2009	Detention for lack of water
U2	3:55	25-06-2009	16:08	25-06-2009	Detention for lack of water
U2	2:38	26-06-2009	17:24	26-06-2009	Detention for lack of water
U2	13:04	29-06-2009	15:08	29-06-2009	Detention for lack of water

There were no events that endangered the applicability of the selected methodology.

B.2. Revision of the monitoring plan

>> N/A

B.3.	Request for deviation applied to this monitoring period

>>N/A

B.4.	Notification or request of approval of changes

>> A change in the PDD was approved on 18th of March 2011.

SECTION C.	Description of the monitoring system

The monitoring methodology determines the baseline emissions by observing the actual power dispatch data from CDEC-SIC and additional information provided by CNE.

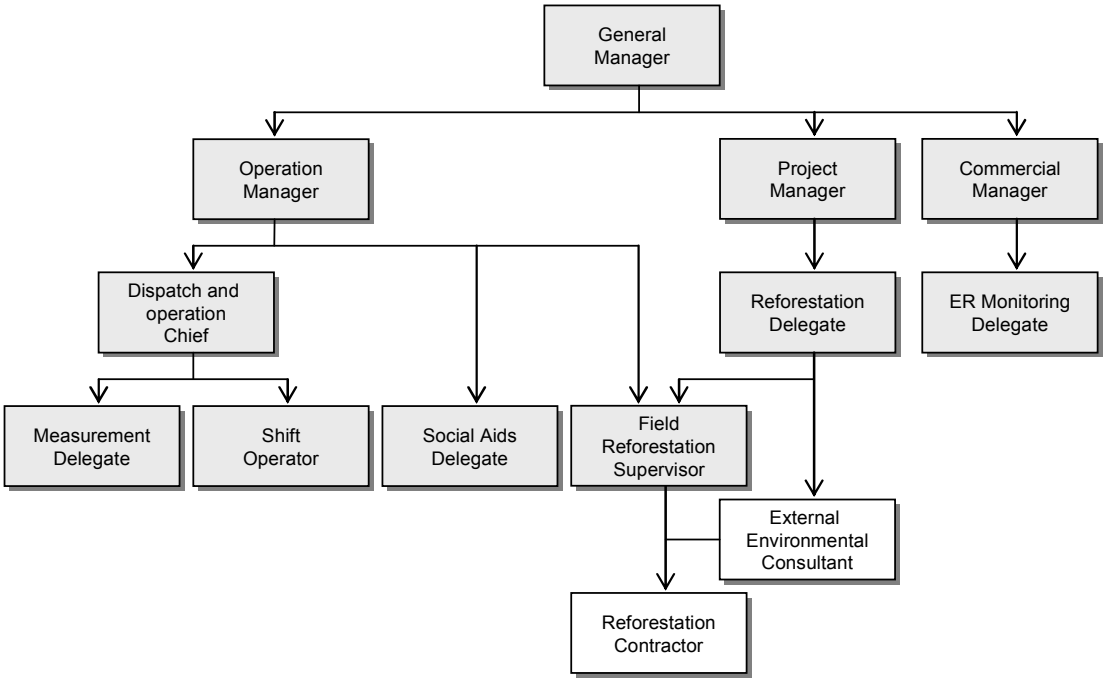
The monitoring methodology involves the monitoring of the following:

- Electricity generated and fed into the grid by the CDM project, and other CDM registered projects (data available at CDEC-SIC).
- Public data on dispatch of electricity and other relevant information from the CDEC-SIC. This data is used to calculate the emission factor for the operating margin based on a dispatch increment analysis.
- Additional data needed to calculate the operating margin emission factor consistent with the AM0026 approved methodology.

1-. Operational and Management structure

HGV has implemented a basic organization with roles and responsibilities to ensure proper monitoring procedures for the Chacabuquito CDM Project. Detailed description of the monitoring roles is available at the Management and Operational System Handbook.

Figure A.3 Monitoring Organization



2.- Monitored Data

The data required for the ER monitoring is in line with the kind of information collected by an electricity utility. The data used is collected by HGV and comes from the following sources:

- The hourly generation of the project is obtained from the metering system of the plant, which is submitted to CDEC-SIC.
- The actual dispatch of all units in the system and the dispatch priority list of the power units is collected from the CDEC-SIC website (www.cdec-sic.cl).
- The CO_2e Conversion Factor for thermal power plants is obtained from the Node Price Fixation Report issued by the CNE (Comisión Nacional de Energía, the government agency for the energy) and complemented with the IPCC Guidelines.

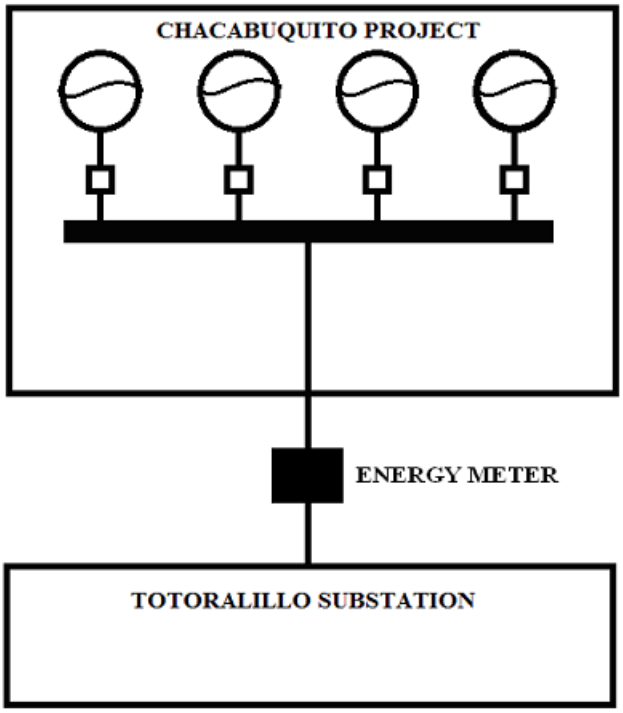
3.- Energy Generation Data Capture Procedure

The energy generation data is captured by an automated data acquisition system (measurement equipments and data capture). This system operates for Chacabuquito power plant, monitoring, capturing and continuously storing the hourly energy generation, which is automatically downloaded to an excel spreadsheet.

An emergency procedure has been put in place in order to address situations that may endanger the consistency and quality of the monitoring plan.

In the figure A.4, is shown the energy meter of Chacabuquito project, Located at the transmission line between Chacabuquito power plant and Totoralillo Substation, which measures the electricity from the four generators.

Figure A.4.: Energy meter location scheme



SECTION D. Data and parameters

D.1. Data and parameters determined at registration and not monitored during the monitoring period, including default values and factors

Data / Parameter:	Fuel Carbon Content

Data / Parameter:	**Fuel Carbon Content**
Data unit:	tC/ TJ
Description:	Determination of carbon content for different fuels
Source of data used:	IPCC revised Guidelines (2006)
Value applied:	Please refer to emission factor calculation spreadsheet
Indicate what the data are used for (Baseline /Project/ Leakage emission calculations):	Baseline emissions
Any comment:	

Data / Parameter:	**Combustion efficiency**
Data unit:	%
Description:	Determination combustion efficiency of different fuel based generation technologies
Source of data used:	IPCC 2006 revised guidelines
Value applied:	Please refer to emission factor calculation spreadsheet
Indicate what the data are used for (Baseline/Project/ Leakage emission calculations):	Baseline emissions
Any comment:	

Data / Parameter:	**CO_2 conversion factor**
Data unit:	%
Description:	Molecular weight of carbon dioxide relative of that of carbon
Source of data used:	IPCC revised Guidelines (2006)
Value applied:	44/12 = 3.67
Indicate what the data are used for (Baseline/Project/ Leakage emission calculations):	Baseline emissions
Any comment:	

D.2. Data and parameters monitored:

Data / Parameter:	$Generation_h$
Data unit:	MWh
Description:	Energy Generation of the Project for each hour ***h***
Measured/ Calculated/ Default:	Measured
Source of data to be used:	On-site metering system (same data submitted to CDEC-SIC)
Indicate what the data are used for (Baseline/Project/ Leakage emission	Baseline emissions
Value(s) of monitored parameter:	Please refer to emission factor calculation spreadsheet

Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	This equipment which measured the energy has the following characteristics: • Type: ION8500 • Accuracy class: 0.2% • Serial number: PQ 0502A113-03 • Verification/calibration frequency: Every two years • Verification/calibration dates: 14th of June 2006, 19th of June 2007, 16th of May 2008. The only local industry standard states that the meters should be verified/calibrated every 5 years. However, according to Colbún's common practice, the verification/calibration of the meters is performed every 2 years, which is a conservative approach. According to the certificates, the last verification/calibration was done in 16th of May 2008, therefore all the monitoring period is covered.
Measuring / Reading /Recording frequency:	Hourly measurement and daily recording
Calculation method (It applicable):	N/A
QA/QC procedures to be applied:	Meter should have a maximum error of 0.2% and be verified/calibrated periodically according to local standards for electricity transactions in CDEC-SIC. The verification/calibration and maintenance of the equipment is carried out by a reputed external entity (TecnoRed) The only maintenance is the periodic verification/calibration, the equipment is not intervened. If occur any equipment fail, it is repaired or replaced

Data / Parameter:	$\boldsymbol{COEF_{i,y}}$
Data unit:	tCO_2 per mass or volume
Description:	CO_2 emission factor of each plant by fuel type used, taking into account the carbon content of the fuels used by relevant power sources i and percent of oxidation of fuel in year y
Measured/ Calculated/ Default:	Calculated
Source of data to be used:	IPCC Guidelines and CNE Node Price Reports
Indicate what the data are used for (Baseline/Project/ Leakage emission	Baseline emissions
Value(s) of monitored parameter:	Please refer to emission factor calculation spreadsheet
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration,	N/A

validity)	
Measuring / Reading /Recording frequency:	Yearly or twice a year recording
Calculation method (It applicable):	Calculated based in net calorific value of fuel i, carbon emission factor of I, and fraction of carbon in fuel I oxidized during combustion.
QA/QC procedures to be applied:	Internal validation check should be performed contrasting historical data for existing plants. For new plants, validation should be accomplished through fuel type normal emission factors form similar plants.

Data / Parameter:	EF_y
Data unit:	tCO2e/MWh
Description:	Emission factor of the displaced grid electricity
Measured/ Calculated/ Default:	Calculated
Source of data to be used:	Calculated based on formula **f7** of the revised PDD
Indicate what the data are used for (Baseline/Project/ Leakage emission	Baseline emissions
Value(s) of monitored parameter:	Please refer to emission factor calculation spreadsheet
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	N/A
Measuring / Reading /Recording frequency:	Annually recording
Calculation method (It applicable):	Calculated based on formula **f7** of the revised PDD
QA/QC procedures to be applied:	Automatic calculation.

Data / Parameter:	$EF_{OM,y}$
Data unit:	tCO2e/MWh
Description:	Operating Margin Emission Factor
Measured/ Calculated/ Default:	Calculated
Source of data to be used:	Calculated based on formula **f1** of the revised PDD using CDEC-SIC data
Indicate what the data are used for (Baseline/Project/ Leakage emission	Baseline emissions
Value(s) of monitored parameter:	Please refer to emission factor calculation spreadsheet

Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	N/A
Measuring / Reading /Recording frequency:	Annually recording
Calculation method (It applicable):	Calculated based on formula **f1** of the revised PDD using CDEC-SIC data
QA/QC procedures to be applied:	Automatically calculated from CDEC-SIC databases and AM0026 procedures. Calculation should be done after CDEC-SIC energy balance to ensure data validity. The information used is validated by the CEDC-SIC. When the CDEC-SIC charge the information in his web page, means that the information it is validated by the CDEC-SIC.

Data / Parameter:	$EF_{j,h}$
Data unit:	tCO2e/MWh
Description:	Operating Margin Emission Factor of hour ***h***
Measured/ Calculated/ Default:	Calculated
Source of data to be used:	Calculated based on formula **f2** of the revised PDD using CDEC-SIC data
Indicate what the data are used for (Baseline/Project/ Leakage emission	Baseline emissions
Value(s) of monitored parameter:	Please refer to emission factor calculation spreadsheet
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	N/A
Measuring / Reading /Recording frequency:	Hourly recording
Calculation method (It applicable):	Calculated based on formula **f2** of the revised PDD using CDEC-SIC data
QA/QC procedures to be applied:	Automatically calculated from CDEC-SIC databases and AM0026 procedures. Calculation should be done after CDEC-SIC energy balance to ensure data validity

Data / Parameter:	***D(j,i)***
Data unit:	MWh
Description:	Energy displacement of the marginal plant i^{th} due to the proposed CDM project j^{th}

Measured/ Calculated/ Default:	Calculated
Source of data to be used:	Calculated based on formula **f3** of the revised PDD using CDEC-SIC data
Indicate what the data are used for (Baseline/Project/ Leakage emission	Baseline emissions
Value(s) of monitored parameter:	Please refer to emission factor calculation spreadsheet
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	N/A
Measuring / Reading /Recording frequency:	Hourly recording
Calculation method (It applicable):	Calculated based on formula **f3** of the revised PDD using CDEC-SIC data
QA/QC procedures to be applied:	Automatically calculated from CDEC-SIC databases and AM0026 procedures. Calculation should be done after CDEC-SIC energy balance to ensure data validity

Data / Parameter:	d_i
Data unit:	tCO_2e/MWh
Description:	Emission factor of the marginal plant "i"
Measured/ Calculated/ Default:	Calculated
Source of data to be used:	IPCC Guidelines and CNE node price report
Indicate what the data are used for (Baseline/Project/ Leakage emission	Baseline emissions
Value(s) of monitored parameter:	Please refer to emission factor calculation spreadsheet
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	N/A
Measuring / Reading /Recording frequency:	Hourly recording
Calculation method (It applicable):	Calculated based on formula **f4** of the revised PDD
QA/QC procedures to be applied:	Calculation based on official data.

Data / Parameter:	SFC_i
Data unit:	Ton/MWh or TJ/MWh
Description:	Specific fuel consumption per unit of electricity produced in the 'i^{th}' marginal plant
Measured/ Calculated/ Default:	Estimated
Source of data to be used:	CNE node price report
Indicate what the data are used for (Baseline/Project/ Leakage emission	Baseline emissions
Value(s) of monitored parameter:	Please refer to emission factor calculation spreadsheet
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	N/A
Measuring / Reading /Recording frequency:	Twice a year recording
Calculation method (It applicable):	N/A
QA/QC procedures to be applied:	Data is obtained from official reports. Historic comparison of each unit can provide data validation for existing and new units in the system.

Data / Parameter:	M
Data unit:	Number
Description:	Number of electricity generation plants on margin, that would supply to the system in the absence of the CDM projects in the system
Measured/ Calculated/ Default:	Estimated
Source of data to be used:	Calculation based on formula **f2** of the revised PDD and CDEC-SIC data
Indicate what the data are used for (Baseline/Project/ Leakage emission	Baseline emissions
Value(s) of monitored parameter:	Please refer to emission factor calculation spreadsheet
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	N/A

Measuring / Reading /Recording frequency:	Hourly recording
Calculation method (It applicable):	Calculation based on formula 2 and CDEC-SIC data
QA/QC procedures to be applied:	Automatic calculations are done in spreadsheets

Data / Parameter:	***N***
Data unit:	Number
Description:	List of CDM registered plants in the system
Measured/ Calculated/ Default:	N/A
Source of data to be used:	CDEC-SIC and UNFCCC registered projects for the country
Indicate what the data are used for (Baseline/Project/ Leakage emission	Baseline emissions
Value(s) of monitored parameter:	Please refer to emission factor calculation spreadsheet
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	N/A
Measuring / Reading /Recording frequency:	As required
Calculation method (It applicable):	N/A
QA/QC procedures to be applied:	Data is obtained from official reports.

Data / Parameter:	C_j
Data unit:	MWh
Description:	Electricity generated by jth CDM plant in hour h
Measured/ Calculated/ Default:	Measured/Estimated
Source of data to be used:	CDEC-SIC
Indicate what the data are used for (Baseline/Project/ Leakage emission	Baseline emissions
Value(s) of monitored parameter:	Please refer to emission factor calculation spreadsheet
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration,	N/A

validity)	
Measuring / Reading /Recording frequency:	Hourly recording
Calculation method (It applicable):	N/A
QA/QC procedures to be applied:	Data is obtained from CDEC-SIC databases

Data / Parameter:	A_i
Data unit:	MWh
Description:	Generation capacity of i^{th} plant on margin during hour h
Measured/ Calculated/ Default:	Measured
Source of data to be used:	CDEC-SIC
Indicate what the data are used for (Baseline/Project/ Leakage emission	Baseline emissions
Value(s) of monitored parameter:	Please refer to emission factor calculation spreadsheet
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	N/A
Measuring / Reading /Recording frequency:	Hourly recording
Calculation method (It applicable):	N/A
QA/QC procedures to be applied:	Data is obtained from CDEC-SIC databases

Data / Parameter:	B_i
Data unit:	MWh
Description:	Electricity generated by i^{th} plant on the margin during hour h
Measured/ Calculated/ Default:	Measured
Source of data to be used:	CDEC-SIC
Indicate what the data are used for (Baseline/Project/ Leakage emission	Baseline emissions
Value(s) of monitored parameter:	Please refer to emission factor calculation spreadsheet
Monitoring equipment (type, accuracy class, serial number, calibration frequency,	N/A

date of last calibration, validity)	
Measuring / Reading /Recording frequency:	Hourly recording
Calculation method (It applicable):	N/A
QA/QC procedures to be applied:	Data is obtained from CDEC-SIC databases

Data / Parameter:	$EF_{BM,y}$
Data unit:	tCO2e/MWh
Description:	CO2 Build Margin emission factor of the grid
Measured/ Calculated/ Default:	Calculated
Source of data to be used:	Calculated based on formula **f5** of the revised PDD, based on CNE Node Price Report and IPCC Guidelines
Indicate what the data are used for (Baseline/Project/ Leakage emission	Baseline emissions
Value(s) of monitored parameter:	Please refer to emission factor calculation spreadsheet
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	N/A
Measuring / Reading /Recording frequency:	Annually recording
Calculation method (It applicable):	Calculated based on formula **f5** of the revised PDD
QA/QC procedures to be applied:	Automatic calculation using CDEC-SIC and official databases and CNE Node Price report values.

Data / Parameter:	$EF_{BM,i}$
Data unit:	tCO2e/MWh
Description:	Emission Factor for the i^{th} plant in the Build Margin Cohort for the year y
Measured/ Calculated/ Default:	Calculated
Source of data to be used:	Calculated based on formula **f6** of the revised PDD**,** CNE Node Price Report, IPCC Guidelines, CDEC-SIC
Indicate what the data are used for (Baseline/Project/ Leakage emission	Baseline emissions
Value(s) of monitored parameter:	Please refer to emission factor calculation spreadsheet
Monitoring equipment (type, accuracy class,	N/A

serial number, calibration frequency, date of last calibration, validity)	
Measuring / Reading /Recording frequency:	Annually recording
Calculation method (It applicable):	Calculated based on formula **f6** of the revised PDD
QA/QC procedures to be applied:	Official data is used

Data / Parameter:	$Gen_{BM,i}$
Data unit:	MWh
Description:	Energy generation of the i^{th} plan on the Build Margin cohort
Measured/ Calculated/ Default:	Estimated
Source of data to be used:	CDEC-SIC (for ex-post calculation)
Indicate what the data are used for (Baseline/Project/ Leakage emission	Baseline emissions
Value(s) of monitored parameter:	Please refer to emission factor calculation spreadsheet
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	N/A
Measuring / Reading /Recording frequency:	Annually recording
Calculation method (It applicable):	N/A
QA/QC procedures to be applied:	Automatic calculation using CDEC-SIC data

Data / Parameter:	***Plant name***
Data unit:	Text
Description:	Identification of power source/ plant
Measured/ Calculated/ Default:	Estimated
Source of data to be used:	CDEC-SIC
Indicate what the data are used for (Baseline/Project/ Leakage emission	Baseline emissions
Value(s) of monitored parameter:	Please refer to emission factor calculation spreadsheet
Monitoring equipment	N/A

(type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	
Measuring / Reading /Recording frequency:	As new power plants are available in the system
Calculation method (It applicable):	N/A
QA/QC procedures to be applied:	Modify, if a new plant is available in the system.

Data / Parameter:	$\underline{CEF_i}$
Data unit:	TC pert ton of fuel or TJ
Description:	Carbon emission factor of fuel used in the i^{th} plant of the Build Margin cohort
Measured/ Calculated/ Default:	Estimated
Source of data to be used:	Estimated based on official data form CNE node price reports and IPCC Guidelines default values
Indicate what the data are used for (Baseline/Project/ Leakage emission	Baseline emissions
Value(s) of monitored parameter:	Please refer to emission factor calculation spreadsheet
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	N/A
Measuring / Reading /Recording frequency:	Annually recording
Calculation method (It applicable):	N/A
QA/QC procedures to be applied:	Official data is used

Data / Parameter:	$Oxid_i$
Data unit:	%
Description:	Fraction of fuel oxidized on combustion
Measured/ Calculated/ Default:	Estimated
Source of data to be used:	IPCC Guidelines
Indicate what the data are used for (Baseline/Project/ Leakage emission	Baseline emissions
Value(s) of monitored	Please refer to emission factor calculation spreadsheet

parameter:	
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	N/A
Measuring / Reading /Recording frequency:	As required
Calculation method (It applicable):	N/A
QA/QC procedures to be applied:	Official data is used

Data / Parameter:	**$SFC_{BM,i}$**
Data unit:	ton of fuel /MWh or TJ of fuel /MWh
Description:	Specific fuel consumption of the i^{th} electricity generation plant
Measured/ Calculated/ Default:	Estimated
Source of data to be used:	CNE node price report and CDEC-SIC
Indicate what the data are used for (Baseline/Project/ Leakage emission	Baseline emissions
Value(s) of monitored parameter:	Please refer to emission factor calculation spreadsheet
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	N/A
Measuring / Reading /Recording frequency:	Yearly or twice a year
Calculation method (It applicable):	N/A
QA/QC procedures to be applied:	Internal validation check should be performed contrasting historical data for existing plants. For new plants, validation should be accomplished through fuel type normal emission factors for similar plants.

Data / Parameter:	**W_{BM}**
Data unit:	%
Description:	Weight for Build Margin emission factor
Measured/ Calculated/ Default:	Estimated
Source of data to be used:	AM0026 default value = 50%
Indicate what the data are used for	Baseline emissions

(Baseline/Project/ Leakage emission	
Value(s) of monitored parameter:	50%
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	N/A
Measuring / Reading /Recording frequency:	Annually
Calculation method (It applicable):	N/A
QA/QC procedures to be applied:	Official data is used

Data / Parameter:	**W_{OM}**
Data unit:	%
Description:	Weight for Operating Margin emission factor
Measured/ Calculated/ Default:	Estimated
Source of data to be used:	AM0026 default value = 50%
Indicate what the data are used for (Baseline/Project/ Leakage emission	Baseline emissions
Value(s) of monitored parameter:	50%
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	N/A
Measuring / Reading /Recording frequency:	Annually
Calculation method (It applicable):	N/A
QA/QC procedures to be applied:	Official data is used

Data / Parameter:	**Changes in the regulatory framework that could affect the methodology**
Data unit:	Text
Description:	Changes in the regulatory framework that could affect the methodology.
Measured/ Calculated/ Default:	N/A
Source of data to be	Official Gazette

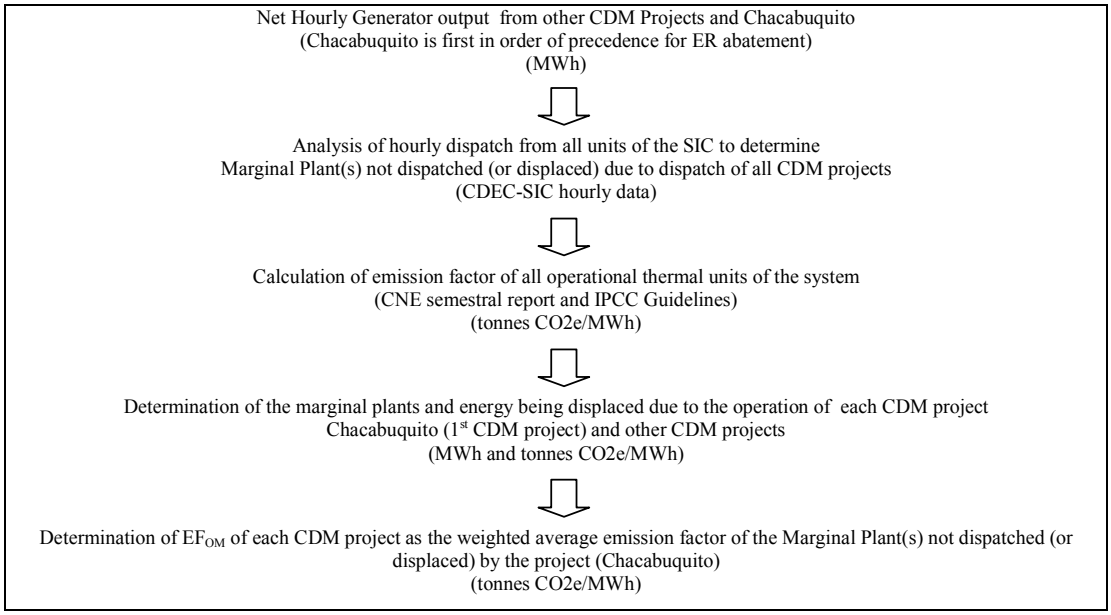
used:	
Indicate what the data are used for (Baseline/Project/ Leakage emission	Baseline, Project and Leakage emission
Value(s) of monitored parameter:	N/A. There has not been any change in the regulatory framework during the monitoring period.
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	N/A
Measuring / Reading /Recording frequency:	As required
Calculation method (It applicable):	N/A
QA/QC procedures to be applied:	Official data is used

SECTION E. Emission reductions calculation

E.1. Baseline emissions calculation

Operating Margin calculation

Key Steps for Estimating Operating Margin Emission Factor



AM0026 calculates ex-post the emission factor for the operating margin by observing actual dispatch data, the generation from the power plants and the merit order. The emission factor for the operating margin is determined by the generation that would be dispatched in the absence of this CDM Project.

The Emission Factor of the operating margin is calculated according to the revised PDD as follows.

$$EF_{OM,y} = \frac{\sum_{h=1}^{H} EF_{j,h} x Generation_{j,h}}{\sum_{h=1}^{H} Generation_{j,h}} \qquad \textbf{(f1)}$$

Where,

$EF_{j,h}$	Operating margin Emission factor for CDM project '***j***' for hour '***h***', expressed in tCO_2/MWh
$Generation_{j,h}$	Generation of CDM project '***j***' during hour '***h***', expressed in MWh
H	Total number of hours of the year '***y***'

The emission factor for the CDM project 'j', in a system with N CDM projects, for a hour 'h' is based on identification of the marginal plant(s) that would be operated to meet the electricity supplied by the CDM project 'j'. The identification of marginal plant(s) displaced by CDM project 'j' is based on the "first-built first served" principle. "Date of built" is defined as the date when the plant begins the dispatch of energy to the grid. In the case of the Chacabuquito project, it is the first power plant in operation in the SIC to be commissioned as a CDM project activity.

Only power plants registered as CDM project at the time of calculation of the emission factor are considered in the calculation of the Operating margin emission factor. For the current Monitoring Period (02/05/2007 - 30/06/2009) only Chacabuquito is considered as CDM project.

The emission factor for any hour 'h' for a CDM project 'j' in system is estimated as weighted average of emission factor of the identified marginal plant(s) that would have supplied electricity to the grid in absence of the jth CDM plant. The emission factor is estimated as follows:

$$EF_{j,h} = \sum_{i=1}^{M} D(j,i) * d_i \ / \sum D(j,i) \qquad \textbf{(f2)}$$

Where,

$D(j,i)$	Energy displacement of the marginal plant '***i***' due to the CDM project '***j***', expressed in MWh
d_i	Emission factor of the marginal plant '***i***', expressed in tCO_2/MWh.
M	***M*** is the total number of marginal plants that would be dispatched if the system is operated without the ***N*** CDM projects.

Energy displacement of the marginal plant '***i***' due to the CDM project '***j***', is calculated as follows:

$$D(j,i) = MIN\left\{ C_j - \sum_{l=1}^{i-1} D(j,l);\quad (A_i - B_i) - \sum_{k=j+1}^{N} D(k,i) \right\} \qquad \textbf{(f3)}$$

Where,

$D(j,i)$	Energy displacement of the marginal plant '***i***' due to the CDM project '***j***', expressed in MWh
Ai	Maximum energy generation of the marginal plant '***i***' expressed in MWh/h (equivalent to plant capacity in MW)
Bi	Actual Energy generation of the CDM marginal plant '***i***' expressed in MWh/h
Cj	Energy generation of the CDM project '***j***' expressed in MWh/h

N	Total number of CDM projects in the system
M	Total number of additional marginal plants that should be dispatched if the system is operated without the **N** CDM projects

Where:

D(***j***,0) = 0 and D(**N**+1 , ***i***) = 0

D(***j***,***i***) = 0 for all ***i***<***m***, *s.t.* $\sum_{i=1}^{m}(A_i - B_i) > \sum_{k=j+1}^{N} C_k$

D(***j***,***i***) = 0 for all ***i***>***m***, *s.t.* $\sum_{i=1}^{m^*}(A_i - B_i) > \sum_{k=j+1}^{N} C_k + C_j$

d_i , the emission factor for displaced marginal plant, is estimated as follows:

$$d_i = SFC_i * CEF_{OM,i} * Oxid_i \quad \textbf{(f4)}$$

Where,

SFC_i	Is the specific fuel consumption of ***i***th marginal power plant, expressed as (ton of fuel or TJ)/MWh.
$CEF_{OM,i,}$	is the CO_2 emission factor of fuel used in ***i***th marginal power plant, expressed as tCO_2/ (ton of fuel or TJ)
$Oxid_i$	is fraction of carbon in fuel, used in ***i***th marginal plant, oxidized during combustion.

The marginal plant(s) are those power plant listed in the top of the grid system dispatch order during hour 'h' needed to meet the electricity demand at the hour "h" without the generation of CDM project(s). If no thermal power plants are needed to meet the demand without the CDM projects, then the emission factor of the marginal plant is zero.

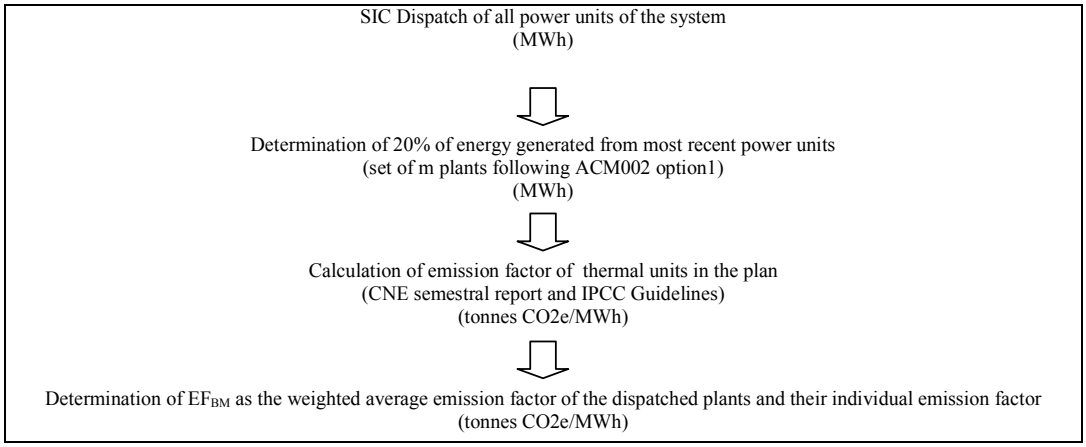
The generation of Chacabuquito is obtained from the metering system which follows a national standard of 0.2% error allowance on a KWh base. Hourly energy data obtained from the metering system is submitted to CDEC-SIC every two hours as for all other generating units of the system.

The Semi-annual Node Price Report and the IPCC Good Practice Guidance provide all the information to calculate the emission factors for all the power plants within the Chilean grids, including future plants projected in the expansion plan. Node Price Reports inform about the specific fuel consumption for every power plant, which are used together with the carbon content of the different fuels as reported by the IPCC.

Finally, $EF_{OM} = 0.645\ tCO_2/MWh$.

Build Margin calculation

Key Steps for Estimating Build Margin Emission Factor



The emission factor for the build margin was calculated using option (i) from AM0026.

$$EF_{BM,y} = \frac{\sum_{i,m} F_{i,m,y} \bullet COEF_{i,m}}{\sum_{m} Gen_{m,y}} \qquad \textbf{(f5)}$$

Where,

$F_{i,m,y}$ is the amount of fuel i (in mass or volume unit) consumed by relevant power sources "m" in year(s) y,

M the sample group m consists of either the five power plants that have been built most recently or the power plant capacity additions in the electricity system that comprise 20% of the system generation (in MWh) and that have been built most recently. Project participants should use from these two options that sample group that comprises the larger annual generation,

$COEF_{i,m,y}$ is the CO_2 emission coefficient of fuel i (tCO_2/mass or volume unit of fuel), taking into account the carbon content of the fuel used by relevant power sources "m" and the percent oxidation of the fuel in year(s) y,

$Gen_{m,y}$ is the electricity (MWh) delivered to the grid by source "m".

The CO_2 emission coefficient $COEF_i$ is obtained as:

$$COEF_i = NCV_i \bullet EF_{CO2,i} \bullet Oxid_i \qquad \textbf{(f6)}$$

Where,

NCV_i is the net calorific value (energy content) per mass or volume unit of a fuel I,

$Oxid_i$ is the oxidation factor of the fuel,

$EF_{CO2,I}$ is the CO_2 emission factor per unit of energy of the fuel i.

Finally, EF_{BM} = 0.385 tCO_2/MWh.

Combined Emission Factor calculation

The combined emission factor for the Chacabuquito project, according to AM0026 v2.0, is calculated with the weighted average for both the Operating Margin (OM) and the Build Margin (BM) as follows:

$$EF_y = w_{OM} * EF_{OM,y} + w_{BM} * EF_{BM} \quad \textbf{(f7)}$$

Where,

$EF_{OM,y}$	Emission factor for operating margin power generation sources, in tCO_2/MWh
$w_{OM}=0.5$	Weight for operating margin emission factor.
EF_{BM}	Emission factor for build margin power generation sources, in tCO_2/MWh
$w_{BM}=0.5$	Weight for build margin emission factor.

Finally, $EF_{CM} = 0.515\ tCO_2/MWh$.

Baseline emissions calculation

The baseline emissions for the project are calculated as follows:

$$BE_y = EF_y * Generation_y \quad \textbf{(f8)}$$

Where,

EF_y	Baseline emission factor, in tCO_2/MWh
$Generation_y$	Electricity generated by the CDM Project in year y (in MWh).

E.2. Project emissions calculation

>> According to the applied methodology ACM0026 version 02 this project activity does not consider project emissions since it is a hydroelectric project with no reservoir.

E.3. Leakage calculation

>> According to the applied methodology ACM0026 version 02 and the registered PDD, leakage is not considered in this project.

E.4. Emission reductions calculation / table

>> The project mainly reduces CO_2 emissions through substitution of power generation supplied by the existing generation sources connected to the grid and likely future additions to the grid. The emission reduction (ER_y) by the project activity during year *y* is equal to the Baseline Emissions (BE_y).

Since the Chacabuquito project consists of a run-off-river hydro power plant with no reservoir, there are no Project Emissions (PE_y).

Additionally, as per AM0026, no leakage (L_y) was identified for this project activity. The emission reduction can be expressed as follows:

$$ER_y = BE_y - PE_y - L_y = BE_y \quad \textbf{(f9)}$$

Estimation of Emission Reductions (Period: 2nd of May 2007 – 30th of June 2009)

From	To	Estimation of	Estimation of	Estimation	Estimation

		baseline emissions reductions (tonnes of CO_2/MWh)	project activity emissions reductions (tonnes of CO_2e)	of Leakage (tonnes of CO_2e)	of Emission Reduction (tonnes of CO_2e)
02/05/2007	30/06/2009	185,117	0	0	185,117
Total (tonnes of CO_2 e)		**185,117**	**0**	**0**	**185,117**

Total baseline emissions: **185,117 tCO_2 e**
Total project emissions: **0**
Total leakage: **0**
Total emission reductions: **185,117 tCO_2 e**

E.5. Comparison of actual emission reductions with estimates in the CDM-PDD

>> The monitoring period is from 2nd of May 2007 – 30th of June 2009.

From	To	Values applied in ex-ante calculation of the registered CDM-PDD (tCO_2e)	Actual values reached during the monitoring period (tCO_2e)
02/05/2007	30/06/2009	173,369	185,117
Total Emission Reductions (tCO_2 e)		**173,369**	**185,117**

E.6. Remarks on difference from estimated value in the PDD

>> Hydroelectric projects are highly dependent to the annual hydrology level, so the annual electricity generation is subject to significant changes from year to year.

The ex-ante energy generation declared in the PDD was of 170,000 MWh/year. This means that during the current monitoring period, the ex-ante energy generated could be 368,411 MWh for the period from 02/05/2007 to 30/06/2009. In the same period the actual energy generated 359,451 MWh, which is slightly lower than the ex-ante energy generation of the PDD.

On the other hand, the emission factor from the PDD is 0.475 tCO_2/MWh, which is lower than the actual emission factor.

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History of the document

Version	Date	Nature of revision
01	EB 54, Annex 34 May 28, 2010	Initial adoption.
Decision Class: Regulatory **Document Type**: Guideline, Form **Business Function**: Issuance		