Project design document form
(Version 10.1)

Complete this form in accordance with the instructions attached at the end of this form.

BASIC INFORMATION	
Title of the project activity	Chacabuquito Hydroelectric Power Project
Scale of the project activity	☒ Large-scale ☐ Small-scale
Version number of the PDD	2.0
Completion date of the PDD	05/09/2018
Project participants	Colbun S.A.; Government of Sweden - Swedish Energy Agency; GDF Suez; Electrabel S. A.; Netherlands' Ministry of Infrastructure and the Environment (IenM); Netherlands' Ministry of Economic Affairs, Agriculture and Innovation (EL&I); Deutsche Bank AG; Government of Norway - Ministry of Foreign Affairs; Norsk Hydro ASA; Statoil ASA; Government of Canada - Ministry of Foreign Affairs and International Trade[1]; Government of Finland - Ministry of Foreign Affairs; Fortum Corporation; Chubu Electric Power Co.[2], Inc.; The Chugoku Electric Power Co.[3], Inc.; Japan International Cooperation Agency (JICA); Kyushu Electric Power Co., Inc.; MIT Carbon Fund Co., Ltd. (MIT)[4]; Mitsubishi Corporation[5]; Shikoku Electric Power Co., Inc.; Tohoku Electric Power Co. Inc.; The Tokyo Electric Power Co., Inc; Mitsui & Co., Ltd[6].
Host Party	Chile
Applied methodologies and standardized baselines	AM0026: Methodology for zero-emissions grid-connected electricity generation from renewable sources in Chile or in countries with merit order based dispatch grid --- Version 3.0
Sectoral scopes linked to the applied methodologies	Sectoral Scope 01: Energy Industries (renewable/non-renewable)
Estimated amount of annual average GHG emission reductions	86,905 tCO_2e

[1] Withdrawn on 15/12/2012

[2] Withdrawn on 16/08/2018

[3] Withdrawn on 14/08/2018

[4] Withdrawn on 30/07/2012

[5] Withdrawn on 14/08/2018

[6] Withdrawn on 21/06/2018

SECTION A. Description of project activity

A.1. Purpose and general description of project activity

>>
The Chacabuquito Hydroelectric Power Project consists of a run-of-river power plant. The nameplate capacity of Chacabuquito power plant, as seen during the validation audit for the second crediting period, is 30 MW[7]. The average net annual generation of the project is 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 "Sistema Interconectado Central" (SIC[8]) and energy is delivered to industrial and residential consumers in the area. The plant does not consider a dam.

This plant is in cascade with three other upstream existent power plants, Los Quilos, Aconcagua and Hornitos, which have been successfully operated since 1939, 1994 and 2008 respectively.

This project uses well-proven technologies for run-of-river power generation. The design consists of a diversion weir, a system of canals and tunnels, a penstock and a powerhouse with four turbine-generator kits.

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.

Furthermore, domestic and local environmental and socio-economic benefits are summarized in the following table.

Table 1. Domestic and local benefits

Subject	Explanation
Local environmental benefits	The project contributes to clean energy provision to the SIC in Chile, displacing thermal generation.
	The project provides 18 hectares of reforestation with locally native trees.
Socio-economic benefits	The project allows the V Region de Valparaíso to exploit its significant economic potential.
	Two new bridges and new access roads for semi-isolated villages in the region have been developed.
	Job creation during the construction period and also during the operation.
	Economic activity during the construction period and also during all of its lifetime.

[7] 30 MW installed capacity is given by the turbines, but the effective capacity is limited to 28.872 MW by the generators. Additionally, it should be clarified that Chacabuquito Hydroelectric Power Plant cannot produce more than 26 MW due to physical constrains in the water intake civil works, which allow a maximum inflow of 21.5 m^3/s, situation that is indirectly monitored by the hourly energy generation measurement. Slight over generation capacity can be achieved in isolated situations (less than 1 MW over less than a 3% of the time) due to the intake civil works standard accuracy, which are anyway covered by the 24 m^3/s water rights granted by the DGA (General Water Direction).

[8] In English: "Central Interconnected System"

Subject	Explanation
Technology transfer	Introduction and demonstration of environmentally friendly power production techniques for the V Region of Valparaíso is an explicit objective of the project.
	The demonstration that ERs from renewable energy can earn additional income and the introduction of CDM know-how is expected to raise environmental awareness and may create interest in low carbon energy technologies.
Project authorization request	During December 1994 the Project Participant requested to the proper authorities the project approval and the authorization to build the Chacabuquito run-off-river power plant. The project was approved in November 1996 and it is mentioned that the authorized works construction will not affect the safety of others and will not produce water pollution.
	World Bank safeguard policies were applied as part of the detailed project design. Typically, small scale run-of-river hydropower projects have very limited environmental impacts.

A.2. Location of project activity

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The project is located in Los Andes, V Región de Valparaíso, Chile.

Los Andes is located 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 three existing upstream hydropower plants (Hornitos, Aconcagua and Los Quilos).

The project coordinates are the following:

32º51’12.35” S
70º30’22.21” W

The following figures show the geographic location of the project.

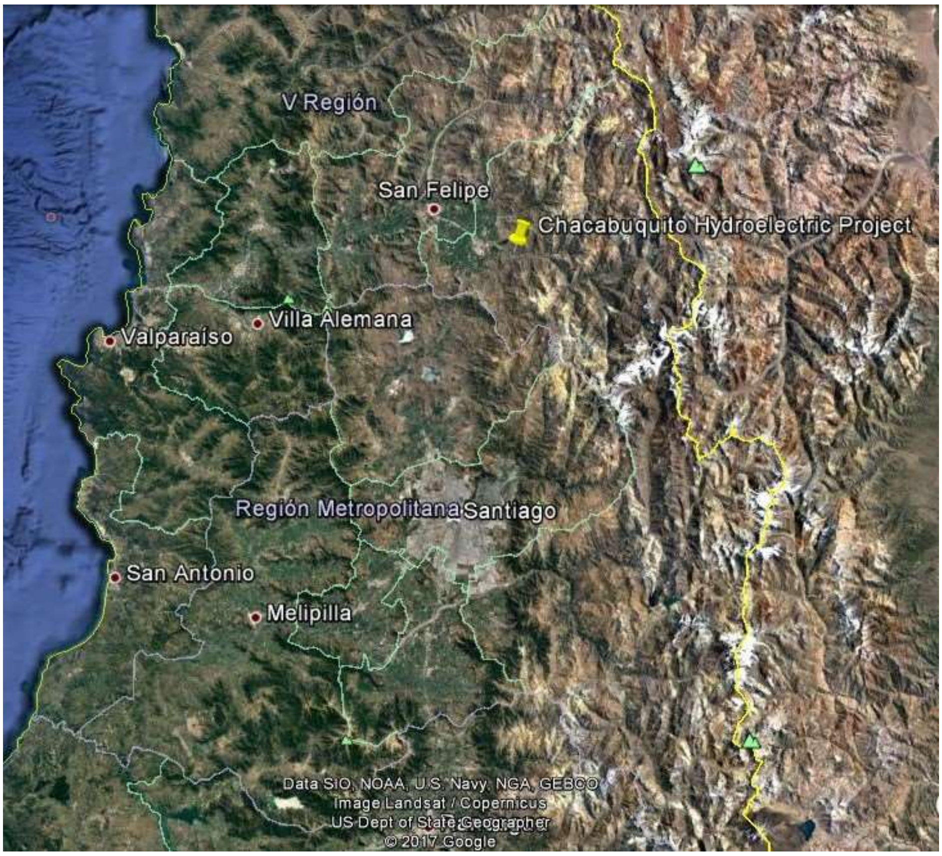

Figure 1. Chacabuquito project geographic location
Source: Google Earth, 2017

Figure 2. Chacabuquito project location, road map
Source: Google Earth, 2017

Figure 3. Chacabuquito project location, project view
Source: Google Earth, 2017

A.3. Technologies/measures

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The Chacabuquito Hydroelectric Power Project uses a simple layout and well proven technologies in Chile and worldwide. The project participant has demonstrated a successful experience of construction, setting up and operating similar plants. It consists of:

- Diversion weir
- System of canals (approximately 11 km)
- Tunnels (approximately 3 km)
- Pressure penstock (water fall of 1,372 m, 134.58 m net water fall)
- Powerhouse
- High voltage line
- Upgrade of existing transmission system

The following table shows a description of the project activity technologies[9].

Table 2. Project activity technologies

Turbines	Generator	Meters
- 4 VA Tech Francis turbines - Year of construction: 2001 - Design flow: 6.25 m^3/s - Nominal power: 7.5 MW - Efficiency: Up to 94%[10]	- 4 AVK Synchronous generators - Nominal power: 8020 kVA - Frequency: 50 Hz - 3 phases - Load factor: 0.65	- 3 Schneider meters (or equivalent) - 1 ION 8600 (M1) - 2 ION 8500 (M2 and M3)

[9] Evidences are provided in attached documents (Nameplates pictures for turbine and generator, certificate of accuracy for meters).

[10] At maximum inflow. Efficiency rates available in the following link

Turbines	Generator	Meters
- Lifetime: 30 years	- Lifetime: 30 years	- All with 0.2 accuracy class

The following figure shows the project configuration and design diagrams.

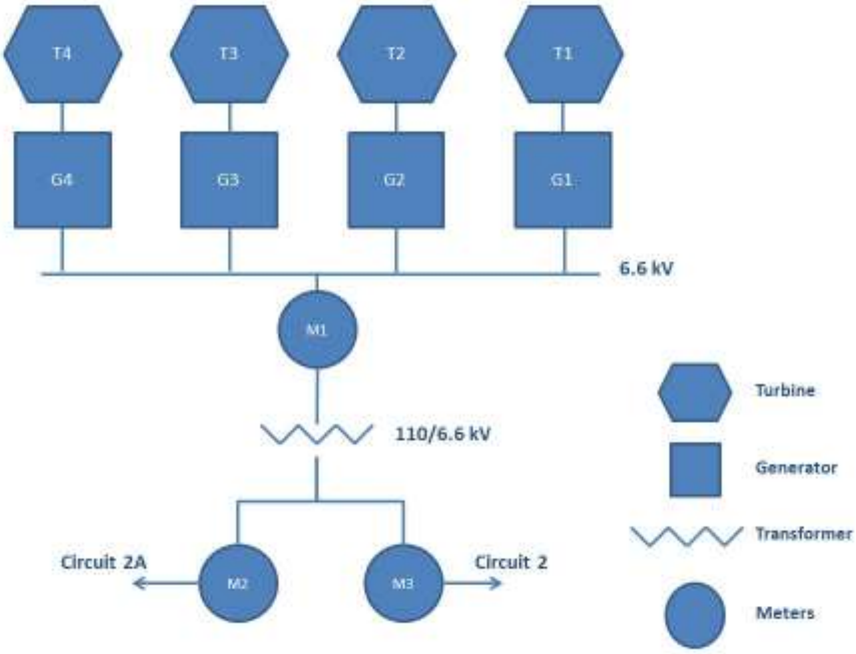

Figure 4. Project activity configuration
Source: Project Participant

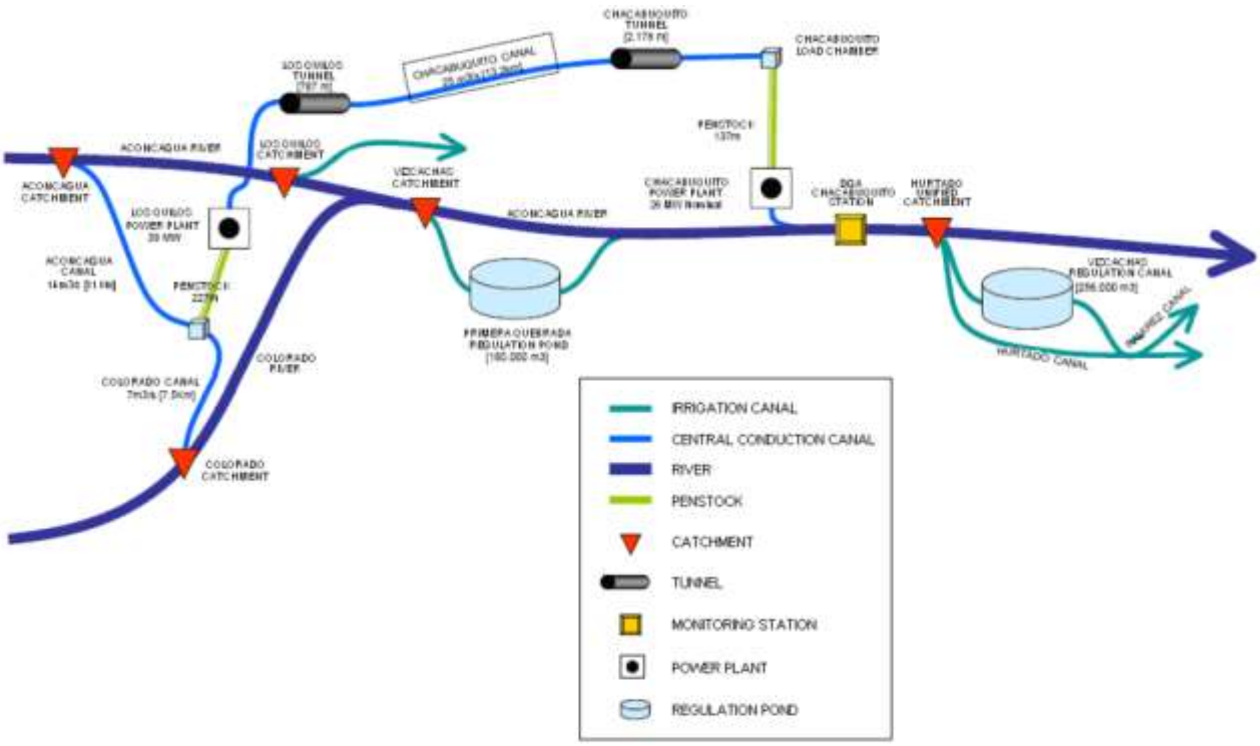

Figure 5. Project diagram
Source: Project Participant

Canals, tunnels and the penstock will take the water flow from the Los Quilos plant through a series of canals and tunnels over a distance of approximately 10 km and 137 m of water fall (134.58 m net head penstock). From the Chacabuquito power house, the water used for energy generation will be discharged back to the Aconcagua River in order to fulfil all authority requirements regarding water flow.

A.4. Parties and project participants

Parties involved	Project participants	Indicate if the Party involved wishes to be considered as project participant (Yes/No)
Chile (Host Party)	• Colbun 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[11]	• Government of Canada – Ministry of Foreign Affairs and International Trade	No
Finland	• Government of Finland - Ministry of Foreign Affairs • Fortum Corporation	Yes
Japan	• Chubu Electric Power Co., Inc[12] • The Chugoku Electric Power Co., Inc.[13] • Japan International Cooperation Agency (JICA) • Kyushu Electric Power Co., Inc. • MIT Carbon Fund Co., Ltd. (MIT)[14] • Mitsubishi Corporation[15] • Shikoku Electric Power Co., Inc. • Tohoku Electric Power Co., Inc. • The Tokyo Electric Power Co., Inc. • Mitsui & Co., Ltd.[16]	No

[11] Withdrawn from KP effective on 15/12/2012

[12] Withdrawn on 16/08/2018

[13] Withdrawn on 14/08/2018

[14] Withdrawn on 30/07/2012

[15] Withdrawn on 14/08/2018

[16] Withdrawn on 21/06/2018

A.5. Public funding of project activity

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The project activity does not consider public funding.

A.6. History of project activity

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This PDD covers the third crediting period of the registered CDM project activity "Chacabuquito", ref. N° 1052.

The project participant confirms that the proposed CDM project activity is neither registered as a CDM project activity nor included as a component project activity (CPA) in a registered CDM programme of activities (PoA).

A.7. Debundling

>>
Not applicable

SECTION B. Application of selected methodologies and standardized baselines

B.1. Reference to methodologies and standardized baselines

>>
Approved baseline methodology AM00026. Methodology for zero-emissions grid-connected electricity generation from renewable sources in Chile or in countries with merit order based dispatch grid (Version 03). Available at:

https://cdm.unfccc.int/methodologies/DB/OOI7OYUFZOXN07H7EDBA9GVHJ4GK20

In order to estimate the emission factor for the grid, AM00026 (Version 3) refers to the "Tool to calculate the emission factor for an electricity system (Version 6)". Available at:

https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-07-v6.pdf

Since this PDD is submitted for the renewal of the project activity crediting period, the following tool was also applied: "Assessment of the validity of the original/current baseline and update of the baseline at the renewal of the crediting period" (version 3.0.1). Available at:

http://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-11-v3.0.1.pdf

B.2. Applicability of methodologies and standardized baselines

>>
The chosen methodology for the development of the project design document is the AM0026 Methodology for zero-emissions grid-connected electricity generation from renewable sources in Chile or in countries with merit order based dispatch grid (Version 03); the applicability conditions in this methodology and its fulfilment reasons are presented in the following table.

Applicability conditions	Fulfilment
1) Projects that are renewable electricity generation projects of the following types: (a) Run-of-river hydro power plants and hydroelectric power projects with existing reservoirs where the volume of the reservoir is not increased; (b) New hydroelectric power projects with reservoirs having power densities (installed power generation capacity divided by the	The project activity is a Run-of-river hydro power plant, fulfilling letter (a).

surface area at the full reservoir level) greater than 4 W/m^2 (c) Wind sources; (d) Solar sources; (e) Geothermal sources; (f) Wave and tidal sources.	
2) Projects that are connected to the interconnected grids of the Republic of Chile and Projects that fulfils all the legal obligations under the Chilean Electricity Regulation; or Proposed projects implemented in countries other than Chile provided the country has a regulatory framework for electricity generation and dispatch that meets the following conditions: (a) An identifiable independent identity is responsible for optimal operation of the system based on the principle of lowest marginal costs. (b) The data for merit order based on marginal costs is publicly made available by the authority responsible for operation of the system. (c) The data on specific fuel consumption for each generation source in the system is publicly available. (d) It is possible with the information available, to ensure that power plants dispatched for other considerations (e.g. safety conditions, grid stability, transmission constraints, and other electrical reasons) are not identified as marginal plants.	The project activity is connected to SIC of Chile.

B.3. Project boundary, sources and greenhouse gases (GHGs)

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According to the CDM methodology AM0026 v.3.0, the spatial extent of the project boundary includes the project site and all power plants connected physically to the electricity system to which the CDM project power plant is connected to. As described in section B.4, until November 2017 the relevant electricity system was the “Sistema Interconectado Central” (SIC) grid and since December 2017, the national system called “Sistema Eléctrico Nacional” (SEN[17]) which considers the interconnection of the “Sistema Interconectado Central” (SIC) and the “Sistema Interconectado Del Norte Grande” (SING[18]). Considering this, all GHG emissions generated by the power plants of this electricity system are accounted as part of the baseline emissions.

The methodology only claims emissions reductions from the substitution of power generation due to the implementation of a CDM activity in one of the grids. Only CO_2 derived from the combustion of the thermal plants is accounted.

[17] In English: “National Electric System”

[18] In English: “Great North Interconnected System”

	Source	GHG	Included?	Justification/Explanation
Baseline	SIC thermal dispatch	CO_2	Yes	Emission due to thermal power plant dispatch
		CH_4	No	Methodology does not consider other GHGs beside CO_2
		N_2O	No	Methodology does not consider other GHGs beside CO_2
Project activity	SIC thermal dispatch	CO_2	No	The project is a zero emissions electricity generation activity
		CH_4	No	The project is a zero emissions electricity generation activity
		N_2O	No	The project is a zero emissions electricity generation activity

The following figure represents a flow diagram of the project boundary.

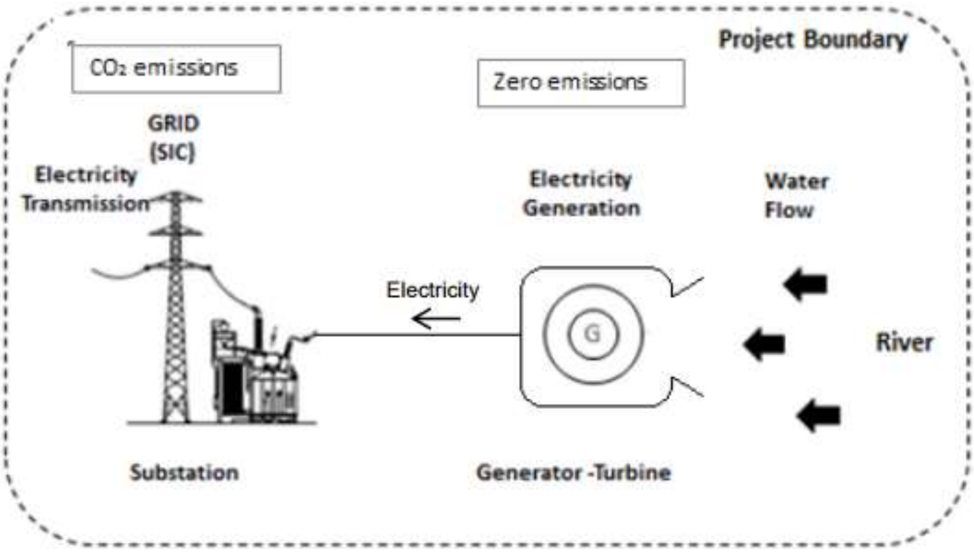

Figure 6. Flow diagram of the project activity

B.4. Establishment and description of baseline scenario

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Identification of the Baseline Scenario

According to the CDM methodology AM0026 v.3.0, for project activities that do not modify or retrofit an existing electricity generation facility, the baseline scenario is defined as 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) calculated as per the methodology.

At the time of the project registration under the CDM, the boundaries of the baseline scenario of Chacabuquito project activity was the “Sistema Interconectado Central” (SIC) grid, as it was connected to this electric system, which covered an extension from the northern city of Tal Tal, located at the II Región of Antofagasta, to the southern island of Chiloé, located at the X Región of Los Lagos, including all the regions between them (from II to X, including RM and XIV Región de Los Ríos).

In November 21th, 2017, the SIC grid was interconnected to the “Sistema Interconectado Del Norte Grande” (SING) grid, creating a new electric system called Sistema Eléctrico Nacional (SEN),

which represents 99% of the installed capacity of the country, covering from Arica, in the XV Región de Arica y Parinacota (the most northern region in the Chile) to Chiloé.

For the ex-ante emission reduction calculation, data from the year 2016 is considered, thus the relevant electricity system for the project activity was the SIC grid.

Description of the identified Baseline Scenario

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

Revalidation of the baseline of the project activity

According to the CDM project standard for project activities Version 01.0, the validity of the original baseline or its update should be assessed as per the tool "Assessment of the validity of the original/current baseline and update of the baseline at the renewal of the crediting period" (Version 03.0.1).

The tool provides a stepwise procedure to assess the continued validity of the baseline and to update the baseline at the renewal of a crediting period. The tool consists of two steps:

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

The validity of the current baseline is assessed using the following Sub-steps:

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

According to the tool "Assessment of the validity of the original/current baseline and update of the baseline at the renewal of the crediting period" (Version 03.0.1)", "if the current baseline complies with all relevant mandatory national and/or sectoral policies which have come into effect after the submission of the project activity for validation or the submission of the previous request for renewal of the crediting period and are applicable at the time of requesting renewal of the crediting period, go to Step 1.2".

There are no new national and/or sectoral policies that have come into effect after the submission of the project for the second validation that are applicable to the project activity.

According to the registered PDD, the original baseline is "the electricity delivered to the grid that would have otherwise been generated by the operation of the currently operating power plants and by the addition of new generation sources."

The original baseline complies with all the current relevant mandatory national and sectoral policies.

Step 1.2: Assess the impact of circumstances

According to the tool, "in the situation where the baseline scenario identified at the validation of the project activity was the continuation of the current practice without any investment, an assessment of the changes in market characteristics is required for the renewal of the crediting period".

Currently, the market characteristics for the electricity sector are still the same than described in the original baseline scenario. In fact, the planning authority (CNE) is still the same as originally described and the private sector is still the responsible actor in electricity generation, distribution and transmission market. There have not been relevant changes to the original circumstances in the market that could affect the applicability of the original baseline scenario.

The conditions used to determine the baseline emissions in the previous crediting period are still valid, as baseline emissions depend on the grid connected power plants operation.

Step 1.3: Assess whether the continuation of use of current baseline equipment(s) or an investment is the most likely scenario for the crediting period for which renewal is requested.

According to the tool, "this sub-step should only be applied if the baseline scenario identified at the validation of the project activity was the continuation of use of the current equipment(s) without any investment and, the projects proponents or third party (or parties) would undertake an investment later due, for example, to the end of the technical lifetime of the equipment(s) before the end of the crediting period or the availability of a new technology".

The tool also clarifies that it should be assessed "whether the remaining technical lifetime of the equipment that would have continued to be used in the absence of the project activity, as determined in the PDD, exceeds the crediting period for which renewal is requested".

Since the baseline scenario identified at the validation of the project has not been modified and the baseline didn't consider the use of any existing equipment by the project participant, because in the absence of the project activity the energy generated would have been generated by the operation of grid-connected power plants and by the addition of new generation sources to the grid, this substep is not applicable.

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

According to the tool, in this step it should be assessed "whether data and parameters that were only determined at the start of the crediting period and not monitored during the crediting period are still valid or whether they should be updated".

As the emission factor of the grid was estimated ex-post for the first crediting period (in accordance with the methodology ACM0026), there were no fixed values over the first crediting period except for the weight for operating margin emission factor and build margin emission factor, which corresponded to 0.5 for each value.

During the second and third crediting period the weight for operating margin emission factor and build margin emission factor is fixed in 0.25 and 0.75 respectively, in accordance to the description provided in the "Tool to calculate the emission factor for an electricity system" (as required in the updated applicable methodology ACM0026 Version 03.0).

Since some data and parameters were only determined at the beginning of the crediting period (and not monitored during it), they are not valid anymore, so the current baseline needs to be updated for the third crediting period.

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

Step 2.1: Update the current baseline

According to the tool, in this step it should be updated "the current baseline emissions for the subsequent crediting period, without reassessing the baseline scenario, based on the latest approved version of the methodology applicable to the project activity. The procedure should be

applied in the context of the sectoral policies and circumstances that are applicable at the time of request for renewal of the crediting period"

In order to meet the abovementioned requirements, the calculation of baseline emissions was developed for the third crediting period as described in section B.6.3 of this PDD.

Step 2.2: Update the data and parameters

According to the tool "if the application of Step 1.4 showed that the data and/or parameters that were only determined at the start of the crediting period and not monitored during the crediting period are not valid anymore, project participants should update all applicable data and parameters, following the guidance in Step 1.4."

Specifically, as mentioned in Step 1.4, and considering that the baseline emission calculation was developed for the third crediting period, the operating margin has been updated, and the build margin and combined margin weighting remained unaltered during the period renewal, as described on sections B.6.1 and B.6.3 from the PDD.

B.5. Demonstration of additionality

>>
As the current PDD is developed for the third crediting period of a registered project activity, a re-assessment of additionality is not required.

The following steps show the demonstration of additionality according to the previous PDDs.

Step 0. Preliminary screening based on the starting date of the project activity.

The Chacabuquito Hydroelectric Power Project started its operations on July 1st, 2002 and began its construction around one year before. Before its implementation HGV[19] submitted this project to the Prototytpe Carbon Fund of the World Bank (PCF) seeking for additional funding from the Emissions Reductions generated by the project. In March 2001 HGV and the PCF signed a Letter of Intent for the purchase of Emissions Reductions; in April, 2001 the government of Chile endorsed the project for the purpose CDM component of the project and the PCF as buyer were crucial for the investment decision of the Article 12 of the Kyoto Protocol; and in February 2002 an Emission Reduction Purchase Agreement (ERPA) was signed, reflecting what was originally agreed in the Letter of Intent. Therefore, the CDM was seriously considered before the start of the project and the expected revenues from the CDM component of the project and the PCF as buyer were crucial for the investment decision

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

The CNE establishes for every Node Price Report the Optimal Expansion Plan of the SIC, and uses it to calculate the regulated prices. The expansion plan consists of successive iterations of comparing different options of system expansion that minimizes the net present cost of the energy supply, which includes the sum of the net present value of investments, operation and maintenance, and shortage cost for a period of ten years (see the formula below). Therefore, the model picks the technologies and projects that minimize the objective formula, assuring the minimum economic cost for the expansion and operation of the system.

$$Min \left\{ \sum \text{Investments} + \text{O\&M} + \text{VariableCosts} - \text{ResidualValues} \right\}$$

The relevant report at the time was the Node Price Report of April 2001 and thus, the one that

[19] Hidroeléctrica Guardia Vieja S.A., former society of Colbun S.A. in charge of the Project activity.

impacted on the investment decision; it is thus the relevant report to test the additionality of the Chacabuquito Project. The following table shows the expansion plan from that report (page 5 of Annex 5 of the Report available at www.cne.cl).

Table 3. Expansion plan

Power Plant	Capacity [MW]	Commissioning Date	Chilean Region
Optimal Plan			
Taltal combined cycle	360.0	Jan.2003	Third
SIC-SING Interconnection	250.0	Jan.2004	Third
Combined cycle 1	372.6	Apr.2004	Fifth
Combined cycle 2	372.6	Apr.2005	Fifth
Combined cycle 3	372.6	Apr.2006	Fifth
SIC-SADI Interconnection	400.0	Jan.2007	Metropolitan
Combined cycle 4	372.6	Apr.2007	Fifth
Neltume hydro	400.0	Jan.2008	Tenth
Combined cycle 5	372.6	Apr.2008	Fifth
Combined cycle 6	372.6	Jan.2009	Fifth
Combined cycle 7	372.6	Apr.2009	Fifth
Combined cycle 8	372.6	Apr.2010	Fifth
Plants under construction			
Ralco hydro	570.0	Jul.2003	Eighth

Source: www.cne.cl

As shown above, the least cost alternative for the expansion of the SIC are combined cycle natural gas fired power plants and two hydro dams called Ralco (570 MW, 2003) and Neltume (400 MW, 2007). The Ralco hydro dam is under construction and it was expected to start generating electricity by July 2003. There are no run-of-the-river hydroelectric power plants picked by the model.

Step 2. Investment analysis / Substep 2b Option II. Investment comparison analysis

The Official Expansion Plan elaborated by the CNE is the primary source to test the additionality. The methodology requires an extra test to confirm additionality. This test consists of running the expansion model again with the same information from the CNE but adding the project official data (hydrological data, construction cost and operation and maintenance cost), and comparing both results. The comparison was done in two scenarios, the effective capacity (28.872 MW) and the total installed capacity (30 MW). The outcome of this comparison is shown below, annually and in net present value:

Table 4. Project investment and costs

In Million USD	2001-02	2002-03	2003-04	2004-05	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11
Baseline Scenario										
Generation	157.8	182.7	186.3	205.1	239.9	281.7	328.6	371.8	444.1	517.9
Unserved Energy	0.1	7.9	22.2	10.7	7.3	5.2	1.1	0.6	0.4	2.8
TOTAL	**157.9**	**190.6**	**208.5**	**215.8**	**247.2**	**286.9**	**329.7**	**372.4**	**444.5**	**520.7**
Including Project 28.872 MW										
Generation	156.6	179.8	183	202.3	237.3	278.8	325.3	368.9	440.7	514.3
Unserved Energy	0.1	7.4	20.9	9.9	6.7	4.9	1.0	0.6	0.3	2.4
Project Investment	0	40.7	0	0	0	0	0	0	0	-25.9
Project O&M Costs	0	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
TOTAL	**156.7**	**228.2**	**204.2**	**212.5**	**244.3**	**284.0**	**326.6**	**369.8**	**441.3**	**491.1**
Including Project 30 MW										
Generation	156.5	179.6	182.9	202.2	237.2	278.6	325.1	368.7	440.6	514.1
Unserved Energy	0.1	7.4	20.8	9.9	6.7	4.8	1.0	0.6	0.3	2.4
Project Investment	0	40.7	0	0	0	0	0	0	0	-25.9
Project O&M Costs	0	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
TOTAL	**156.6**	**228.0**	**204.0**	**212.4**	**244.2**	**283.7**	**326.4**	**369.6**	**441.2**	**490.9**

In million USD	2001-02	2002-03	2003-04	2004-05	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11
Baseline Scenario										
Generation	157,8	182,7	186,3	205,1	239,9	281,7	328,6	371,8	444,1	517,9
Unserved Energy	0,1	7,9	22,3	10,7	7,3	5,2	1,1	0,6	0,4	2,8
TOTAL	**157,9**	**190,6**	**208,6**	**215,8**	**247,2**	**286,9**	**329,7**	**372,4**	**444,5**	**520,7**
Including Project										
Generation	156,7	179,9	183,2	202,4	237,4	278,9	325,5	369,0	440,9	514,6
Unserved Energy	0,1	7,5	21,0	10,1	6,8	4,9	1,0	0,6	0,3	2,5
Project Investment	-	40,7	-	-	-	-	-	-	-	-25,9
Project O&M costs	-	0,3	0,3	0,3	0,3	0,3	0,3	0,3	0,3	0,3
TOTAL	**156,8**	**228,4**	**204,5**	**212,8**	**244,5**	**284,1**	**326,8**	**369,9**	**441,5**	**491,5**

Source: Project participant

Table 5. Investment analysis 28.872 MW

In million USD (*)	
Baseline Scenario	
Generation	1.773,8
Unserved Energy	44,3
TOTAL	**1.818,1**
Including Project	
Generation	1.756,1
Unserved Energy	41,6
Project Investment	26,0
Project O&M costs	2,0
TOTAL	**1.825,7**
Generation+Unserved	-20,4
Project Costs	28,0
Cost Difference	7,6
Investment Cost (apr-01)	37,0
Commissionig date	Jul-02
Annua Discount rate	10%
Annual O&M costs	0,3

In Million USD*	
Baseline Scenario	
NPV Generation	1,773.8
NPV Unserved Energy	44.2
TOTAL	**1,818.0**
Including Project 28.872 MW	
NPV Generation	1,755.1
NPV Unserved Energy	41.2
Project Investment	26.0
Project O&M Costs	1.7
TOTAL	**1,824.0**
Generation+Unserved	-21.7
Project Costs	27.7
Costs Difference	**6.0**
Invesment cost (apr-01)	37.0
Commisionig date	Jul.02
Annual Discount rate	10%
Annual O&M costs	0.3

(*) As in April 2001

Source: Project participant

Table 6. Investment analysis 30 MW

In Million USD*	
Baseline Scenario	
NPV Generation	1,773.8
NPV Unserved Energy	44.2
TOTAL	**1,818.0**
Including Project 30 MW	
NPV Generation (10%)	1,754.1
NPV Unserved Energy (10%)	41.0
Project Investment	26.0
Project O&M Costs	1.7
TOTAL	**1,822.9**
Generation+Unserved	-22.8
Project Costs	27.7
Costs Difference	**4.9**
Invesment cost (apr-01)	37.0
Commisionig date	Jul.02
Annual Discount rate	10%
Annual O&M costs	0.3

Source: Project participant

The above tables show the proposed CDM project has the following economic impact on the overall system:

To the 28.872 MW case:

- Savings in the system operation cost of US$ 18.7 million (US$ 1,773.8 - US$ 1,755.1);
- Savings in expected shortage of US$ 3 million (US$ 44.2 – US$ 41.2); and
- US$ 27.7 million of additional investment, maintenance, and operation of the Project.

To the 30 MW case:

- Savings in the system operation cost of US$ 19.7 million (US$ 1,773.8 - US$ 1,754.1);

- Savings in expected shortage of US$ 3.144 million (US$ 44.186 – US$ 41.042)[20]; and
- US$ 27.7 million of additional investment, maintenance, and operation of the Project.

The overall outcome is US$ 6 and US$ 4.9 million of additional cost for the system in the 28.872 MW and 30 MW respectively, for serving the same energy demand in the scenario with the project activity.

It should be noted that the model and all the information is publicly available and could be run by independent experts. The model cannot be manipulated and the information added by sponsor is official (construction cost and hydrological data). The project data used by the model can be confirmed during the validation process.

Therefore, according to the investment analysis, the Project is additional in both cases.

Step 4. Common practice analysis.

Sub-step 4a Analyse other activities similar to the proposed activity:

Since natural gas was introduced as a resource to Chile in 1996, system prices were significantly reduced; completely changing the business environment in both main grids (SICS and SINGS). While this situation prevailed in the country, all other generating technologies using renewable resources became non-competitive, with the exception of big hydro dam power projects. Since 1996, only one other hydro run-of-the-river power project was built in the Chilean interconnected central grid (the Peuchen and Mampil Project),

The following figure shows SIC's historic energy price variations. It can be clearly identified an energy price reduction in the system after natural gas introduction. As indicated on Step 0. Chacabuquito investment decision was taken in early 2001, only after seeking additional funding from carbon credits.

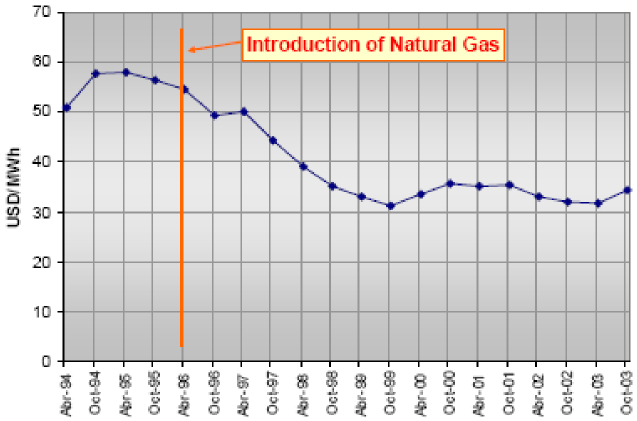

Figure 7. CNE Node Price Fixation (in Real USD as of Oct-2003)
Source: CNE price reports and bls.gov CPI

Sub-step 4b. Discuss similar options that are occurring:

There are no similar activities observed in the SIC being carried at the time the project initiated its construction and its operation, with the exception of those projects that have been submitted under, or are seeking, carbon credits finance under the CDM.

[20] Numbers presented in tables 5 and 6 were rounded to one decimal.

Step 5. Impact of CDM Registration

The revenues from the sales of Emissions Reductions have two main impacts for the project: First, the revenues come from one of the most creditworthy organization in the world, reducing the overall risk of the project and the exchange risk of the cash flows. Second, the additional revenues, in US dollar, increases the IRR by about 2.5 points of the internal rate of return of the project, making the project attractive to the investors.

Since all above steps are satisfied, it demonstrates the additionality of the proposed CDM project activity according to the Tool for the demonstration and assessment of additionality.

B.6. Estimation of emission reductions

B.6.1. Explanation of methodological choices

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According to the selected methodology AM0026 “Methodology for zero-emissions grid-connected electricity generation from renewable sources in Chile or in countries with merit order based dispatch grid” v.3.0 the emission reduction calculation is given by the following equation.

Equation 1. Emission reduction calculation

$$ER_y = BE_y - PE_y - L_y$$

Where:

ER_y	=	Emission reductions of the project activity during year y (tCO_2)
BE_y	=	Baseline emissions due to displacement of electricity during year y (tCO_2)
PE_y	=	Project emissions during year y (tCO_2)
L_y	=	Leakage emissions during year y (tCO_2)

Baseline emissions

According to the methodology the baseline scenario are the emissions from electricity that would be generated by the operation of the existing and likely future grid-connected power plants. It is calculates as follows:

Equation 2. Baseline emissions calculation

$$BE_y = EF_y \times Generation_y$$

Where:

BE_y	=	Baseline emissions due to displacement of electricity during year y (tCO_2)
EF_y	=	Baseline emission factor for year y (tCO_2/MWh)
$Generation_y$	=	Electricity generated by the proposed CDM project during year y (MWh)

The baseline emission factor (EF_y) is calculated as a combined (CM) emission factor, consisting of the combination of operation margin (OM and build margin (BM) emission factors according to the following steps.

Equation 3. Emission factor calculation

$$EF_y = w_{OM} \times EF_{OM} + w_{BM} \times EF_{BM}$$

Where:

EF_y = Baseline emission factor for year y (tCO_2/MWh)
w_{OM} = Weight for operating margin emission factor
EF_{OM} = Operating margin emission factor (tCO_2/MWh)
w_{BM} = Weight for build margin emission factor
EF_{BM} = Build margin emission factor (tCO_2/MWh)

The values for w_{OM} and w_{BM} must be determined according to the latest version of the methodological tool “Tool to calculate the emission factor for an electricity system”.

Operating margin emission factor

The OM emission factor from the project activity will depend on the actual generation data from the SIC. The dispatch data, to be provided ex-post by the Economic Dispatch Center (“Coordinador Eléctrico Nacional”), will conclusively indicate the type of generation displaced by the addition of Chacabuquito in the generation mix in the SIC. The monitoring and verification plan for the project utilizes the data provided by “Coordinador Eléctrico Nacional”, CNE and IPCC.

The next diagram shows the complete process for calculating and assigning the operating emission factors for the Chacabuquito Hydroelectric Power Project:

Net Hourly Generator output from other CDM Projects and Chacabuquito
(“Coordinador Eléctrico Nacional”[21] and Project Participant hourly energy generation data)
(MWh)

↓

Analysis of hourly dispatch from all units of the SIC to determine the
Marginal Plant(s) that would be dispatched if the system is operated
without all the CDM projects in the system
(“Coordinador Eléctrico Nacional”[22])

↓

Calculation of emission factor of all operational thermal units of the system
(“Coordinador Eléctrico Nacional”, CNE report[23] and 2006 IPCC manual)
(tonnes CO_2e/MWh)

↓

Determination of the marginal plants and energy being displaced due to the operation of the
Chacabuquito CDM project
(MWh and tonnes CO_2e/MWh)

↓

Determination of EF_{OM} of each CDM project as the weighted average emission factor
of the Marginal Plant(s) not dispatched (or displaced) by the project
(tonnes CO_2e/MWh)

The Emission Factor of the operating margin is calculated by the Emissions Factor Estimation Methodological Tool as explained above and in accordance with the following equations:

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[21] https://www.coordinadorelectrico.cl/

[22] Energy generation data and Merit Order

[23] www.cne.cl

Equation 4. Operating margin emission factor calculation

$$EF_{OM,y} = \frac{\sum_{h=1}^{8760} EF_{j,h} \times Generation_{j,h}}{\sum_{h=1}^{8760} Generation_{j,h}}$$

Where:

$EF_{OM,y}$	=	Operating margin emission factor for year y (tCO_2/MWh)
$EF_{j,h}$	=	Operating margin emission factor for proposed CDM project activity 'j' for hour 'h' (tCO_2/MWh)
$Generation_{j,h}$	=	Generation of proposed CDM project "j" during hour 'h' (MWh)

The emission factor for the proposed CDM project 'j', in a system with N CDM projects, for an hour 'h' is based on identification of the marginal plant(s) that would be operated to meet the electricity supplied by the proposed CDM project 'j'. The identification of marginal plant(s) displaced by proposed 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 was the first power plant in operation in the SIC to be commissioned as a CDM project activity.

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

Equation 5. Project 'j' emission factor calculation

$$EF_{j,h} = \frac{\sum_{i=1}^{M} D(j,i) \times d_i}{\sum D(j,i)}$$

Where:

$EF_{j,h}$	=	Project *'j'* emission factor
$D(j,i)$	=	Energy displacement of the marginal plant *'i'* due to the proposed CDM project *'j'* (MWh)
d_i	=	Emission factor of the marginal plant *'i'* (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.

M is such that:

Equation 6. Number of marginal plants determination

$$\sum_{j=1}^{N} C_j \leq \sum_{i=1}^{M} (A_i - B_i)$$

Where:

C_i	=	Energy generation of the CDM project *'j'* (MWh/h)
N	=	Total number of CDM projects in the system
A_i	=	Maximum energy generation of the marginal plant *'i'* (MWh/h, equivalent to plant capacity in MW)
B_i	=	Actual Energy generation of the CDM marginal plant *'i'* (MWh/h)

The difference (A_i - B_i) represents the maximum possible additional electric energy that can be supplied by the 'i'th marginal plan.

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

Equation 7. Energy displacement calculation

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

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:

Equation 8. Emission factor calculation

$$d_i = SFC_i \times CEF_{OM,i} \times Oxid_i$$

Where:

d_i	=	Displaced marginal plant emission factor (tCO_2e/MWh)
SFC_i	=	Specific fuel consumption of 'i'th marginal power plant (TJ/MWh)
$CEF_{OM,i}$	=	CO_2 emission factor of fuel used in 'i'th marginal power plant (tCO_2e/(ton of fuel or TJ))
$Oxid_i$	=	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 allowed[24] on a kWh base. Hourly energy data obtained from the metering system is periodically submitted to "Coordinador Eléctrico Nacional" as for all other generating units of the system.

The Semi-annual Node Price Report[25] and the 2006 IPCC Good Practice Guidance[26] provide all the information to calculate the emission factors for all the power plants within the Chilean grids. 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.

Calculation of the Build Margin

Not applicable since the PDD is developed for the third crediting period. The Build Margin value from the second crediting period will be used.

[24] Chilean Regulation NCH 2542.

[25] https://www.cne.cl/tarificacion/electrica/precio-nudo-corto-plazo/

[26] http://www.ipcc-nggip.iges.or.jp/public/2006gl/index.html

Project emission reductions

The combined margin emission factor for the proposed Chacabuquito project, according to AM0026 v.3.0, is calculated with weighted average for both the Operating Margin (OM) and the Build Margin (BM).

Calculation of Combined Margin Emission factor of EF_{BM} and EF_{OM}
(tonnes CO_2e/MWh)

↓

Energy generation of the Chacabuquito CDM Project
(Project Developer)
(MWh)

↓

Calculation of Baseline Emissions of the Project
(tonnes CO_2e)

↓

Discount any leakage or project activity emissions, if any
(No leakage emission was identified for Chacabuquito, and project emissions are null)
(tonnes CO_2e)

The combined margin emission factor for the proposed Chacabuquito project, according to AM0026 v.3.0, is calculated by the Emissions Factor Estimation Mathematical Tool considering the weighted average for both the Operating Margin (OM) and the Build Margin (BM) as follows:

Equation 9. Combined margin calculation

$$EF_y = w_{OM} \times EF_{OM,y} + w_{BM} \times EF_{BM,y}$$

Where:

EF_y	=	Combined emission factor (tCO_2e/MWh)
w_{OM}	=	Weight for operating margin emission factor
$EF_{OM,y}$	=	Operating margin emission factor (tCO_2e/MWh)
w_{Bm}	=	Weight for build margin emission factor
$EF_{BM,y}$	=	Build margin emission factor (tCO_2e/MWh)

The AM0026 v.3.0 methodology determines the w_{BM} and w_{OM} by using the "Tool to calculate the emission factor for an electricity system" which states that for the third crediting period a value of 75% and 25% should be used for the build margin and operating margin emission factors weight for estimating the combined emission factor.

The baseline emissions for the project are calculated as follows using the emissions factor estimated by the Emissions Factor Estimation Mathematical Tool and the energy generated by the project activity:

Equation 10. Baseline emissions calculation

$$BE_y = EF_y \times Generation_y$$

Where:

BE_y	=	Baseline emissions (tCO_2e)
EF_y	=	Baseline emission factor (tCO_2e/MWh)
$Generation_y$	=	Electricity generated by the proposed CDM project in year y (MWh)

Finally, 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. Since the Chacabuquito project consists of a hydro power plant, there are no Project Emissions (PE_y). Additionally, as per AM0026 v.3.0, no leakage (L_y) was identified for this project activity. The emission reduction can be expressed as follows:

Equation 11. Emission reduction calculation

$$ER_y = BE_y - PE_y - LE_y = BE_y$$

Where:

ER_y	=	Emission reductions (tCO_2e)
BE_y	=	Baseline emissions (tCO_2e)
PE_y	=	Project emissions (tCO_2e)
LE_y	=	Leakage emissions (tCO_2e)

B.6.2. Data and parameters fixed ex ante

Data/Parameter	$EF_{BM,y}$
Data unit	tCO_2e/MWh
Description	Build margin emission factor
Source of data	Second period PDD
Value(s) applied	0.44810
Choice of data or measurement methods and procedures	According to the “Tool to calculate the emission factor for an electricity system” Version 06.0, the build margin emission factor for the third crediting period should be the one calculated for the second crediting period.
Purpose of data	Calculation of baseline emissions
Additional comment	No additional comments

Data/Parameter	w_{BM}
Data unit	%
Description	Weight for build margin emission factor
Source of data	“Tool to calculate the emission factor for an electricity system” Version 06.0
Value(s) applied	75
Choice of data or measurement methods and procedures	According to the “Tool to calculate the emission factor for an electricity system” Version 06.0, for the third crediting period the weighting is w_{OM} = 0.25 and w_{BM} = 0.75
Purpose of data	Calculation of baseline emissions
Additional comment	No additional comments

Data/Parameter	w_{OM}
Data unit	%
Description	Weight for operating margin emission factor

Source of data	"Tool to calculate the emission factor for an electricity system" Version 06.0
Value(s) applied	25
Choice of data or measurement methods and procedures	According to the "Tool to calculate the emission factor for an electricity system" Version 06.0, for the third crediting period the weighting is w_{OM} = 0.25 and w_{BM} = 0.75
Purpose of data	Calculation of baseline emissions
Additional comment	No additional comments

B.6.3. Ex ante calculation of emission reductions

>>

Operating margin emission factor

AM0026 v.3.0 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 based on the latest available data at time of submission of the PDD to the DOE, which is year 2016.

An example of the operating margin emission factor calculation for the 2832th hour of the year is given below.

In this case the Chacabuquito power plant displaces electricity (2.7 MWh, C_j) from Coronel diesel power plant remaining capacity (A_i – B_i). This displacement ($D_{j,i}$) is multiplied by the Coronel power plant emission factor (d_i) to calculate the amount of displaced CO_2 in this hour.

Chacabuquito@Run of the River	Coronel@Diesel Oil
C_j (MWh)	**A_i - B_i (MWh)**
2.70	25.76
$D(j,i)$ (MWh)	**d_i (tCO_2e/MWh)**
2.70	0.698
$D(j,i)*d_i$ (tCO_2e)	
1.885	

As seen on the table above, and according to Equation 5, the emission factor was calculated as follows:

$$EF_{40,2832} = \frac{1.885}{2.70} = 0.698\ (tCO2e/MWh)$$

Based on Equation 4, by replying the previous calculation for every hour of the year the result for the Operating margin emission factor calculation is:

$EF_{OM,y}$ (tCO_2/MWh)
0.70054

For a complete and step by step calculation of the $EF_{OM,y}$ value, please refer to the Emission factor calculation spreadsheet.

Build Margin Emission Factor Calculation

According to the “Tool to calculate the emission factor for an electricity system” the Build margin emission factor calculation for the third crediting period should be the one used for the second crediting period, thus:

$EF_{BM,y}$ (tCO_2/MWh)
0.44810

Combined Margin Emission Factor Calculation

Following the Equation 9, the combined margin emission factor was calculated as follows:

$$EF_{CM,y} = 0.44810 \times 0.75 + 0.70054 \times 0.25 = 0.51121$$

Thus,

$EF_{CM,y}$ (tCO_2/MWh)
0.51121

Please note that, w_{BM} and w_{OM} values were determined in accordance with the “Tool to calculate the emission factor for an electricity system” for the third crediting period.

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)
04/11/2018 – 31/12/2018	13,809	0	0	13,809
01/01/2019 – 31/12/2019	86,905	0	0	86,905
01/01/2020 – 31/12/2020	86,905	0	0	86,905
01/01/2021 – 31/12/2021	86,905	0	0	86,905
01/01/2022 – 31/12/2022	86,905	0	0	86,905
01/01/2023 – 31/12/2023	86,905	0	0	86,905
01/01/2024 – 31/12/2024	86,905	0	0	86,905
01/01/2025 – 03/11/2025	73,096			73,096
Total	608,335	0	0	608,335
Total number of crediting years	7			
Annual average over the crediting period	86,905	0	0	86,905

B.7. Monitoring plan

B.7.1. Data and parameters to be monitored

Data/Parameter	$EF_{OM,y}$

Data unit	tCO_2e/MWh
Description	Operating margin emission factor for year y
Source of data	Calculated according to AM0026 v.3.0, using “Coordinador Eléctrico Nacional” data
Value(s) applied	0.70054
Measurement methods and procedures	Yearly calculation according to AM0026 v.3.0 procedures
Monitoring frequency	Annually
QA/QC procedures	Automatically calculated from “Coordinador Eléctrico Nacional” databases and AM0026 v.3.0 procedures. Calculation should be done after “Coordinador Eléctrico Nacional” makes the data official (validation).
Purpose of data	Calculation of baseline emissions
Additional comment	No additional comments

Data/Parameter	$EF_{j.h}$
Data unit	tCO_2e/MWh
Description	Emission factor for proposed CDM project ‘j’ for hour ‘h’
Source of data	Calculated according to AM0026 v.3.0, using “Coordinador Eléctrico Nacional” data
Value(s) applied	Values available in the Emission Factor Calculation spreadsheet
Measurement methods and procedures	Calculated annually for each hour, according to AM0026 v.3.0 procedures
Monitoring frequency	Annually
QA/QC procedures	Automatically calculated from “Coordinador Eléctrico Nacional” databases and AM0026 v.3.0 procedures. Calculation should be done after “Coordinador Eléctrico Nacional” makes the data official (validation).
Purpose of data	Calculation of baseline emissions
Additional comment	No additional comments

Data/Parameter	$Generation_y$
Data unit	MWh
Description	Electricity exported to the grid by the proposed CDM project in year y
Source of data	On-site metering system
Value(s) applied	170,000
Measurement methods and procedures	Measured with electricity meters in according to monitoring plan.
Monitoring frequency	Hourly
QA/QC procedures	Meter should have a maximum error of 0.2% and be verified periodically according to local standards for electricity transactions in “Coordinador Eléctrico Nacional”. Metering data is regularly cross checked against the “Coordinador Eléctrico Nacional” data, where a balance is made for energy transactions between power generators.
Purpose of data	Calculation of baseline emissions
Additional comment	The value used for ex ante baseline emission calculation was calculated as an approximate average of the yearly generation, according to the Monitoring report 01 Jul 2002 – 01 May 2007, whose data was obtained from CDEC-SIC.

Data/Parameter	***D(j,i)***
Data unit	MWh
Description	Energy displacement of the marginal plant ‘i’ due to proposed CDM project ‘j’

Source of data	“Coordinador Eléctrico Nacional” data
Value(s) applied	Values available in the Emission Factor Calculation spreadsheet
Measurement methods and procedures	Calculation according to AM0026 v.3.0 guidelines, with “Coordinador Eléctrico Nacional” Data
Monitoring frequency	Hourly
QA/QC procedures	Automatically calculated from “Coordinador Eléctrico Nacional” databases and AM0026 v.3.0 procedures. Calculation should be done after “Coordinador Eléctrico Nacional” makes the data official (validation).
Purpose of data	Calculation of baseline emissions
Additional comment	No additional comments

Data/Parameter	d_i
Data unit	tCO_2e/MWh
Description	Emission factor for electricity displaced *D(j,i)*
Source of data	IPCC Guidelines and CNE Node Price Report
Value(s) applied	Values available in the Emission Factor Calculation spreadsheet
Measurement methods and procedures	Calculation according to AM0026 v.3.0 and IPCC Guidelines, with CNE data
Monitoring frequency	Hourly
QA/QC procedures	Calculation based on official data
Purpose of data	Calculation of baseline emissions
Additional comment	No additional comments

Data/Parameter	***M***
Data unit	Number
Description	Number of power plants on the margin that would supply to the grid in the absence of the CDM projects of the system.
Source of data	“Coordinador Eléctrico Nacional” data
Value(s) applied	Values available in the Emission Factor Calculation spreadsheet
Measurement methods and procedures	Calculation according to AM0026 v.3.0 guidelines, with “Coordinador Eléctrico Nacional” Data
Monitoring frequency	Hourly
QA/QC procedures	An Excel worksheet will be developed to deliver automatic calculations based on “Coordinador Eléctrico Nacional” databases
Purpose of data	Calculation of baseline emissions
Additional comment	No additional comments

Data/Parameter	A_i
Data unit	MWh
Description	Generation capacity of the ‘i’ power plant on the margin during hour h
Source of data	“Coordinador Eléctrico Nacional” data
Value(s) applied	Values available in the Emission Factor Calculation spreadsheet
Measurement methods and procedures	Calculation according to AM0026 v.3.0 guidelines, with “Coordinador Eléctrico Nacional” Data
Monitoring frequency	Hourly
QA/QC procedures	An Excel worksheet will be developed to deliver automatic calculations based on “Coordinador Eléctrico Nacional” databases
Purpose of data	Calculation of baseline emissions
Additional comment	No additional comments

Data/Parameter	B_i
Data unit	MWh
Description	Electricity generated by the ‘i’ power plant on the margin during hour h
Source of data	“Coordinador Eléctrico Nacional” data
Value(s) applied	Values available in the Emission Factor Calculation spreadsheet
Measurement methods and procedures	Direct data obtained from “Coordinador Eléctrico Nacional”.
Monitoring frequency	Hourly
QA/QC procedures	Data is obtained from “Coordinador Eléctrico Nacional” databases
Purpose of data	Calculation of baseline emissions
Additional comment	No additional comments

Data/Parameter	C_j
Data unit	MWh
Description	Electricity generated by the ‘j’ CDM power plant during hour h
Source of data	“Coordinador Eléctrico Nacional” data
Value(s) applied	Values available in the Emission Factor Calculation spreadsheet
Measurement methods and procedures	Direct data obtained from “Coordinador Eléctrico Nacional”.
Monitoring frequency	Hourly
QA/QC procedures	Data is obtained from “Coordinador Eléctrico Nacional” databases
Purpose of data	Calculation of baseline emissions
Additional comment	No additional comments

Data/Parameter	N
Data unit	Number
Description	Total number of CDM projects in the system, where N is the first built CDM project and 1 is the last CDM project built in the system
Source of data	“Coordinador Eléctrico Nacional” and UNFCCC registered projects for the country
Value(s) applied	Values available in the Emission Factor Calculation spreadsheet
Measurement methods and procedures	Direct data obtained from “Coordinador Eléctrico Nacional” and UNFCCC
Monitoring frequency	Hourly
QA/QC procedures	Data is obtained from “Coordinador Eléctrico Nacional” and UNFCCC Clean Development Mechanism
Purpose of data	Calculation of baseline emissions
Additional comment	No additional comments

Data/Parameter	SFC_i
Data unit	TJ/MWh
Description	Specific fuel consumption per unit of electric energy produced in the ‘i’ marginal plant
Source of data	CDEC SIC Annual Report and CNE node price report
Value(s) applied	Values in Appendix 4.
Measurement methods and procedures	Values from official sources may be reported in other units, for example m^3/MWh, kg/MWh, or others. As the data unit needed for the calculation is [TJ/MWh], the net calorific value of fossil fuel type ‘i’ in year y (NCVi,y) may be used for unit conversion, if deemed necessary (parameter presented below).
Monitoring frequency	Annually

QA/QC procedures	Annual information is used if available; if not, CNE information is used. For ex-post estimations, the values will be updated in accordance to the latest report available.
Purpose of data	Calculation of baseline emissions
Additional comment	No additional comments

Data/Parameter	***$NCV_{i,y}$***
Data unit	TJ/m^3 for natural gas. TJ/kg for other fuels
Description	Net calorific value of fossil fuel type ‘i’ in year y
Source of data	National Energy Commission Annual Energy Balance Report and IPCC 2006.
Value(s) applied	Values available in the Emission Factor Calculation spreadsheet.
Measurement methods and procedures	The data from the CNE and the IPCC 2006 represent the most recent and reliable information available.
Monitoring frequency	Annually
QA/QC procedures	Official data from CNE and IPCC
Purpose of data	Calculation of baseline emissions
Additional comment	The CNE Energy Balance Report includes Gross Calorific Values for the different fuels, these values were corrected to Net Calorific Values based on the IPCC 2006 assumption that for Diesel, Net Calorific Value is 5% lower than its Gross Calorific Value and for Natural Gas; Net Calorific Value is 10% lower than its Gross Calorific Value.

Data/Parameter	***$CEF_{OM,i}$***
Data unit	tCO_2e/GJ
Description	CO_2 emission factor of fuel used in ‘i’ marginal power plant.
Source of data	IPCC Guidelines 2006.
Value(s) applied	Values in Appendix 4.
Measurement methods and procedures	Estimation of emission factors for different fuel based generation technologies, IPCC guidelines will used in a conservative manner.
Monitoring frequency	Annually reviewed
QA/QC procedures	Official data from IPCC
Purpose of data	Calculation of baseline emissions
Additional comment	No additional comments

Data/Parameter	***$Oxid_i$***
Data unit	%
Description	Fraction of fuel oxidized on combustion
Source of data	IPCC Guidelines 2006.
Value(s) applied	1
Measurement methods and procedures	Estimation of emission factors for different fuel based generation technologies, IPCC guidelines will used in a conservative manner.
Monitoring frequency	Annually reviewed
QA/QC procedures	Official data from IPCC
Purpose of data	Calculation of baseline emissions
Additional comment	No additional comments

Data/Parameter	***EF_y***
Data unit	tCO_2e/MWh
Description	CO_2e Emission factor of the displaced energy from the grid
Source of data	Calculated according to AM0026 v.3.0
Value(s) applied	0.51121

Measurement methods and procedures	Calculated following AM0026 v.3.0 procedures,
Monitoring frequency	Annually
QA/QC procedures	Automatic calculation through a revised worksheet
Purpose of data	Calculation of baseline emissions
Additional comment	No additional comments

B.7.2. Sampling plan

>>
Not applicable

B.7.3. Other elements of monitoring plan

>>
Emission Factor Parameters

The monitoring methodology involves the monitoring of the following:

- Net electricity generated and fed into the grid by the proposed CDM project, and other CDM registered projects (data available at “Coordinador Eléctrico Nacional”).

- Public data on dispatch of electricity and other relevant information from the “Coordinador Eléctrico Nacional”. 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 v.3.0 approved methodology.

The project participant has developed a Management and Operation System Manual in order to establish all the procedures and responsibilities related to the fulfilment of the CDM related issues. This System includes all the procedures related to the monitoring plan, such as the monitoring and verification procedures, in order to assure the proper development of the activities of the monitoring plan.

Electricity delivered to the grid by the project activity

Chacabuquito project has three electricity meters, M1, M2 and M3. The electricity meter M1, which is located between the generation bar and the power transformer, measures the electricity from the four units. The meters M2 and M3 (main meters for the CDM monitoring plan) measure the electricity at the injection point. Figure C.3 illustrates meters distribution for Chacabuquito project activity.

As result, M1 measurements are regularly sent and validated by “Coordinador Eléctrico Nacional” (see Energy Generation Data Capture Procedure section below). These measurements are used as quality assurance procedure for CDM purposes.

It bears mentioning that energy meters are bidirectional and therefore net electricity is monitored.

Net electricity delivered to the grid by the project activity is calculated as the difference between net electricity measurements from M2 and M3 (please refer to the following figure).

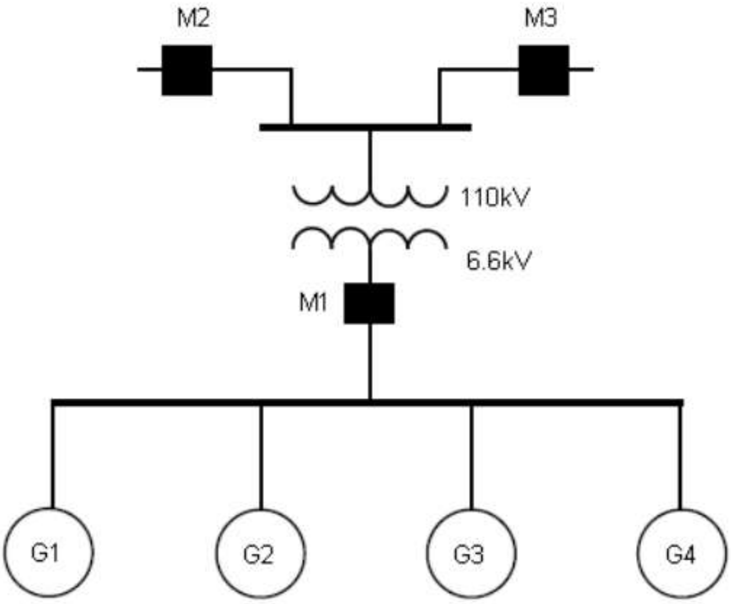

Figure 7. Metering system
Source: Project participant

The operator is responsible for the data acquisition system and its maintenance (measurement equipment, data capture and to send it to the company's personnel). This person also coordinates the dispatch of the power plant with the "Coordinador Eléctrico Nacional" and periodically sends its hourly power generation data.

An automatic data acquisition and measuring equipment management system operates for Chacabuquito power plant, monitoring, capturing and storing the data continuously. Then, the data is downloaded and an excel file is generated, which is sent to the operator. This spreadsheet received by the operator contains generation data acquired by the measuring system every 15 minutes. Once the data is received, it is integrated for calculating the hourly energy generation of the plant as an average of the four measurements taken each 15 minutes for each hour of the year. Finally, the hourly energy generation from M2 and M3 is sent to the Sustainability Department and M1 is sent to the "Coordinador Eléctrico Nacional" as illustrated in the following figure:

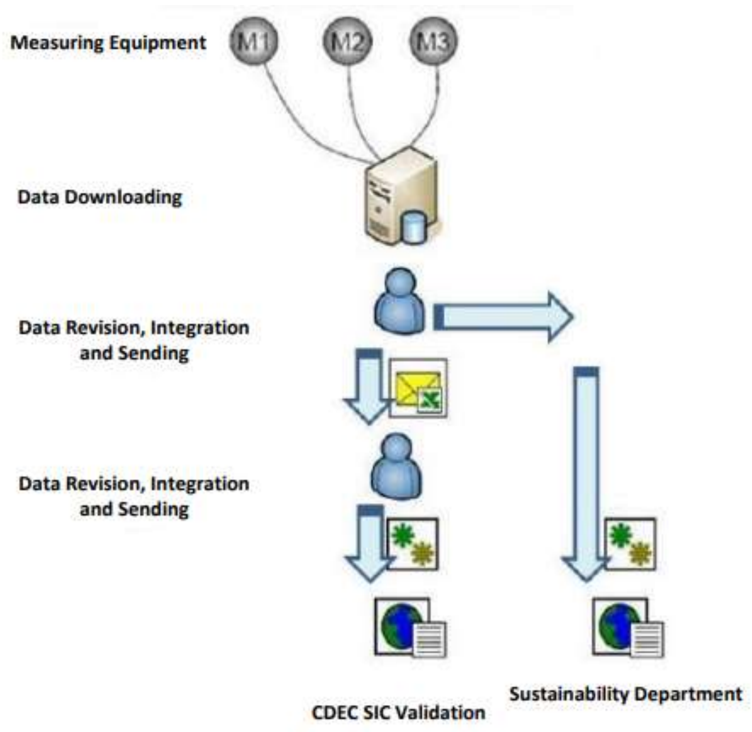

Figure 8. Information flow
Source: Project participant

Emergency procedure

In case of failure of the main electricity meters, the secondary meter measurements are validated by the "Coordinador Eléctrico Nacional" and used for CDM purposes.

Energy Measuring Equipment Periodic Verification Procedure

Equipment verification is performed according to national standards (NCh 2542.Of2001), every two years by qualified and competent certifiers.

Operational and Management structure

The following figures show the General Management, Generation Division and Sustainable Development Division structures, which are responsible of the project management and monitoring procedures declared in the PDD.

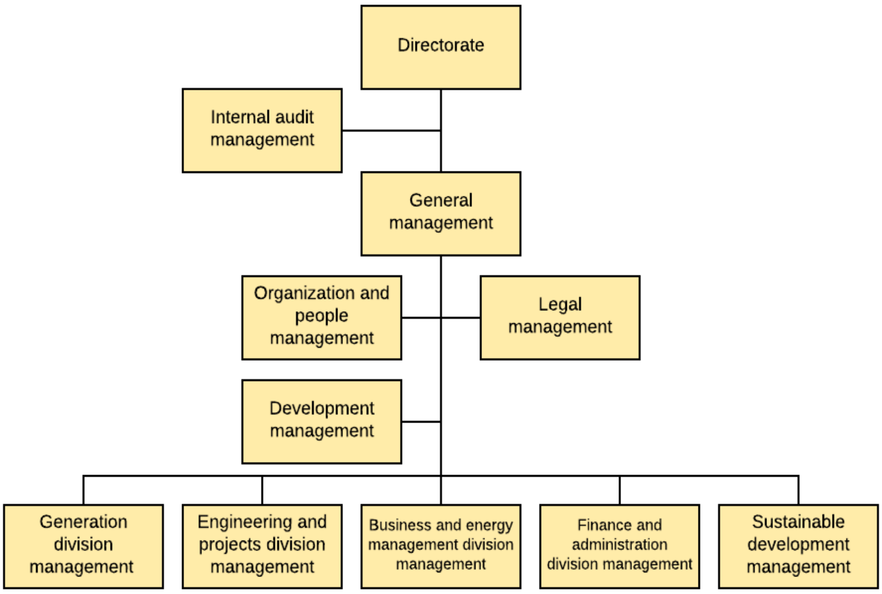

Figure 9. General Management structure
Source: Project participant

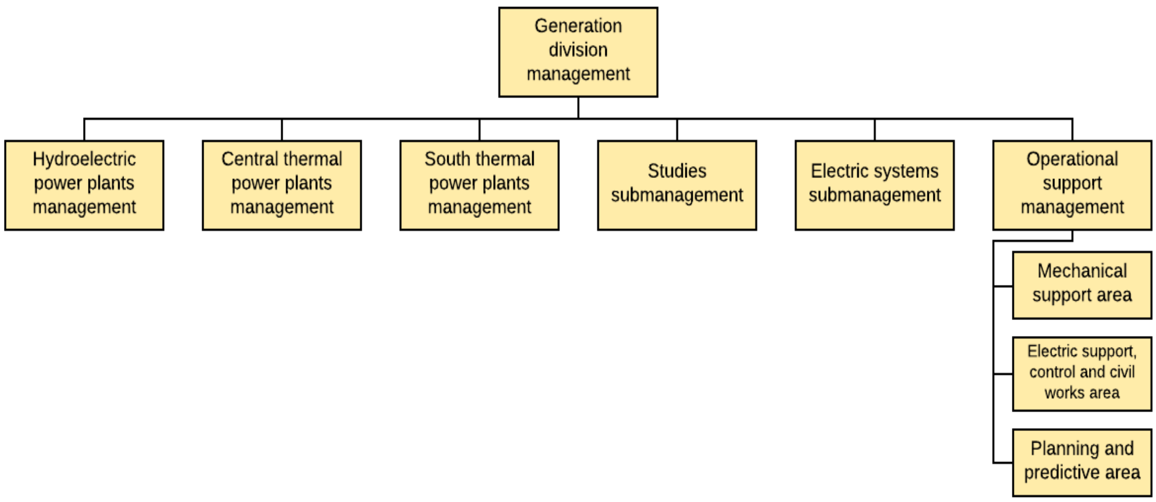

Figure 10. Generation Division structure
Source: Project participant

Figure 11. Sustainable Development Division structure
Source: Project participant

Under this structure CDM related responsibilities are accomplished as follows:

- Internal training:

  I. Trainings related to specific operational procedures such as PO.17. "Verification of energy meters under the carbon market standards" and PO.18. "Data collection from energy meters for carbon market reports", established in the Management and Operation System Manual, and CDM topics are executed by the Innovation and Climate Change department from the Sustainable Development Division.

  II. Operator trainings are performed by a staff which is established by the Power Plant Manager (from the Hydroelectric Power Plants Department - Generation Division).

- Monitoring and record keeping of power generation data (data recording, measurements, etc.): The responsible for monitoring related data to the CER's calculation are the Power Plant Staff (Operations) (from the Generation Division), TI Management (from Finance and Administration Division).

- Generation and maintenance activities: Power plant staff as a part of the Generation Division.

- CER's calculation: This is performed by the Innovation and Climate Change Department (as part of the Sustainable Development Division) and includes accounting for the generation of ERs including monitoring, record keeping, computation of ERs, on site trainings, audits and verifications.

SECTION C. Start date, crediting period type and duration

C.1. Start date of project activity

>>
12/03/2001

C.2. Expected operational lifetime of project activity

>>
30 years and 0 months

C.3. Crediting period of project activity

C.3.1. Type of crediting period

>>
Renewable, third crediting period.

C.3.2. Start date of crediting period

>>
04/11/2018

C.3.3. Duration of crediting period

>>
7 years and 0 months

SECTION D. Environmental impacts

D.1. Analysis of environmental impacts

>>

During December 1994 the Project Participant requested the project approval and authorization to build Chacabuquito run-off-river power plant to the proper authorities. In the approval it is stated that the authorized works construction will not affect the safety of others and will not produce water pollution.

Chilean Law 19.300 of 1994, effective since 1997, established an Environmental Impact Assessment System (SEIA) in the country. This system requires projects to either prepare a full scale Environmental Impact Assessment (EIA) or, for projects with lesser or insignificant impacts, an Environmental Impact Statement (DIA) would be required. Review and clearance of all EIAs or DIAs is a perquisite for an environmental license issued by the National Commission for the Environment (CONAMA)[27].

The implementation of the Chacabuquito power plant was approved in November 1996 and the studies and part of its construction began before the date the Chilean Law 19.300 became effective.

The Project Participant required the national authorities to authorize the construction of the Chacabuquito power plant without being submitted to the SEIA. In October of 2000 it was decided that the Chacabuquito power plant was not obligated to be submitted to the SEIA.

The project considers a number of measures to mitigate environmental impacts during the construction and implementation phases:

- Minimum Ecological Flow: The project commissioned a specific study to analyse and propose minimum ecological flows in that stretch of the Aconcagua River. The DGA established a minimum ecological flow of 3 m^3/s. This minimum flow is considered adequate and any potentially negative impacts on aquatic biodiversity are further minimized by the presence of a major affluent to the Aconcagua downstream from the intake.

- Land Acquisition and Compensation: This processes considered the acquisition of 17.5 hectares along the canal and power house. A private compensation was made for each land owner affected by the project.

- Reforestation Plan: In addition, any tree removed due to construction activity needs to be compensated by adhering to the National Forestry Corporation (CONAF, Corporación Nacional Forestal in Spanish) requirements. A Management Plan for Clearing of Vegetation and Reforestation for the Chacabuquito Project (Plan de Manejo de Corta y Reforestación para Ejecutar Obras Civiles, Proyecto Chacabuquito, June 2005) was approved by CONAF in August 2005, by means of the Resolution N° 1415 (the Plan and the Official resolution are in project files). The Plan requires the reforestation of 18 hectares in an area proposed by the project sponsor, but approved by CONAF together with the Los Andes municipality. The Plan established the protection of riverine vegetation along two streams that cannot be cleared during construction activities. This plan was carried out during 2006 and its maintenance works were made in 2009.

- Environmental Management during Construction: Environmental and social mitigation measures implemented during the construction phase where included in technical specifications in bidding documents and Supervision of the Construction as part of the civil works supervision contract. These specifications considered all construction activities.

D.2. Environmental impact assessment

>>

Chacabuquito Hydroelectric Power Project does not entail any physical construction such as dams and dikes, or cause reservoir-like impoundments on the Aconcagua River or any of its branches.

[27] Please note that, at the time of the project registration this was the valid institutional arrangement. Actually, the Environmental Assessment Service (SEA, Spanish acronym) is the institution in charge.

Low height diversion weirs are placed on the river bed to ensure adequate diversion of water and hydraulic heads during the low flow winter months.

The main negative impact of the Chacabuquito Hydroelectric Power Project relates to the deforestation area due to civil works such as canals and power house. The total area considered for mitigation was 18 hectares. Mitigation measures are considered in the Management Plan for Clearing of Vegetation and Reforestation for the Chacabuquito Project (Plan de Manejo de Corta y Reforestacion para Ejecutar Obras Civiles, Proyecto Chacabuquito), which was approved by the National Forestry Corporation (CONAF) in August 2005 (the Plan and the Official resolution are in project files).

SECTION E. Local stakeholder consultation

E.1. Modalities for local stakeholder consultation

>>

Since Chacabuquito Hydroelectric Power Project is a small project with a minor impact in the area, and did not require a full Environmental Impact Assessment, there was no obligation to carry out a public consultation. Nevertheless, the project sponsors carried out direct consultations with all directly affected people or institutions. Also, the project sponsor actively participated, and still participates, in local community assemblies such as Asociación del Rio Aconcagua, Asociación de Regantes and Corporación de Empresas Pro Aconcagua. Pro Aconcagua is an environmentally focused institution that develops several community projects in the Aconcagua Valley. Many of the comments received by the project sponsors came from these institutions.

E.2. Summary of comments received

>>

Extensive consultation and negotiations have taken place with downstream water users (Asociación de Usuarios del Rio Aconcagua, and Asociación de Regantes) concerning the need for a unified water outlet for irrigation control purposes. An agreement was reached to build a new reservoir downstream the Chacabuquito power plant for irrigation purposes. The project participant covered the cost of construction and maintenance of this reservoir.

Also, individual agreements were reached with each property owner affected by the project. All in all, consultations have been extensive with the owners of the Los Quilos Canal, the downstream farmers, and the affected landowners. The latter consultations resulted in several reroutes for the canals (for example, at entrance to the "Tunnel Chacabuquito").

E.3. Consideration of comments received

>>

Apart from the above comments and negotiations, no major issues were raised that could be related to the environmental or CDM aspect of the project. All comments and questions were duly taken into account by the project developer. The main concern of the community was related to the construction and location of bridges and the Vizcachas downstream irrigation reservoir. All concerns where addressed by the project developer.

SECTION F. Approval and authorization

>>

The letters of approval are available in the following link:
https://cdm.unfccc.int/Projects/DB/DNV-CUK1175238807.52/view?cp=1

Appendix 1. Contact information of project participants

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Fax	47 22 24 95 80
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Website	
Contact person	Erik Bjørnebye (Ambassador/Special Advisor)

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Contact person	Ms. Anne Brunila

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Website	

Contact person	Mr. Hiromichi Yamagata (Manager)

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Appendix 2. Affirmation regarding public funding

There is no public funding

Appendix 3. Applicability of methodologies and standardized baselines

There is no further information on applicability of methodologies or standardized baselines.

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

Operating Margin Emission Factor Calculation

The following table shows the values used for the calculation of the d_i emission factor for OM calculation. Additionally, the hourly calculation for the displacement is shown in the emission factor calculation spreadsheet.

Power Plant@Fuel	SFC_i (kg/MWh o m^3/MWh)	$CEF_{OM,i}$ (tCO_2/GJ)	$Oxid_i$	d_i (tCO_2e/MWh)
Abanico@Run of the River	-	-	0	0.000
Aconcagua UBlanco@Run of the River	-	-	0	0.000
Aconcagua UJuncal@Run of the River	-	-	0	0.000
Alfalfal@Run of the River	-	-	0	0.000
Allipen@Run of the River	-	-	0	0.000

Power Plant@Fuel	SFC_i (kg/MWh o m^3/MWh)	$CEF_{OM,i}$ (tCO_2/GJ)	$Oxid_i$	d_i (tCO_2e/MWh)
Alto Renaico@Run of the River	-	-	0	0.000
Andes@Diesel Oil	241.74	0.0031	1	0.761
Angostura@Dam	-	-	0	0.000
Antilhue TG@Diesel Oil	224.39	0.0031	1	0.706
Antuco@Dam	-	-	0	0.000
Arauco@Biomass	-	-	0	0.000
Auxiliar del Maipo@Run of the River	-	-	0	0.000
Biocruz@Natural Gas	264.00	0.0019	1	0.505
Biomar@Diesel Oil	221.25	0.0031	1	0.696
Bocamina 1@Bituminous Coal	357.20	0.0025	1	0.890
Bocamina 2@Bituminous Coal	322.48	0.0025	1	0.804
Bonito@Run of the River	-	-	0	0.000
Bureo@Run of the River	-	-	0	0.000
Callao@Run of the River	-	-	0	0.000
Calle-Calle@Diesel Oil	221.22	0.0031	1	0.696
Campiche@Petcoke	0.36	0.0023	1	0.001
Candelaria 1@Diesel Oil	262.49	0.0031	1	0.826
Candelaria 1@LNG	31.34	0.0019	1	0.060
Candelaria 1@Natural Gas	-	0.0019	1	0.000
Candelaria 2@Diesel Oil	262.49	0.0031	1	0.826
Candelaria 2@LNG	312.83	0.0019	1	0.598
Candelaria 2@Natural Gas	-	0.0019	1	0.000
Canela 1@Wind	-	-	0	0.000
Canela 2@Wind	-	-	0	0.000
Canutillar@Dam	-	-	0	0.000
Cañete@Diesel Oil	241.60	0.0031	1	0.760
Capullo@Run of the River	-	-	0	0.000
Cardones@Diesel Oil	-	0.0031	1	0.000
Carena@Run of the River	-	-	0	0.000
Carilafquen@Run of the River	-	-	0	0.000
Carrera Pinto@Solar	-	-	0	0.000
Casablanca 1@Diesel Oil	255.02	0.0031	1	0.803
Celco@Biomass	-	-	0	0.000
Cem Bio Bio@Diesel Oil	191.99	0.0031	1	0.604
Cem Bio Bio@Residual Fuel Oil	217.99	0.0032	1	0.687
Cenizas@Diesel Oil	-	0.0031	1	0.000
Chacabuquito@Run of the River	-	-	0	0.000
Chacayes@Run of the River	-	-	0	0.000
Chañares@Solar	-	-	0	0.000
Chiburgo@Run of the River	-	-	0	0.000
Chiloe@Diesel Oil	281.75	0.0031	1	0.887
Cholguan@Biomass	-	-	0	0.000
Chuchiñi@Solar	-	-	0	0.000
Chufken@Diesel Oil	241.60	0.0031	1	0.760
Chuyaca@Diesel Oil	221.87	0.0031	1	0.698

Power Plant@Fuel	SFC_i (kg/MWh o m^3/MWh)	$CEF_{OM,i}$ (tCO_2/GJ)	$Oxid_i$	d_i (tCO_2e/MWh)
Cipreses@Dam	-	-	0	0.000
CMPC Cordillera@Natural Gas	116.38	0.0019	1	0.222
CMPC Laja@Biomass	-	-	0	0.000
CMPC Pacifico@Biomass	-	-	0	0.000
CMPC Santa Fe@Biomass	-	-	0	0.000
CMPC Tissue@Natural Gas	286.33	0.0019	1	0.547
Coelemu@Biomass	-	-	0	0.000
Colbun@Dam	-	-	0	0.000
Colihues@Diesel Oil	214.00	0.0031	1	0.674
Colihues@Residual Fuel Oil	213.92	0.0032	1	0.675
Colmito@Diesel Oil	297.99	0.0031	1	0.938
Colmito@LNG	274.71	0.0019	1	0.525
Concon@Diesel Oil	232.88	0.0031	1	0.733
Conejo@Solar	-	-	0	0.000
Confluencia@Run of the River	-	-	0	0.000
Constitucion@Diesel Oil	281.75	0.0031	1	0.887
Cordillerilla@Solar	-	-	0	0.000
Coronel@Diesel Oil	221.89	0.0031	1	0.698
Coronel@Natural Gas	273.58	0.0019	1	0.523
Coya@Run of the River	-	-	0	0.000
Cuel@Wind	-	-	0	0.000
Cumpeo@Run of the River	-	-	0	0.000
Curacautin@Diesel Oil	220.41	0.0031	1	0.694
Curanilahue@Diesel Oil	229.57	0.0031	1	0.723
Curauma@Diesel Oil	255.02	0.0031	1	0.803
Curillinque@Run of the River	-	-	0	0.000
Danisco@Diesel Oil	217.07	0.0031	1	0.683
Degan@Diesel Oil	218.74	0.0031	1	0.689
Diego de Almagro@Diesel Oil	336.98	0.0031	1	1.061
Diego de Almagro@Solar	-	-	0	0.000
Diuto@Run of the River	-	-	0	0.000
Don Walterio@Run of the River	-	-	0	0.000
Dongo@Run of the River	-	-	0	0.000
Donguil@Run of the River	-	-	0	0.000
Eagon@Diesel Oil	221.25	0.0031	1	0.696
El Agrio@Run of the River	-	-	0	0.000
El Arrayan@Wind	-	-	0	0.000
El Canelo@Run of the River	-	-	0	0.000
El Divisadero@Solar	-	-	0	0.000
El Galpon@Run of the River	-	-	0	0.000
El Llano@Run of the River	-	-	0	0.000
El Manzano@Run of the River	-	-	0	0.000
El Mirador@Run of the River	-	-	0	0.000
El Paso@Run of the River	-	-	0	0.000
El Peñon@Diesel Oil	219.36	0.0031	1	0.690

Power Plant@Fuel	SFC_i (kg/MWh o m^3/MWh)	$CEF_{OM,i}$ (tCO_2/GJ)	$Oxid_i$	d_i (tCO_2e/MWh)
El Pilar-Los Amarillos@Solar	-	-	0	0.000
El Rincon@Run of the River	-	-	0	0.000
El Romero@Solar	-	-	0	0.000
El Salvador@Diesel Oil	336.98	0.0031	1	1.061
El Toro@Dam	-	-	0	0.000
Emelda 1@Diesel Oil	291.98	0.0031	1	0.919
Emelda 2@Diesel Oil	313.97	0.0031	1	0.988
Energia Pacifico@Biomass	-	-	0	0.000
Escuadron@Biomass	-	-	0	0.000
Esperanza 1@Diesel Oil	243.06	0.0031	1	0.765
Esperanza 2@Diesel Oil	233.18	0.0031	1	0.734
Esperanza TG@Diesel Oil	351.39	0.0031	1	1.106
Esperanza@Solar	-	-	0	0.000
Estancilla@Diesel Oil	228.00	0.0031	1	0.718
Eyzaguirre@Run of the River	-	-	0	0.000
Florida@Run of the River	-	-	0	0.000
Guacolda 1@Bituminous Coal	369.60	0.0025	1	0.921
Guacolda 2@Bituminous Coal	370.01	0.0025	1	0.922
Guacolda 3@Bituminous Coal	341.87	0.0025	1	0.852
Guacolda 4@Bituminous Coal	350.50	0.0025	1	0.873
Guacolda 5@Bituminous Coal	347.99	0.0025	1	0.867
Guayacán@Run of the River	-	-	0	0.000
Horcones@Diesel Oil	342.76	0.0031	1	1.079
Horcones@Natural Gas	-	0.0019	1	0.000
Hormiga Solar@Solar	-	-	0	0.000
Hornitos@Run of the River	-	-	0	0.000
Huasco TG@Diesel Oil	347.98	0.0031	1	1.095
Huasco TG@Residual Fuel Oil	361.98	0.0032	1	1.141
Isla@Run of the River	-	-	0	0.000
Itata@Run of the River	-	-	0	0.000
Javiera@Solar	-	-	0	0.000
Juncalito@Run of the River	-	-	0	0.000
La Arena@Run of the River	-	-	0	0.000
La Chapeana@Solar	-	-	0	0.000
La Esperanza@Wind	-	-	0	0.000
La Higuera@Run of the River	-	-	0	0.000
La Paloma@Run of the River	-	-	0	0.000
La Silla@Solar	-	-	0	0.000
Laguna Verde TG@Diesel Oil	-	0.0031	1	0.000
Laguna Verde TV@Diesel Oil	-	0.0031	1	0.000
Lagunilla@Solar	-	-	0	0.000
Laja 1@Run of the River	-	-	0	0.000
Laja@Biomass	-	-	0	0.000
Lalackama 2@Solar	-	-	0	0.000
Lalackama@Solar	-	-	0	0.000

Power Plant@Fuel	SFC_i (kg/MWh o m^3/MWh)	$CEF_{OM,i}$ (tCO_2/GJ)	$Oxid_i$	d_i (tCO_2e/MWh)
Las Araucarias@Solar	-	-	0	0.000
Las Flores@Run of the River	-	-	0	0.000
Las Mollacas@Solar	-	-	0	0.000
Las Pampas@Biomass	-	-	0	0.000
Las Terrazas@Solar	-	-	0	0.000
Las Vegas@Diesel Oil	171.56	0.0031	1	0.540
Las Vertientes@Run of the River	-	-	0	0.000
Lautaro Comasa 1@Biomass	-	-	0	0.000
Lautaro Comasa 2@Biomass	-	-	0	0.000
Lautaro@Biomass	-	-	0	0.000
Lebu@Diesel Oil	241.60	0.0031	1	0.760
Lebu@Wind	-	-	0	0.000
Lican@Run of the River	-	-	0	0.000
Licanten@Biomass	-	-	0	0.000
Linares Norte@Diesel Oil	215.66	0.0031	1	0.679
Lircay@Run of the River	-	-	0	0.000
Llano de Llampos@Solar	-	-	0	0.000
Llauquereo@Run of the River	-	-	0	0.000
Loma Alta@Run of the River	-	-	0	0.000
Loma Los Colorados 1@Biomass	-	-	0	0.000
Loma Los Colorados 2@Biomass	-	-	0	0.000
Loma Los Colorados@Solar	-	-	0	0.000
Lonquimay@Diesel Oil	267.20	0.0031	1	0.841
Los Alamos@Diesel Oil	241.60	0.0031	1	0.760
Los Bajos@Run of the River	-	-	0	0.000
Los Bueno Aires@Wind	-	-	0	0.000
Los Corrales 1@Run of the River	-	-	0	0.000
Los Corrales 2@Run of the River	-	-	0	0.000
Los Cururos@Wind	-	-	0	0.000
Los Espinos@Diesel Oil	221.25	0.0031	1	0.696
Los Guindos@Diesel Oil	243.99	0.0031	1	0.768
Los Hierros 1@Run of the River	-	-	0	0.000
Los Hierros 2@Run of the River	-	-	0	0.000
Los Loros@Solar	-	-	0	0.000
Los Molles@Run of the River	-	-	0	0.000
Los Morros@Run of the River	-	-	0	0.000
Los Padres@Run of the River	-	-	0	0.000
Los Pinos@Diesel Oil	185.95	0.0031	1	0.585
Los Quilos@Run of the River	-	-	0	0.000
Los Vientos TG@Diesel Oil	266.99	0.0031	1	0.840
Louisiana Pacific@Diesel Oil	225.42	0.0031	1	0.709
Luna@Solar	-	-	0	0.000
Luz del Norte@Solar	-	-	0	0.000
Machicura@Dam	-	-	0	0.000
Maisan@Run of the River	-	-	0	0.000

Power Plant@Fuel	SFC_i (kg/MWh o m^3/MWh)	$CEF_{OM,i}$ (tCO_2/GJ)	$Oxid_i$	d_i (tCO_2e/MWh)
Maitenes@Run of the River	-	-	0	0.000
Malalcahuello@Run of the River	-	-	0	0.000
Mallarauco@Run of the River	-	-	0	0.000
Mampil@Run of the River	-	-	0	0.000
María Elena@Run of the River	-	-	0	0.000
Mariposas@Run of the River	-	-	0	0.000
Masisa@Biomass	-	-	0	0.000
Maule@Diesel Oil	281.75	0.0031	1	0.887
Molinera Villarica@Run of the River	-	-	0	0.000
Monte Redondo@Wind	-	-	0	0.000
Muchi@Run of the River	-	-	0	0.000
Multiexport 1@Diesel Oil	221.25	0.0031	1	0.696
Multiexport 2@Diesel Oil	221.25	0.0031	1	0.696
Munilque 1@Run of the River	-	-	0	0.000
Munilque 2@Run of the River	-	-	0	0.000
Nalcas@Run of the River	-	-	0	0.000
Nehuenco 1@Diesel Oil	152.52	0.0031	1	0.480
Nehuenco 1@LNG	193.55	0.0019	1	0.370
Nehuenco 1@Natural Gas	-	0.0019	1	0.000
Nehuenco 2@Diesel Oil	152.16	0.0031	1	0.479
Nehuenco 2@LNG	177.58	0.0019	1	0.339
Nehuenco 2@Natural Gas	-	0.0019	1	0.000
Nehuenco 9B@Diesel Oil	264.70	0.0031	1	0.833
Nehuenco 9B@LNG	312.64	0.0019	1	0.598
Nehuenco 9B@Natural Gas	-	0.0019	1	0.000
Newen@Butane/Propane	-	0.0030	1	0.000
Newen@Diesel Oil	283.74	0.0031	1	0.893
Newen@Natural Gas	326.54	0.0019	1	0.624
Newen@Propane Gas	240.86	0.0030	1	0.676
Nueva Aldea 1@Biomass	-	-	0	0.000
Nueva Aldea 2@Diesel Oil	282.90	0.0031	1	0.890
Nueva Aldea 3@Biomass	-	-	0	0.000
Nueva Renca@Diesel Oil	166.90	0.0031	1	0.525
Nueva Renca@LNG	197.27	0.0019	1	0.377
Nueva Renca@LPG	192.27	0.0030	1	0.540
Nueva Renca@Natural Gas	-	0.0019	1	0.000
Nueva Ventanas@Bituminous Coal	347.85	0.0025	1	0.867
Ojos de Agua@Run of the River	-	-	0	0.000
Olivos@Diesel Oil	231.00	0.0031	1	0.727
Palmucho@Run of the River	-	-	0	0.000
Pampa Solar Norte@Solar	-	-	0	0.000
Pangue@Dam	-	-	0	0.000
Pehuenche@Dam	-	-	0	0.000
Pehui@Run of the River	-	-	0	0.000
Petropower@Petcoke	377.86	0.0023	1	0.872

Power Plant@Fuel	SFC_i (kg/MWh o m^3/MWh)	$CEF_{OM,i}$ (tCO_2/GJ)	$Oxid_i$	d_i (tCO_2e/MWh)
Peuchen@Run of the River	-	-	0	0.000
Pichilonco@Run of the River	-	-	0	0.000
Picoiquén@Run of the River	-	-	0	0.000
Pilmaiquen@Run of the River	-	-	0	0.000
Placilla@Diesel Oil	227.96	0.0031	1	0.718
Providencia@Run of the River	-	-	0	0.000
PSF Lomas Coloradas@Solar	-	-	0	0.000
PSF Pama@Solar	-	-	0	0.000
Puclaro@Run of the River	-	-	0	0.000
Pulelfu@Run of the River	-	-	0	0.000
Pullinque@Run of the River	-	-	0	0.000
Punta Colorada@Diesel Oil	190.96	0.0031	1	0.601
Punta Colorada@Residual Fuel Oil	218.95	0.0032	1	0.690
Punta Colorada@Wind	-	-	0	0.000
Punta Palmeras@Wind	-	-	0	0.000
Puntilla@Run of the River	-	-	0	0.000
Purisima@Run of the River	-	-	0	0.000
PV Salvador@Solar	-	-	0	0.000
Quellon 2@Diesel Oil	238.00	0.0031	1	0.749
Queltehues@Run of the River	-	-	0	0.000
Quilapilún@Solar	-	-	0	0.000
Quillaileo@Run of the River	-	-	0	0.000
Quilleco@Run of the River	-	-	0	0.000
Quintay@Diesel Oil	227.96	0.0031	1	0.718
Quintero 1@Diesel Oil	-	0.0031	1	0.000
Quintero 1@LNG	315.24	0.0019	1	0.603
Quintero 2@Diesel Oil	-	0.0031	1	0.000
Quintero 2@LNG	315.24	0.0019	1	0.603
Raki@Wind	-	-	0	0.000
Ralco@Dam	-	-	0	0.000
Rapel@Dam	-	-	0	0.000
Reca@Run of the River	-	-	0	0.000
Renaico@Run of the River	-	-	0	0.000
Renaico@Wind	-	-	0	0.000
Renca@Diesel Oil	-	0.0031	1	0.000
Rio Huasco@Run of the River	-	-	0	0.000
Rio Mulchen@Run of the River	-	-	0	0.000
Robleria@Run of the River	-	-	0	0.000
Rucatayo@Dam	-	-	0	0.000
Rucue@Run of the River	-	-	0	0.000
San Andres@Run of the River	-	-	0	0.000
San Andres@Solar	-	-	0	0.000
San Clemente@Run of the River	-	-	0	0.000
San Gregorio@Diesel Oil	215.66	0.0031	1	0.679
San Ignacio@Run of the River	-	-	0	0.000

Power Plant@Fuel	SFC_i (kg/MWh o m^3/MWh)	$CEF_{OM,i}$ (tCO_2/GJ)	$Oxid_i$	d_i (tCO_2e/MWh)
San Isidro 1@Diesel Oil	179.26	0.0031	1	0.564
San Isidro 1@LNG	196.91	0.0019	1	0.376
San Isidro 1@Natural Gas	-	0.0019	1	0.000
San Isidro 2@Diesel Oil	165.08	0.0031	1	0.520
San Isidro 2@LNG	178.09	0.0019	1	0.340
San Isidro 2@Natural Gas	-	0.0019	1	0.000
San Juan@Wind	-	-	0	0.000
San Lorenzo 1@Diesel Oil	341.99	0.0031	1	1.076
San Lorenzo 2@Diesel Oil	-	0.0031	1	0.000
San Lorenzo 3@Diesel Oil	288.99	0.0031	1	0.910
San Pedro II@Wind	-	-	0	0.000
San Pedro@Wind	-	-	0	0.000
Santa Cecilia@Solar	-	-	0	0.000
Santa Fe@Biomass	-	-	0	0.000
Santa Irene@Biomass	-	-	0	0.000
Santa Julia@Solar	-	-	0	0.000
Santa Lidia@Diesel Oil	263.97	0.0031	1	0.831
Santa Maria@Bituminous Coal	325.35	0.0025	1	0.811
Santa Marta@Biomass	-	-	0	0.000
Sauce Andes@Run of the River	-	-	0	0.000
Sauzal 50Hz@Run of the River	-	-	0	0.000
Sauzal 60Hz@Run of the River	-	-	0	0.000
Sauzalito@Run of the River	-	-	0	0.000
SDGx01@Solar	-	-	0	0.000
Skretting@Diesel Oil	221.25	0.0031	1	0.696
Sol@Solar	-	-	0	0.000
Southern@Diesel Oil	217.07	0.0031	1	0.683
Tal Tal 1@Diesel Oil	253.49	0.0031	1	0.798
Tal Tal 1@LNG	302.39	0.0019	1	0.578
Tal Tal 1@Natural Gas	302.39	0.0019	1	0.578
Tal Tal 2@Diesel Oil	253.49	0.0031	1	0.798
Tal Tal 2@LNG	302.39	0.0019	1	0.578
Tal Tal 2@Natural Gas	-	0.0019	1	0.000
Talinay Poniente@Wind	-	-	0	0.000
Talinay@Wind	-	-	0	0.000
Taltal@Wind	-	-	0	0.000
Tambo Real@Solar	-	-	0	0.000
Tamm@Biomass	-	-	0	0.000
Tapihue@Natural Gas	296.49	0.0019	1	0.567
Techos de Altamira@Solar	-	-	0	0.000
Teno@Diesel Oil	219.30	0.0031	1	0.690
Termopacifico@Diesel Oil	224.99	0.0031	1	0.708
Til Til@Solar	-	-	0	0.000
Tirua@Diesel Oil	267.20	0.0031	1	0.841
Tomaval@Diesel Oil	262.00	0.0031	1	0.825

Power Plant@Fuel	SFC_i (kg/MWh o m^3/MWh)	$CEF_{OM,i}$ (tCO_2/GJ)	$Oxid_i$	d_i (tCO_2e/MWh)
Totoral@Diesel Oil	232.13	0.0031	1	0.731
Totoral@Wind	-	-	0	0.000
Trailelfu@Run of the River	-	-	0	0.000
Tranquil@Run of the River	-	-	0	0.000
Trapen@Diesel Oil	219.30	0.0031	1	0.690
Trebal Mapocho@Biomass	-	-	0	0.000
Trueno@Run of the River	-	-	0	0.000
Truful Truful@Run of the River	-	-	0	0.000
Ucuquer 2@Wind	-	-	0	0.000
Ucuquer@Wind	-	-	0	0.000
Valdivia@Biomass	-	-	0	0.000
Valdivia@Residual Fuel Oil	320.00	0.0032	1	1.009
Ventanas 1@Bituminous Coal	394.62	0.0025	1	0.983
Ventanas 2@Bituminous Coal	376.36	0.0025	1	0.938
Viñales@Biomass	-	-	0	0.000
Volcan@Run of the River	-	-	0	0.000
Yungay 1@Diesel Oil	280.00	0.0031	1	0.881
Yungay 1@Natural Gas	-	0.0019	1	0.000
Yungay 2@Diesel Oil	252.00	0.0031	1	0.793
Yungay 2@Natural Gas	-	0.0019	1	0.000
Yungay 3@Diesel Oil	274.00	0.0031	1	0.862
Yungay 3@Natural Gas	-	0.0019	1	0.000
Yungay 4@Diesel Oil	296.99	0.0031	1	0.935

Appendix 5. Further background information on monitoring plan

All relevant information is provided in the PDD.

Appendix 6. Summary report of comments received from local stakeholders

All data regarding stakeholders comments is presented in the respective section.

Appendix 7. Summary of post-registration changes

The PDD for the first crediting period has a post-registration change related to the assessment of the additionality, which was approved on 18th of March 2011. During the first verification process it was identified that the additionality assessment in the registered PDD was based on the maximum permissible capacity, 26 MW, and was not based on the installed capacity of the power plant[28], thus the additionality was conservatively reassessed based on the nominal capacity of the power plant. Specifically, the revised PDD reassessed the additionality in two cases: a) the nominal installed capacity of the generators, 28.872 MW, and b) the installed capacity of the turbines, 30 MW (technically the effective capacity is limited to the capacity of the generators). All the

[28] Chacabuquito Hydroelectric Power Plant cannot produce more than 26 MW due to physical constrains in the water intake civil works, which allow a maximum inflow of 21.5 m^3/s.

information and supporting documents provided in the revised PDD were validated by the DOE and finally this change in the PDD was approved by the Executive Board in March 2011.

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Document information

Version	*Date*	*Description*
10.1	28 June 2017	Revision to make editorial improvement.
10.0	7 June 2017	Revision to: • Improve consistency with the “CDM project standard for project activities” and with the PoA-DD and CPA-DD forms; • Make editorial improvement.
09.0	24 May 2017	Revision to: • Ensure consistency with the “CDM project standard for project activities” (CDM-EB93-A04-STAN) (version 01.0); • Incorporate the “Project design document form for small-scale CDM project activities” (CDM-SSC-PDD-FORM); • Make editorial improvement.
08.0	22 July 2016	EB 90, Annex 1 Revision to include provisions related to automatically additional project activities.
07.0	15 April 2016	Revision to ensure consistency with the “Standard: Applicability of sectoral scopes” (CDM-EB88-A04-STAN) (version 01.0).
06.0	9 March 2015	Revision to: • Include provisions related to statement on erroneous inclusion of a CPA; • Include provisions related to delayed submission of a monitoring plan; • Provisions related to local stakeholder consultation; • Provisions related to the Host Party; • Make editorial improvement.
05.0	25 June 2014	Revision to: • Include the Attachment: Instructions for filling out the project design document form for CDM project activities (these instructions supersede the "Guidelines for completing the project design document form" (Version 01.0)); • Include provisions related to standardized baselines; • Add contact information on a responsible person(s)/ entity(ies) for the application of the methodology (ies) to the project activity in B.7.4 and Appendix 1; • Change the reference number from F-CDM-PDD to CDM-PDD-FORM; • Make editorial improvement.
04.1	11 April 2012	Editorial revision to change version 02 line in history box from Annex 06 to Annex 06b.
04.0	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).

Version	*Date*	*Description*
03.0	26 July 2006	EB 25, Annex 15
02.0	14 June 2004	EB 14, Annex 06b
01.0	03 August 2002	EB 05, Paragraph 12 Initial adoption.

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