VCS CLAIM

EMISSION REDUCTION MONITORING REPORT

CHILE: HORNITOS HYDROELECTRIC PROJECT

CDM registration number: 1374

Sponsor: Colbún S.A.

Monitoring Period: From 10/01/2008 to 08/7/2008

Consultant: Poch Ambiental S.A.

Version 6
16/11/2010

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1. PROJECT BACKGROUND

The objective of this verification is to claim Voluntary Carbon Units (VCUs) generated from the project operating start date to the CDM registration date; known as pre-registration VCUs.

The Hornitos Hydroelectric project has been registered as a CDM project by the UNFCCC since July 9th, 2008. The following table shows the summary of the project:

Table 1: Project background

CDM PROJECT DATA	
Project Name	Chile: Hornitos Hydroelectric Project
Registration CDM N°	1374
Registration Date	09th Jul. 08
Crediting Period	09th Jul. 08 – 08th Jul. 15 (Renewable)
Sectoral scope	Scope 1: Energy Industries (renewable/non-renewable sources)
Activity scale	Large
Methodology used	AM0026 ver. 2 – Methodology for zero-emissions grid-connected electricity generation from renewable sources in Chile or in countrieswith merit order based dispatch grid
Project participants	-Colbún S.A. in name of Hidroeléctrica Guardia Vieja S.A. -International Bank for Reconstruction and Development (IBRD) as Trustee of the Netherlands Clean Development Mechanism Facility (NCDMF)
Ex-ante average annual ER estimation	110,160 tonnes of CO_2
Project boundary	Chile, Central Interconnected System (SIC)
PROJECT DESCRIPTION	
Installed Capacity	55 MW
Average annual energy generation	270 GWh per year
Project Location	The Hornitos Hydroelectric Project is located near Los Andes city. This is approximately 100 km northeast from Santiago, Chile.
Project Activity	The Hornitos Hydroelectric Project consists of a run-of-river power plant of 55 MW that uses water of the Aconcagua river. It produces an average annual generation of 270 GWh. The project connects to the 5th Region's at a 220/110 KV sub-system within the Central Interconnected

	System (SIC) and energy is delivered to industrial and residential consumers in the area.
Technology used	The project uses well-proven technologies for run-of-river power generation. The design consists of a Pelton vertical turbine power generator of 55 MW capacity that uses the waters of the Juncal and Juncalillo rivers, both tributary of the Aconcagua River, a system of channels and tunnels (12.1 km), a penstock and a powerhouse with one vertical pelton turbine-generator. The project construction costs are about US$ 62.8 million including 5% contingencies but without financing charges. Of this, US$ 56.7 million corresponds to the civil works and related equipment costs and US$ 6.1 million is required for the expansion of the current 220KV transmission lines.
VCS PROJECT STATUS	
Commissioning date	10th January 2008
Energy generation from 10/01/2008 to 8/07/2008	125,139.63 MWh
Build Margin option (i)	0.38551 tonCO_2/MWh (calculated ex-post for year 2008)
Build Margin option (ii)	0.50317 tonCO_2/MWh (calculated ex-post for year 2008)
Operating Margin	0.67452 ton CO_2/ MWh (calculated ex-post for year 2008)
Combined Margin	0.53002 ton CO_{2e}/ MWh
Generated ERs from 10/01/2008 to 08/07/2008	66,318 tonnes of CO_2
SUSTAINABLE DEVELOPMENT PERFORMANCE	
Use of renewable energy resources 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.	

Further background on this project can be found in the PDD and associated documents, which are available on the UNFCCC website:

http://cdm.unfccc.int/Projects/DB/DNV-CUK1191820137.74/view

2. MONITORING METHODOLOGY

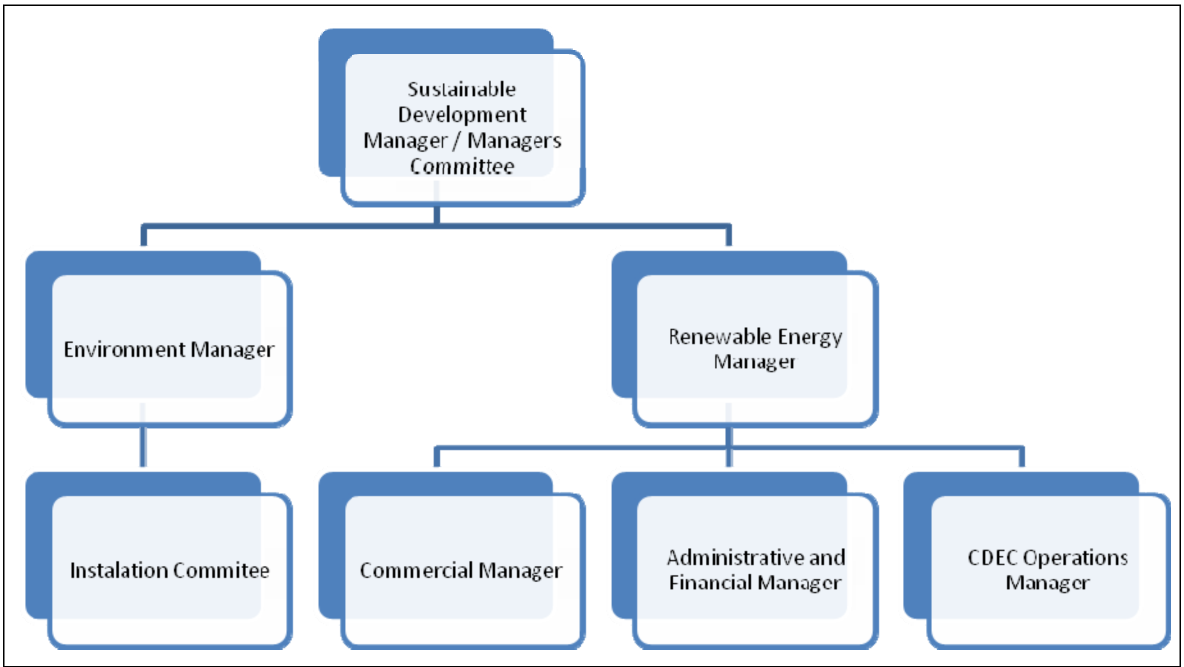
2.1 Responsibilities concerning CDM

During year 2005, Colbún S.A. merged with Hidroeléctrica Cenelca S.A., including the assets that belonged to this company, which considered the set of hydroelectric power plants owned by Hidroeléctrica Guardia Vieja S.A.

Consequently, the administration, operation, maintenance, commercial aspects and environmental management of the Hornitos Power Plant is currently conducted by Colbún S.A.

In order to fulfil the commitments established in the Hornitos Project Design Document, and the Emission Reduction Purchase Agreement, Colbún S.A. has the following CDM functional management structure:

Figure 1: CDM responsibilities structure



The fulfillment of the CDM responsibilities are detailed in the MGI.01 table: "Structure and responsibilities" of the Integrated Management System Handbook of Colbún. It is established that the Managers Committe must ensure the fulfillment of the CDM responsibilities of the company. Likewise, the Installation Commitee must ensure the fulfillment of the CDM commitment of the installation.

Furthermore, under the structure shown above, specific responsibilities are settled. The Commercial Manager is responsible of gathering the generation of the project activity and gathering the necessary data for the $EF_{OM,y}$ and $EF_{BM,y}$ calculation. The Renewable Energy Manager is responsible of reviewing and approving the calculation of the emission reduction of the project, to coordinate external audits, to issue the monitoring reports and relationship with CERs buyers. The Administrative and Financial Manager is responsible of the sale invoicing of CERS. The CDEC Operation Manager and the Commercial Manager will be responsible of the cross checking of the sources of $Generation_h$.

2.2 Monitoring system

The list of equipments used in the project activity is included in the following table:

Table 2: List of equipment

Equipment	Specifications
Meter	• Meter ION 7650 • Type: 0.2 • Voltage: 0.1% • Frequency: 0.005 HZ
Turbine	• Type: Pelton Turbine vertical axis • Hnet: 555.22 m • Q: 11 m3/seg • Pnom: 55.02 MW • Rotation velocity: 500 min-1 • Manufacturer: VaTech Hydro
Generator	• Sincrone triphasic generator • Year: 2006 • Type: Ssv 355/12-210 • Serial Nº: 1.660008 • Nnom: 59.8 MVA • Vnom: 11 kV • Current: 3138.7 A • Power Factornom : 0.9 • Frequencynom: 50 HZ • Nominal velocity: 500 rpm • Phases: 3 • Manufacturer: VaTech Hydro
Transformer	• Triphasic transformer • Frequency: 50 Hz • Manufacturing year: 2006 • Number: 89491
Diesel generating set	• Manufacturing year: 2007 • Installation year: 2007 • Model: V500 KVA • Internal Nº: 001 hor • Vent diameter: 12.7 cm • Vent height: 16 mt • Manufacturer: Lureye

The monitoring system of Hornitos power plant begins with the metering and data capture and ends with the transfer of the data every two hours to the CDEC-SIC. The procedure of capture and data transfer is described in detail in the file "MVP-PMED-01". In Hornitos Power Plant there is one meter, but there are two different methods to capture data which are described below.

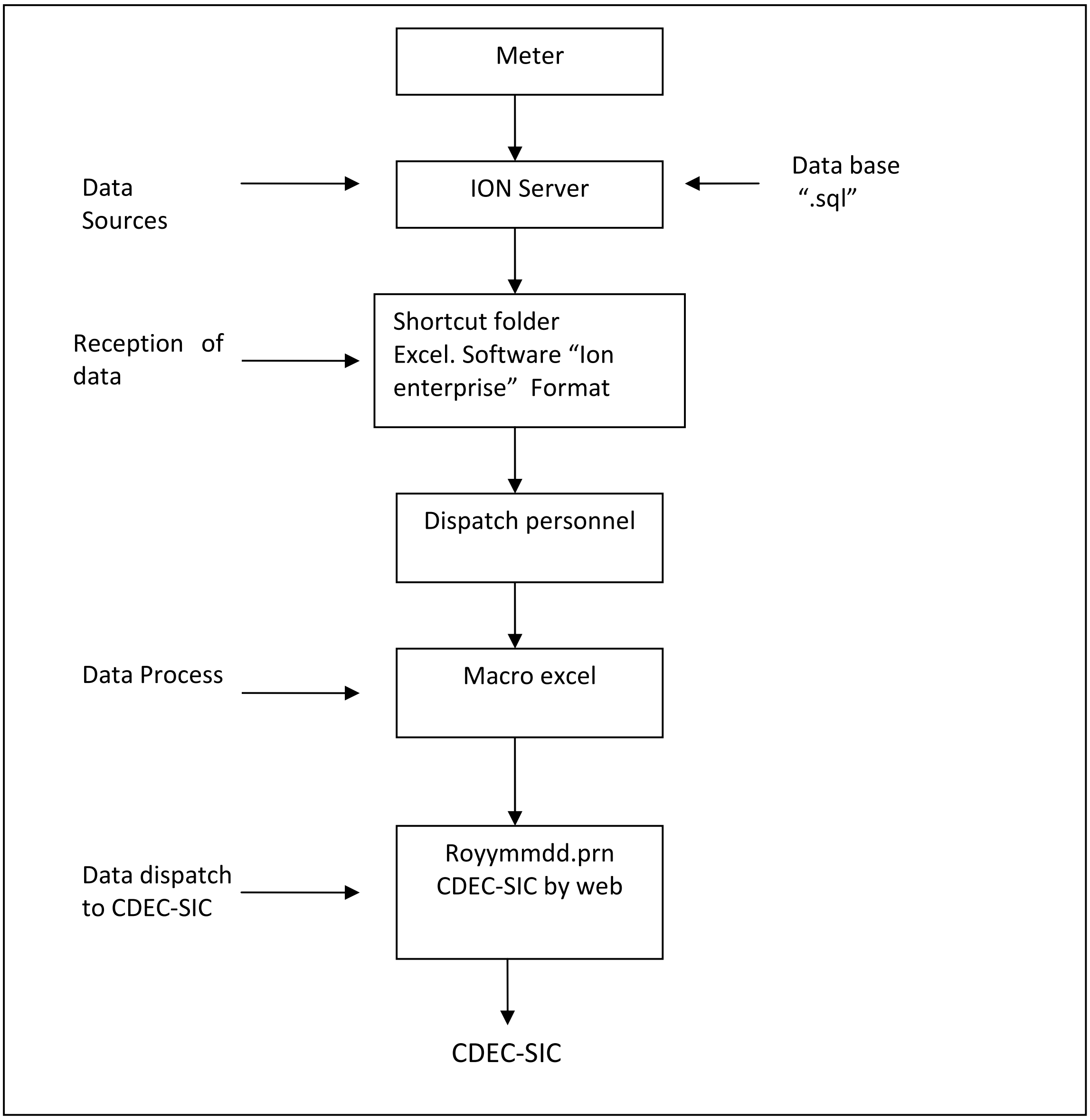
Route 1

The generation data is downloaded automatically from the meter. Data are obtained through an automatic system called ION Reporter. The download frequency is every 15 minutes and the generation report is uploaded every two hours to CDEC-SIC.

The data information is saved in the dispatch personnel's computer, in a folder, which contains the daily reports. The reports are saved every two hours in an Excel spreadsheet generation data every 15 minutes. The files are named "archivoDDMMYY.xls".

To determine the hourly generation, the dispatch personnel creates an Excel Macro MS which determines the hourly measurement of Hornitos as an average of the four pulses that the meter sends by hour.

Once the hourly generation is obtained, it is transferred by accessing web page to CDEC-SIC (www.cdec-sic.c/ro/). Only entities registered can use this page and requires authentication managed by the dispatch personnel.



The four pulses of energy coming through the meter have 11 significant figures. For calculation purposes only one significant figure will be used, which is equivalent with the values published by CDEC-SIC.

<u>Route 2</u>

In case of failure of the database server, the meter can be interrogated directly by the Ethetnet network via network or locally by serial port using the software ION setup. The meter can store the information for 35 days long.

2.2.1 Data validation and cross check

The validation of Hornitos power plant electricity generation, described in the MVP-PMED-01 procedure, is done with the metering equipments in the transmission lines of the "Los Maquis" sub-station, which allow a redundant metering of the generation of Hornitos power plant.

2.2.2 Meter Verification

The meter shall be verified sporadically as specified in the "Periodical verification of the energy meters in the Hornitos power plant procedure MVP–PMED-02".

The verification shall be performed once a year by a qualified and competent certifier, authorized by the national official organism (Electricity and Fuels Superintendent, SEC for its Spanish acronym).

The verification procedure consists in comparing the measurement equipment with a higher precision reference meter, in order to certify the meter precision. A single verification certificate is then issued for each meter. If the equipment does not fulfill the Class 0.2, it will be immediately replaced.

For the verification of the energy measuring equipments, the Chilean Official Regulation NCh 2542.Of2001 "Alternating Current Watt-Meter for Active Energy (Classes 0.2 S and 0.5 S)" will be applied. The elaboration of the NCh 2542 considered the international norm IEC 60687 "Alternating Current Watt-Meter for Active Energy (Classes 0.2 S and 0.5 S)" in addition to others like NCh 2024/1 and IEC 61036.

For the period of this monitoring process, the verifications were made in the following dates and are attached in the file "Certificados de exactitud y actas de intervencion medidores":

- June 20th, 2007 by Tecnored S.A.
- July 6th, 2007 by Tecnored S.A.
- October 14th, 2008 by Cam.

2.2.3 Changes in the regulatory framework that could affect the methodology

The CDEC-SIC has manuals in order to establish the correct functioning and regulation of the national electric system. The first manual called "Manual de procedimientos de facturación en el CDEC-SIC" and the second called "Manual de procedimientos para los sistemas de medición y sistemas de supervisión en el CDEC-SIC". The last update of these manuals was May 2006; therefore there are no modifications in the regulatory framework.

Colbún S.A. has addressed the changes in the regulatory framework that could affect the methodology within the Integrated Management System. Each power plant records the applicable legal requirements. The legal updates are made by an external company.

2.2.4 Events occurred during the Monitoring Period

The energy generation depends on natural flow in the river. From April to September, water is accumulated in a regulation tank for energy generation during peak hours.

The events occurred during the monitoring period are the following:

Table 3: Events ocurred during the monitoring period

From		to		Cause
Day	Hour	Day	Hour	
16.01.2008	12:00	16.01.2008	19:00	Testing, plant not functioning
17.01.2008	7:00	17.01.2008	8:00	Testing, plant not functioning
18.01.2008	11:00	18.01.2008	12:00	Testing, plant not functioning
27.03.2008	23:00	28.03.2008	5:00	Programmed disconnection, under maintenance

In addition, measurements carried out since the starting date of the hydro power plant revealed differences in terms of power plant capacity according to operating conditions originally described in the registered PDD. The Hornitos Project is currently operating with a power plant capacity of 60 MW, which represents an increase of 5 MW with respect to the information included in the PDD (55 MW with a design adduction capacity of 12.1 (m^3/s)).

The increase of power plant capacity from 55 MW (PDD) to 60 MW is explained mainly by the better technical characteristics and efficiency of the as-built power plant. The manufacturer (Andritz Hydro) certifies that the Hornitos power plant was designed with a power capacity of 55 MW plus a 10 % of permanent overload, thus 60.5 MW.

2.3 Calculation methodology

The Central Interconnected System (SIC) is coordinated by an independent entity called Load Economic Dispatch Centre (CDEC-SIC). The CDEC-SIC is responsible for optimal operation of the system based on the principle of lowest marginal costs.

The outcome is the hourly dispatch program and marginal cost for each power unit. The CDEC must coordinate in real time the dispatch at minimum cost of the power units according to the weekly programs. The weekly priority program Excel sheet contains a daily dispatch program which has three hour blocks: from hour 0 to 8, from 9 to 18, and from 19 to 24.

The CDEC-SIC publishes daily reports of the actual operation of the SIC, including the hourly generation for each power unit. The information required is provided by CDEC-SIC and is available publicly through its website at a subscription fee.

In addition, CDEC-SIC publishes an Annual Report with fuel consumption of the mayor power units. On the other hand, the National Energy Commission (CNE) publishes every six months the Node price report with the specific consumption of fuel of most of the power units and the indicative expansion plan of the system. The information is publicly available at www.cne.cl. Both sources are used for specific fuel consumption parameter.

Project emission reductions are calculated as a combined margin emission factor (CM), consisting of the weighted average of an operating margin (OM) and a Build Margin (BM), following AM0026 (v.2) approved methodology.

The OM emission factor from the project activity depends on the actual generation data from the SIC. The dispatch data, obtained from the Economic Dispatch Center (CDEC-SIC), conclusively indicates the type of generation displaced by the addition of Hornitos in the generation mix in the SIC. The monitoring and verification plan for the project uses the data provided by CDEC-SIC.

The BM emission factor is determined as option (i) and (ii) in AM0026 v2. If the value of the EF_{BM} estimated using option (i) is lower by more than 20% than the value of EFBM estimated using option (ii) method, then the value of EFBM estimated using option (i) should be used for estimating the grid electricity emission factor.

The calculation of the project emissions reductions requires gathering and analyzing a considerable quantity of data primarily for the estimation of the emission factor.

The amount of data to be analyzed and processed and the procedures to be followed do not allow the estimation of the Emission Factor to be simple and expedite. In order to make the emissions reduction estimation procedures accessible and efficient, the Project Participant has programmed a Mathematical Tool for the Emissions Factor Calculation in Microsoft Office Access. This Mathematical Tool permits qualified personnel to conduct ex-ante and ex-post emissions factor estimations based on available data.

In general terms, the procedure executed by the Emission Factor Calculation Mathematical Tool consider the following stages:

1. Data Acquisition
2. Operational Margin Emission Factor Calculation
3. Building Margin Emission Factor Calculation
4. Combined Margin Emission Factor Calculation

The first stage consists on gathering the required information for the emissions factor estimation. The data to be gathered for every period is the energy generated and general data of all power plants of the system, the priority of the dispatch, data related to fuel consumption and the information associated to the different fossil fuels being used. This information has to be uploaded in the Mathematical Tool and its sources verified prior to its use.

The second, third and four stage of the estimation use the information previously uploaded, following the estimation procedures stated in the approved baseline and monitoring methodology AM0026 v2.

The Mathematical Tool counts with an audit mode, which allows the Designated Operational Entity to access and verify the assumptions, calculations and procedures.

Finally, and using the Mathematical Tool, the emissions reductions associated to the operation of the project activity can be calculated.

The following steps represent a description of the emissions reduction estimation associated to the project, which are applied in the Mathematical Tool with Microsoft Office Access.

Step 1) Operating Margin Emission Factor ($EF_{OM,y}$):

The operating margin emission factor is calculated as follows:

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

Where,

EFj,h	Operating margin Emission factor for proposed CDM project ‘j’ for hour ‘h’, expressed in tCO2/MWh,
Generationj,h	Generation of proposed CDM project ‘j’ during hour ‘h’, expressed in MWh,
H	Total number of hours of the year ‘y’.

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

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

Where,

D(j,i)	Energy displacement of the marginal plant 'i' due to the proposed CDM project 'j', expressed in MWh,
Di	Emission factor of the marginal plant 'i', expressed in tCO2/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:

$$\sum_{j=1}^{N} C_j \leq \sum_{i=1}^{M} \left(A_i - B_i\right)$$ **(f3)**

Where,

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

The difference (Ai – Bi) represents the maximum possible additional electric energy that can be supplied by the ith marginal plant.

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

$$D(j,i) = MIN\left\{C_j - \sum_{l=1}^{i-1} D(j,l); (A_i - B_i) - \sum_{k=j+1}^{N} D(k,i)\right\}$$ **(f4)**

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. $\sum_{i=1}^{m^*} (A_i - B_i) > \sum_{k=j+1}^{N} C_k + C_j$

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

$$d_i = SFC_i \bullet CEF_{OM,i} \bullet Oxid_i \qquad \textbf{(f5)}$$

Where,

SFC_i	Is the specific fuel consumption of ith marginal power plant, expressed as (ton of fuel or TJ)/MWh,
$CEF_{OM,i}$	Is the CO2 emission factor of fuel used in ith marginal power plant, expressed as tCO2/ (ton of fuel or TJ),
$Oxid_i$	Is fraction of carbon in fuel, used in ith marginal plant, oxidized during combustion.

The marginal plant(s) are those power plants 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 Hornitos power plant is obtained from the metering system which follows a national standard of 0.2% error allowance on a KWh base. Hourly energy data obtained from the metering system is submitted to CDEC-SIC every two hours as for all other generating units of the system.
The Official Annual Report by CDEC-SIC from year 2008, the semi-annual Node Price Report from CNE for 2008 April, the National Energy Balance from CNE for year 2007 and the 2006 IPCC Guidelines for National Greenhouse Gas Inventories provide all the information to calculate the emission factors for all the power plants within the Central Interconnected System.

Step 2) Build Margin Emission Factor (EF_{BM})

<u>(i) Build margin emission factor estimation process described in ACM002 v6 (ex-post, which means Option 2):</u>

$$EF_{BM,y} = \frac{\sum_{i,m} EF_{i,m,y} \bullet COEF_{i,m}}{\sum_{m} Gen_{m,y}} \qquad \textbf{(f6)}$$

Where,

$F_{i,m,j}$	is the amount of fuel i (in mass or volume unit) consumed by relevant power sources "m" in year(s) y,
M	the sample group m consists of either the five power plants that have been built most recently or the power plant capacity additions in the electricity system that comprise 20% of the system generation (in MWh) and that

have been built most recently. Project participants should use from these two options that sample group that comprises the larger annual generation,

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

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

The CO_2 emission coefficient $COEF_i$ is obtained as:

$$COEF_i = NCV_i \bullet EF_{CO2,i} \bullet Oxid_i \qquad \textbf{(f7)}$$

Where,

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

$Oxid_i$ is the oxidation factor of the fuel,

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

<u>(ii) The electricity generation options identified by the least cost expansion plan developed by the electricity regulatory authority.</u>

$$EF_{BM,i} = \frac{\sum_{i=1}^{L} EF_{BM,i} \bullet Gen_{BM,i}}{\sum_{i=1}^{L} Gen_{BM,i}} \qquad \textbf{(f8)}$$

Where,

L Group of electricity generation plants included in the expansion plan for the next 10 years. All the power plants, included in the expansion plan, where construction has already been initiated are excluded from the build margin group,

$EF_{BM,i}$ Emission factor of i^{th} electricity generation plant in the build margin, expressed in tCO_2/MWh,

$Gen_{BM,i}$ projected generation for the i^{th} electricity generation plant included in the build margin, expressed in MWh.

$$EF_{BM,i} = SFC_{BM,i} \bullet CEF_{BM,i} \bullet Oxid_i \qquad \textbf{(f9)}$$

Where,

$SFC_{BM,i}$	Specific fuel consumption of the i^{th} electricity generation plant, expressed in ton of fuel /MWh or TJ of fuel/MWh. The data shall be taken from published data of electricity regulatory authority,
$CEF_{BM,i}$	CO_2 content of fuel used in i^{th} electricity generation plant, expressed as tCO_2/(ton of fuel or TJ of fuel),
$Oxid_i$	Fuel oxidation factor, expressed as fraction.

Step 3) Baseline

The baseline emissions for the project are calculated as follows:

$$BE_y = EF_y \bullet Generation_y \qquad \textbf{(f10)}$$

Where,

EFy	Baseline emission factor, in tCO2/MWh,
Generationy	Electricity generated by the proposed CDM Project in year y (in MWh).

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

$$EF_y = w_{OM} \bullet EF_{OM,y} + w_{BM} \bullet EF_{BM,y} \qquad \textbf{(f11)}$$

Where,

EFOM,y	Emission factor for operating margin power generation sources, in tCO2/MWh,
wOM	0.5 Weight for operating margin emission factor,
EFBM	Emission factor for build margin power generation sources, in tCO2/MWh,
wBM	0.5 Weight for build margin emission factor.

Step 4) Emission Reduction

Finally, the project mainly reduces CO2 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 (ERy) by the project activity during year y is equal to the Baseline Emissions. Since the Hornitos Hydroelectric Project consists of a hydro power plant, there are no Project Emissions (PEy). Additionally, as per AM0026 (v.2), no leakage was identified for this project activity (Ly=0). The emission reduction can be expressed as follows:

$$ER_y = BE_y - PE_y - L_y = BE_y \qquad \textbf{(f12)}$$

3. MONITORING DATA AND CALCULATION RESULTS

3.1 Monitoring period

The purpose is to verify this project under VCS, from the project starting operating date to the CDM registration date. Thus, from 10th January 2008 to 8th July 2008. The project was registered on 9th July 2008.

3.2 Baseline information

The hourly energy generation data and hourly priority of dispatch per power unit in the Central Interconnected System for year 2008 is presented in Excel Spreadsheet "Hornitos Audit Assistant". The data was downloaded from the CDEC website. Additionally data was saved in a CD as reading file and in the database of Colbun, as specified in section 5.1 and 8.3. of the Access Manual.

The data of all power plants of the system such as data related to fuel type, fuel consumption, plant capacity, CO_2 emission factor, oxidation factor, net calorific value, operation starting date and CDM registry date is presented in Spreadsheet "Hornitos Audit Assistant" and in table below.

The Specific Fuel Consumption (SFCi) is based on:

> *i) Annual Fuel Consumption per power unit from Official Annual Report by CDEC-SIC 2008 (https://www.cdec-sic.cl/contenido_es.php?categoria_id=11&contenido_id=000034), divided by total energy generation per power unit obtained from CDEC-SIC (https://www.cdec-sic.cl/index_es.php). SFCi in kg/MWh or m3/MWh.*
>
> *ii) Otherwise, specific fuel consumption from CNE is used*
>
> *(http://www.cne.cl/cnewww/opencms/07_Tarificacion/01_Electricidad/Otros/Precios_nudo/otros_precios_de_nudo/precios_de_nudo.html). SFCi in kg/MWh or m3/MWh.*
>
> *iii) If there is no information on fuel consumption, then emission factor for the power unit is considered zero. This is a risk free assumption.*

The emission factor for displaced marginal plants (di) is calculated using the equation f5:

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

Where:

i) *SFCI is described above. Units are in kg/MWh or m3/MWh, therefore this parameter must be multiplied by net calorific value (NCVi) obtained from CNE (Lower calorific value of CNE multiplied by: 0,9 for gas and 0,95 for liquid and solid fuels. Units conversion is appplied from Kcal to GJ.*

http://www.cne.cl/cnewww/export/sites/default/06_Estadisticas/Documentos/BNE2007.xls

ii) *$CEF_{OM,i}$ is the CO2 content of fuel. http://www.ipcc-nggip.iges.or.jp/public/2006gl/vol2.html. Units in tCO2/GJ.*

iii) *Oxid is considered 1, value obtained from IPCC. http://www.ipcc-nggip.iges.or.jp/public/2006gl/vol2.html*

Table 4: Power plants information

Common Name	Fuel	Max. Power (MW)	OperationStartingDate	SFCi (kg/MWh or m3/MWh)	Tool Efficiency	CEF (tCO2/GJ)	Oxid	NCVi (GJ/kg or GJ/m3)	Yearly Generation (MWh/y)	Fuel Consumption (kg/y or m3/y)	CDM Reg
Abanico	Run of the River	128.6	01-ene-48			0.00	0		341,503.00		
Aconcagua	Run of the River	89	01-ene-93			0.00	0		439,144.00		
Alfalfal	Run of the River	177.64	01-ene-91			0.00	0		907,285.82		
Ancud	Diesel Oil	2.475	01-ene-06	223.5305289		0.07	1	0.04	6,039.44	1,350,000.00	
Antilhue TG	Diesel Oil	100.6	01-ene-05	228.1212475		0.07	1	0.04	241,056.02	54,990,000.00	
Antuco	Run of the River	327.157	01-ene-81			0.00	0		1,440,153.00		
Arauco	Biomass	36.3	01-ene-96			0.00	0		12,311.20		
Bocamina	Bituminous Coal	119.38	01-ene-70	416.7536534		0.09	1	0.03	958,000.00	399,249,999.96	
Campanario	Natural Gas	326.64	01-ene-07	281.9906189		0.05	1	0.04	18,901.34	5,330,000.00	
Campanario	Diesel Oil	326.64	01-ene-07	246.4923626		0.07	1	0.04	221,264.46	54,540,000.00	
Candelaria 1	Natural Gas	270.64	01-ene-05	333.5323723		0.05	1	0.04	22,814.00	7,609,207.54	
Candelaria 1	Diesel Oil	270.64	01-ene-05	271.9022068		0.07	1	0.04	263,387.00	71,615,506.54	
Candelaria 2	Natural Gas	270.64	01-ene-05	333.5323723		0.05	1	0.04	12,355.00	4,120,792.46	
Candelaria 2	Diesel Oil	270.64	01-ene-05	271.9022068		0.07	1	0.04	277,837.00	75,544,493.43	
Canela	Wind	17.968	01-ene-07			0.00	0		30,838.63		
Canutillar	Dam	171.6	01-ene-90			0.00	0		798,509.00		

Common Name	Fuel	Max. Power (MW)	OperationStartingDate	SFCi (kg/MWh or m3/MWh)	Tool Efficiency	CEF (tCO2/GJ)	Oxid	NCVi (GJ/kg or GJ/m3)	Yearly Generation (MWh/y)	Fuel Consumption (kg/y or m3/y)	CDM Reg
Cañete	Diesel Oil	1.65	01-ene-07	256.7089481		0.07	1	0.04	4,635.60	1,190,000.00	
Capullo	Run of the River	10.885	01-ene-95			0.00	0		68,601.00		
Casablanca 1	Diesel Oil	0.8	01-ene-07	214.625		0.07	1	0.04	4,073.93	874,367.23	
Casablanca 2	Diesel Oil	0.8	01-ene-07	295.9615		0.07	1	0.04	55.99	16,570.88	
Celco	Biomass	20	01-ene-96			0.00	0		43,449.30		
Chacabuquito	Run of the River	28.4	01-ene-02			0.00	0		177,039.90		7-Jul-07
Chiburgo	Run of the River	19.16	01-ene-07			0.00	0		98,890.00		
Chiloe	Diesel Oil	9	01-ene-08	269		0.07	1	0.04	110.90	29,832.10	
Cholguan	Biomass	30	01-ene-03			0.00	0		89,947.60		6-Jun-06
Chufken	Diesel Oil	3.3	01-ene-07	223.852		0.07	1	0.04	2,591.29	580,066.34	
Cipreses	Dam	99.73	01-ene-55			0.00	0		480,228.00		
Colbun	Dam	476.805	01-ene-85			0.00	0		2,667,367.00		
Concon	Diesel Oil	2.72	01-ene-07	231.84		0.07	1	0.04	7,209.91	1,671,544.61	
Constitucion	Biomass	10.056	01-ene-95			0.00	0		58,053.36		
Constitucion 1	Diesel Oil	9.3	01-ene-07	197.1267841		0.07	1	0.04	10,754.50	2,120,000.00	
Coronel	Natural Gas	91.4	01-ene-05	291.9708029		0.05	1	0.04	685.00	200,000.00	
Coronel	Diesel Oil	91.4	01-ene-05	227.4483967		0.07	1	0.04	73,862.91	16,800,000.00	
Curacautin	Diesel Oil	2.998	01-ene-07	230.900213		0.07	1	0.04	6,279.77	1,450,000.00	
Curanilahue	Diesel Oil		02-ene-00			0.07	1	0.04	0.00		
Curauma	Diesel Oil	2.501	01-ene-07	207.57		0.07	1	0.04	5,902.90	1,225,264.95	
Curillinque	Run of the River	85.28	01-ene-93			0.00	0		604,578.00		
Degan	Diesel Oil	36.3	01-ene-07	210.9023016		0.07	1	0.04	68,278.06	14,400,000.00	
Diego de Almagro	Diesel Oil	47.338	01-ene-81	361.7237402		0.07	1	0.04	58,083.00	21,010,000.00	
El Sauce Andes	Run of the River	1.12	01-ene-09			0.00	0		7,875.04		
Puntilla	Run of the River	22.13	01-ene-14			0.00	0		148,537.21		
Esperanza 1	Diesel Oil	1.6	01-ene-07	218.4		0.07	1	0.04	4,546.10	992,868.24	

Common Name	Fuel	Max. Power (MW)	OperationStartingDate	SFCi (kg/MWh or m3/MWh)	Tool Efficiency	CEF (tCO2/GJ)	Oxid	NCVi (GJ/kg or GJ/m3)	Yearly Generation (MWh/y)	Fuel Consumption (kg/y or m3/y)	CDM Reg
Esperanza 2	Diesel Oil	1.59	01-ene-07	225.96		0.07	1	0.04	4,449.00	1,005,296.04	
Esperanza TG	Diesel Oil	18.32	01-ene-07	341.04		0.07	1	0.04	3,581.30	1,221,366.55	
Eyzaguirre	Run of the River	2.119	01-ene-07			0.00	0		8,744.90		
Florida	Run of the River	29	01-ene-09			0.00	0		154,567.00		
Fopaco	Biomass	13.125	01-ene-07			0.00	0		77,222.60		
Guacolda 1	Bituminous Coal	150	01-ene-95	465.9174537		0.09	1	0.03	1,244,684.00	579,919,999.94	
Guacolda 2	Bituminous Coal	150	01-ene-96	472.3687138		0.09	1	0.03	1,285,246.00	607,109,999.94	
Horcones	Natural Gas	50	01-ene-04	466.4027407		0.05	1	0.04	0.00	0.00	
Horcones	Diesel Oil	50	01-ene-04	348.2426237		0.07	1	0.04	6,805.60	2,370,000.00	
Hornitos	Run of the River	55	05-dic-07			0.00	0		256,573.72		10-Jan-08
Huasco TG	Residual Fuel Oil	75.38	01-ene-77	370.3980192		0.08	1	0.04	160,746.00	59,539,999.99	
Huasco TV	Bituminous Coal	15.04	01-ene-65	937		0.09	1	0.03	0.00	0.00	
Isla	Run of the River	66.486	01-ene-63			0.00	0		493,595.00		
Laguna Verde TG	Diesel Oil	18.665	01-ene-90	251.9668844		0.07	1	0.04	38,894.00	9,800,000.00	
Laguna Verde TV	Bituminous Coal	45.6	01-ene-39	692.8583844		0.09	1	0.03	247,381.00	171,399,999.99	
Laja	Biomass	11.7	01-ene-95			0.00	0		53,889.88		
Las Vegas	Diesel Oil	2.32	01-ene-07	231		0.07	1	0.04	6,071.96	1,402,622.76	
Lebu	Diesel Oil	1.65	01-ene-07	221.5012865		0.07	1	0.04	4,469.50	990,000.00	
Licanten	Biomass	27	01-ene-04			0.00	0		13,017.50		
Loma Alta	Run of the River	37.93	01-ene-97			0.00	0		255,992.01		
Los Molles	Run of the River	19.802	01-ene-52			0.00	0		67,826.00		
Los Morros	Run of the River	2.955	01-ene-30			0.00	0		18,437.30		
Los Vientos	Diesel Oil	124.375	01-ene-07	268.0020218		0.07	1	0.04	380,668.77	102,020,000.00	
Machicura	Run of the River	95.76	01-ene-85			0.00	0		566,456.00		
Maitenes	Run of the River	30.9	01-ene-23			0.00	0		136,793.49		
Collipulli	Diesel Oil	2.475	01-ene-07	222.1624562		0.07	1	0.04	7,652.06	1,700,000.00	

Common Name	Fuel	Max. Power (MW)	OperationStartingDate	SFCi (kg/MWh or m3/MWh)	Tool Efficiency	CEF (tCO2/GJ)	Oxid	NCVi (GJ/kg or GJ/m3)	Yearly Generation (MWh/y)	Fuel Consumption (kg/y or m3/y)	CDM Reg
Mampil	Run of the River	49.2	01-abr-00			0.00	0		163,258.64		
Maule	Diesel Oil	6.1	01-ene-07	198.1874507		0.07	1	0.04	5,197.10	1,030,000.00	
Nehuenco 1	Diesel Oil	373.564	01-ene-98	162.7308023		0.07	1	0.04	312,172.00	50,800,000.02	
Montepatria	Diesel Oil	9.2	01-ene-07	223.083589		0.07	1	0.04	17,078.80	3,810,000.00	
Nehuenco 1	Natural Gas	373.564	01-ene-98	218.3844601		0.05	1	0.04	0.00	0.00	
Nehuenco 2	Diesel Oil	382.494	01-ene-03	165.8394444		0.07	1	0.04	2,202,552.00	365,269,999.94	
Nehuenco 2	Natural Gas	382.494	01-ene-03	189.4854563		0.05	1	0.04	189,566.00	35,920,000.01	
Nehuenco 9B	Diesel Oil	203.94	01-ene-02	289.0882153		0.07	1	0.04	137,017.00	39,610,000.00	
Nehuenco 9B	Natural Gas	203.94	01-ene-02	333.4965121		0.05	1	0.04	98,052.00	32,700,000.00	
Nueva Aldea 1	Biomass	29.3	01-ene-05			0.00	0		107,463.40		31-Mar-06
Nueva Renca	Diesel Oil	370.88	01-ene-97	172.1848218		0.07	1	0.04	1,501,468.00	258,530,000.02	
Nueva Aldea 3	Biomass	63.9	01-ene-06			0.00	0		209,736.40		2-Jun-06
Nueva Renca	Natural Gas	370.88	01-ene-97	194		0.05	1	0.04	945.00	183,330.00	
Palmucho	Run of the River	32	01-ene-07			0.00	0		225,053.00		
Pangue	Run of the River	454.86	01-ene-96			0.00	0		1,792,577.00		
Pehuenche	Dam	545.48	01-ene-91			0.00	0		2,752,905.00		
Petropower	Petroleo Combustible	61.8	01-ene-98			0.08	1	0.04	493,853.00		
Peuchen	Run of the River	79.8	01-ene-00			0.00	0		242,580.89		
Pilmaiquen	Run of the River	38.86	01-ene-44			0.00	0		243,588.00		
Pullinque	Run of the River	48.3	01-ene-62			0.00	0		219,891.00		
Punitaqui	Diesel Oil	9.3	01-ene-07	215.1013299		0.07	1	0.04	18,084.50	3,890,000.00	
Quellon	Diesel Oil	5.64	01-ene-05	217.6839573		0.07	1	0.04	10,473.90	2,280,000.00	
Queltehues	Run of the River	48.84	01-ene-28			0.00	0		358,838.00		
Quilleco	Run of the River	72.048	17-abr-07			0.00	0		362,782.00		9-Jul-08
Quilos	Run of the River	39.9	01-ene-43			0.00	0		282,210.10		
Ralco	Dam	756.162	01-ene-04			0.00	0		2,578,244.00		

Common Name	Fuel	Max. Power (MW)	OperationStartingDate	SFCi (kg/MWh or m3/MWh)	Tool Efficiency	CEF (tCO2/GJ)	Oxid	NCVi (GJ/kg or GJ/m3)	Yearly Generation (MWh/y)	Fuel Consumption (kg/y or m3/y)	CDM Reg
Rapel	Dam	378.632	01-ene-68			0.00	0		1,030,368.00		
Renca	Diesel Oil	92	01-ene-62	385.5305077		0.07	1	0.04	12,398.50	4,780,000.00	
Rincon	Run of the River	0.299	01-ene-07			0.00	0		2,536.10		
Rucue	Run of the River	177.733	01-ene-98			0.00	0		888,041.00		
San Francisco Mostazal	Diesel Oil	24.9	01-ene-02	334.6905187		0.07	1	0.04	32,567.40	10,900,000.00	
San Ignacio	Run of the River	36.914	01-ene-96			0.00	0		212,802.00		
San Isidro 1	Natural Gas	367.727	01-ene-98	208.2704497		0.05	1	0.04	795,120.00	165,599,999.97	
San Isidro 1	Diesel Oil	367.727	01-ene-98	173.800778		0.07	1	0.04	590,216.00	102,579,999.99	
San Isidro 2	Diesel Oil	172.956	01-ene-07	175.2549082		0.07	1	0.04	1,646,573.00	288,569,999.96	
San Isidro 2	Natural Gas	172.956	01-ene-07			0.05	1	0.04	998.00		
Sauzalito	Run of the River	11.88	01-ene-59			0.00	0		84,796.60		
Sauzal	Run of the River	76.377	01-ene-48			0.00	0		489,949.00		
Taltal 1	Natural Gas	239.52	01-abr-00	333.6390736		0.05	1	0.04	17,444.00	5,820,000.00	
Taltal 1	Diesel Oil	239.52	01-abr-00	275.5727019		0.07	1	0.04	332,668.00	91,674,219.60	
Taltal 2	Diesel Oil	239.52	01-mar-00	275.5727019		0.07	1	0.04	602,548.00	166,045,780.38	
Taltal 2	Natural Gas	239.52	01-mar-00	325.2013835		0.05	1	0.04	87,023.00	28,300,000.00	
Trongol	Diesel Oil		02-ene-00			0.07	1	0.04			
Valdivia	Biomass	70	01-ene-04			0.00	0		218,893.00		
Ventanas 1	Bituminous Coal	108.68	01-ene-64	372.5170926		0.09	1	0.03	941,487.00	350,719,999.96	
Ventanas 2	Bituminous Coal	207.14	01-ene-77	371.710478		0.09	1	0.03	1,633,368.00	607,140,000.03	
Nueva Aldea 2	Diesel Oil	22	01-ene-06	289.8		0.07	1	0.04	36.60	10,606.68	
Angol	Diesel Oil	3.3	01-ene-07	218.2249624		0.07	1	0.04	4,719.90	1,030,000.00	
Victoria	Diesel Oil		02-ene-00			0.07	1	0.04	0.00		
Volcan	Run of the River	13.99	01-ene-44			0.00	0		101,137.00		
El Toro	Dam	446.745	01-ene-73			0.00	0		1,204,774.00		
Cenizas	Diesel Oil	15.3	01-ene-08	230		0.07	1	0.04	865.37	199,036.02	

Common Name	Fuel	Max. Power (MW)	OperationStartingDate	SFCi (kg/MWh or m3/MWh)	Tool Efficiency	CEF (tCO2/GJ)	Oxid	NCVi (GJ/kg or GJ/m3)	Yearly Generation (MWh/y)	Fuel Consumption (kg/y or m3/y)	CDM Reg
Chuyaca	Diesel Oil	3	01-ene-08	222		0.07	1	0.04	82.60	18,337.20	
Colmito	Diesel Oil	60	01-ene-08	298		0.07	1	0.04	4,422.28	1,317,839.44	
Coya	Run of the River	11	01-ene-08			0.00	0		43,462.10		
Lircay	Run of the River	18.95	01-ene-08			0.00	0		32,931.00		
Los Pinos	Diesel Oil	89.7	01-ene-08	226		0.07	1	0.04	7,118.20	1,608,713.20	
Ojos de Agua	Run of the River	9.5	01-ene-08			0.00	0		18,759.37		19-Apr-07
Olivos	Diesel Oil	76.8	01-ene-08	227.5907889		0.07	1	0.04	28,296.40	6,440,000.00	
Placilla	Diesel Oil	3	01-ene-08	231.84		0.07	1	0.04	3,020.50	700,271.79	
Puclaro	Run of the River	5.2	01-ene-08			0.00	0		32,635.20		15-Sep-07
Quellon II	Diesel Oil	1.6	01-ene-08	205.5974323		0.07	1	0.04	3,550.63	730,000.00	
Quintay	Diesel Oil	3	01-ene-08	231.84		0.07	1	0.04	3,236.91	750,444.29	
Santa Lidia	Diesel Oil	120	01-ene-08	255		0.07	1	0.04	525.45	133,989.75	
Skretting	Diesel Oil	2.7	01-ene-08			0.07	1	0.04	0.00		
Totoral	Diesel Oil	3	01-ene-08	231.84		0.07	1	0.04	3,430.89	795,416.61	

a. Emission Factor Operating Margin

The emission factor operating margin is presented in Excel Spreadsheet “Hornitos Audit Assistant”. The amount of data does not allow the presentation of tables within this document.

b. Emission Factor Build Margin

Table 5: Option (i) Build Margin 2008

OperationStartingDate	Common Name	Fuel	SFCi (kg/MWh or m3/MWh)	Fuel consumption (kg/y or m3/y)	Tool Efficiency	CEF (tCO2/GJ)	NCVi (GJ/kg or GJ/m3)	Yearly Generation (MWh/y)	Emission Factor_Tool	Emission Tool (tCO2)
01-ene-08	Cenizas	Diesel	230	199036.02	0.0%	0.0726	0.043325	865.374	0.72344085	626.0469021

OperationStartingDate	Common Name	Fuel	SFCi (kg/MWh or m3/MWh)	Fuel consumption (kg/y or m3/y)	Tool Efficiency	CEF (tCO2/GJ)	NCVi (GJ/kg or GJ/m3)	Yearly Generation (MWh/y)	Emission Factor_Tool	Emission Tool (tCO2)
01-ene-08	Chiloe	Diesel	269	29832.1	0.0%	0.0726	0.043325	110.9	0.84611126	93.83373818
01-ene-08	Chuyaca	Diesel	222	18337.2	0.0%	0.0726	0.043325	82.6	0.69827769	57.67773719
01-ene-08	Colmito	Diesel	298	1317839.44	0.0%	0.0726	0.043325	4422.28	0.93732771	4145.125585
01-ene-08	Coya	Agua Pasada	0	0	0.0%	0	0	43462.1	0	0
01-ene-08	Lircay	Agua Pasada	0	0	0.0%	0	0	32931	0	0
01-ene-08	Los Pinos	Diesel	226	1608713.2	0.0%	0.0726	0.043325	7118.2	0.71085927	5060.038456
01-ene-08	Olivos	Diesel	227.5907889	6439999.999	0.0%	0.0726	0.043325	28296.4	0.71586293	20256.3438
01-ene-08	Placilla	Diesel	231.84	700271.7926	0.0%	0.0726	0.043325	3020.496	0.72922838	2202.631395
01-ene-08	Quellon II	Diesel	205.5974323	729999.9999	0.0%	0.0726	0.043325	3550.628	0.64668514	2296.13835
01-ene-08	Quintay	Diesel	231.84	750444.287	0.0%	0.0726	0.043325	3236.906	0.72922838	2360.443708
01-ene-08	Santa Lidia	Diesel	255	133989.75	0.0%	0.0726	0.043325	525.45	0.80207573	421.4506897
01-ene-08	Totoral	Diesel	231.84	795416.6102	0.0%	0.0726	0.043325	3430.886	0.72922838	2501.899429
01-ene-07	Angol	Diesel	218.2249624	1030000	0.0%	0.0726	0.043325	4719.9	0.68640371	3239.75685
01-ene-07	Campanario	Gas Natural	281.9906189	5330000.001	0.0%	0.0543	0.035174	18901.338	0.53858747	10180.02391
01-ene-07	Campanario	Diesel	246.4923626	54540000	0.0%	0.0726	0.043325	221264.462	0.77531584	171549.8433
01-ene-07	Canela	Aire	0	0	0.0%	0	0	30838.63	0	0
01-ene-07	Cañete	Diesel	256.7089481	1190000	0.0%	0.0726	0.043325	4635.6	0.80745104	3743.020049
01-ene-07	Casablanca 1	Diesel	214.625	874367.2263	0.0%	0.0726	0.043325	4073.93	0.67508040	2750.230302
01-ene-07	Casablanca 2	Diesel	295.9615	16570.88439	0.0%	0.0726	0.043325	55.99	0.93091582	52.12197689
01-ene-07	Chiburgo	Agua Pasada	0	0	0.0%	0	0	98890	0	0
01-ene-07	Chufken	Diesel	223.852	580066.3445	0.0%	0.0726	0.043325	2591.294	0.70410296	1824.53778
01-ene-07	Collipulli	Diesel	222.1624562	1700000	0.0%	0.0726	0.043325	7652.058	0.69878868	5347.171501
01-ene-07	Concon	Diesel	231.84	1671544.607	0.0%	0.0726	0.043325	7209.906	0.72922838	5257.668049
01-ene-07	Constitucion 1	Diesel	197.1267841	2120000	0.0%	0.0726	0.043325	10754.5	0.62004160	6668.237399
01-ene-07	Curacautin	Diesel	230.900213	1450000	0.0%	0.0726	0.043325	6279.769	0.72627238	4560.822749
01-ene-07	Curauma	Diesel	207.57	1225264.953	0.0%	0.0726	0.043325	5902.9	0.65288964	3853.942257

OperationStartingDate	Common Name	Fuel	SFCi (kg/MWh or m3/MWh)	Fuel consumption (kg/y or m3/y)	Tool Efficiency	CEF (tCO2/GJ)	NCVi (GJ/kg or GJ/m3)	Yearly Generation (MWh/y)	Emission Factor_Tool	Emission Tool (tCO2)
01-ene-07	Degan	Diesel	210.9023016	14400000	0.0%	0.0726	0.043325	68278.06	0.66337104	45293.68801
01-ene-07	Esperanza 1	Diesel	218.4	992868.24	0.0%	0.0726	0.043325	4546.1	0.68695427	3122.962798
01-ene-07	Esperanza 2	Diesel	225.96	1005296.04	0.0%	0.0726	0.043325	4449	0.71073345	3162.053138
01-ene-07	Esperanza TG	Diesel	341.04	1221366.552	0.0%	0.0726	0.043325	3581.3	1.07270551	3841.680246
01-ene-07	Eyzaguirre	Agua Pasada	0	0	0.0%	0	0	8744.9	0	0
01-ene-07	Fopaco	Biomasa	0	0	0.0%	0	0	77222.6	0	0
01-ene-07	Las Vegas	Diesel	231	1402622.76	0.0%	0.0726	0.043325	6071.96	0.72658625	4411.802616
01-ene-07	Lebu	Diesel	221.5012865	990000	0.0%	0.0726	0.043325	4469.5	0.69670904	3113.94105
01-ene-07	Los Vientos	Diesel	268.0020218	102020000	0.0%	0.0726	0.043325	380668.77	0.84297222	320893.1979
01-ene-07	Maule	Diesel	198.1874507	1030000	0.0%	0.0726	0.043325	5197.1	0.62337782	3239.75685
01-ene-07	Montepatria	Diesel	223.083589	3810000	0.0%	0.0726	0.043325	17078.8	0.70168601	11983.95495
01-ene-07	Palmucho	Agua Pasada	0	0	0.0%	0	0	225053	0	0
01-ene-07	Punitaqui	diesel	215.1013299	3890000.001	0.0%	0.0726	0.043325	18084.5	0.67657865	12235.58655
01-ene-07	Rincon	Agua Pasada	0	0	0.0%	0	0	2536.1	0	0
01-ene-07	San Isidro 2	diesel	175.2549082	288570000	0.0%	0.0726	0.043325	1646573	0.55124591	907666.635
01-ene-07	San Isidro 2	gas natural	0	0	0.0%	0.0543	0.035174	998	0	0
01-ene-06	Ancud	Diesel	223.5305289	1350000	0.0%	0.0726	0.043325	6039.4435	0.70309181	4246.283249
01-ene-06	Nueva Aldea 2	diesel	289.8	10606.68	0.0%	0.0726	0.043325	36.6	0.91153547	33.36219824
01-ene-05	Antilhue TG	Diesel	228.1212475	54990000	0.0%	0.0726	0.043325	241056.02	0.71753143	172965.271
01-ene-05	Candelaria 1	Gas Natural	333.5323723	7609207.542	0.0%	0.0543	0.035174	22814	0.63702955	14533.19225
01-ene-05	Candelaria 1	Diesel	271.9022068	71615506.54	0.0%	0.0726	0.043325	263387	0.85523984	225259.0562
01-ene-05	Candelaria 2	diesel	271.9022068	75544493.43	0.0%	0.0726	0.043325	277837	0.85523984	237617.2719
01-ene-05	Candelaria 2	Gas Natural	333.5323723	4120792.46	0.0%	0.0543	0.035174	12355	0.63702955	7870.500141
01-ene-05	Coronel	Gas Natural	291.9708029	200000	0.0%	0.0543	0.035174	685	0.55764911	381.98964
01-ene-05	Coronel	Diesel	227.4483967	16800000	0.0%	0.0726	0.043325	73862.908	0.71541505	52842.636
01-ene-05	Quellon	Diesel	217.6839573	2280000	0.0%	0.0726	0.043325	10473.9	0.68470203	7171.500601

OperationStartingDate	Common Name	Fuel	SFCi (kg/MWh or m3/MWh)	Fuel consumption (kg/y or m3/y)	Tool Efficiency	CEF (tCO2/GJ)	NCVi (GJ/kg or GJ/m3)	Yearly Generation (MWh/y)	Emission Factor_Tool	Emission Tool (tCO2)
01-ene-04	Horcones	Diesel	348.2426237	2370000	0.0%	0.0726	0.043325	6805.6	1.09536061	7454.58615
01-ene-04	Licanten	biomasa	0	0	0.0%	0	0	13017.5	0	0
01-ene-04	Ralco	Agua Embalse	0	0	0.0%	0	0	2578244	0	0
01-ene-04	Valdivia	biomasa	0	0	0.0%	0	0	218893	0	0
01-ene-03	Nehuenco 2	diesel	165.8394444	365269999.9	0.0%	0.0726	0.043325	2202552	0.52163056	1148918.431
01-ene-03	Nehuenco 2	gas natural	189.4854563	35920000.01	0.0%	0.0543	0.035174	189566	0.36190741	68605.33936
									BM (i) 2008	**0.385514**

Table 6: Option (ii) Build Margin 2008

Starting Year	Common Name	Fuel	Installed Capacity (MW)	SFCi (kg/MWh or m3/MWh)	Fuel consumption (kg/y or m3/y)	CEF (tCO2/GJ)	NCVi (GJ/kg or GJ/m3)	Yearly Generation (MWh/y)	Emission Factor	Emission
2008	Turbina Diesel Teno	Diesel Oil	50	261	27879158.42	0.0726	0.04332532	106,817	0.82095416	87691.6132
2008	Turbina Diesel TG TermoChile	Diesel Oil	60	261	33454990.11	0.0726	0.04332532	128,180	0.82095416	105229.9358
2008	Turbina Diesel TG Peñon	Diesel Oil	37	261	20630577.23	0.0726	0.04332532	79,044	0.82095416	64891.79377
2009	Eolica Concepcion 01	Wind	20	0	0	0	0	34326.16874	0.00000000	0
2009	Eolica IV Region 3	Wind	20	0	0	0	0	34326.16874	0.00000000	0
2009	Central Des.For. VIII Region 01	Biomass	9	0	0	0	0	67,014	0.00000000	0
2009	Central Des.For. VIII Region 02	Biomass	8	0	0	0	0	59,568	0.00000000	0
2009	Eolica IV Region 2	Wind	20	0	0	0	0	34326.16874	0.00000000	0
2010	Central Des.For. VII Region 01	Biomass	15	0	0	0	0	111,690	0.00000000	0
2010	Central Des.For. VII Region 02	Biomass	10	0	0	0	0	74,460	0.00000000	0

Starting Year	Common Name	Fuel	Installed Capacity (MW)	SFCi (kg/MWh or m3/MWh)	Fuel consumption (kg/y or m3/y)	CEF (tCO2/GJ)	NCVi (GJ/kg or GJ/m3)	Yearly Generation (MWh/y)	Emission Factor	Emission
2010	Ciclo Combinado GNL Quintero I	LNG	350	264.17646	566975518.5	0.0583	0.0409	2,146,200	0.62992084	1351936.114
2010	Ciclo Combinado GNL Quintero I FA	LNG	35	355.997016	76404079.57	0.0583	0.0409	214,620	0.84886420	182183.2356
2010	Eolica Concepcion 02	Wind	20	0	0	0	0	34326.16874	0.00000000	0
2011	Carbón I V-Region	Coal	250	376	745,320,170	0.0895	0.0278236	1,982,234	0.93631979	1856005.38
2011	Carbón Pan de Azucar I	Coal	250	376	745,320,170	0.0895	0.0278236	1,982,234	0.93631979	1856005.38
2012	Central Carbón Coronel II	Coal	250	376	745,320,170	0.0895	0.0278236	1,982,234	0.93631979	1856005.38
2012	Central Hidroeléctrica Neltume	Run of the River	403	0	0	0	0	1,968,305	0.00000000	0
2013	Geotermica Calabozo 01	Geothermal	40	0	0	0	0	315,360	0.00000000	0
2013	Geotermica Chillan 01	Geothermal	25	0	0	0	0	197,100	0.00000000	0
2013	Carbón Pan de Azucar II	Coal	250	376	745,320,170	0.0895	0.0278236	1,982,234	0.93631979	1856005.38
2014	Carbón Pan de Azucar III	Coal	200	376	596,256,136	0.0895	0.0278236	1,585,788	0.93631979	1484804.304
2015	Geotermica Calabozo 02	Geothermal	40	0	0	0	0	315,360	0.00000000	0
2015	Geotermica Chillan 02	Geothermal	25	0	0	0	0	197,100	0.00000000	0
2015	Módulo Hidroeléctrico 01	Dam	660	0	0	0	0	2,642,704	0.00000000	0
2015	Carbón Pan de Azucar IV	Coal	200	376	596,256,136	0.0895	0.0278236	1,585,788	0.93631979	1484804.304
2016	Módulo Hidroeléctrico 02	Dam	500	0	0	0	0	2,002,048	0.00000000	0
2017	Geotermica Calabozo 03	Geothermal	40	0	0	0	0	315,360	0.00000000	0
2017	Geotermica Chillan 03	Geothermal	25	0	0	0	0	197,100	0.00000000	0
2018	Módulo Hidroeléctrico 03	Dam	460	0	0	0	0	1,841,885	0.00000000	0
									BM (ii) 2008	**0.503167**

c. Sources of information

Table 7: Sources of information ordered by Excel sheets in "Hornitos Audit Assistant" Excel file

Sheet	AM0026 v2 Parameter	Entity Source	Name File	Comment	Web link
OP-Energy	Cj=Generationj,h, and Bi	CDEC-SIC	OPddmmyy.xls	One file per day. Files can be downloaded with a subscription fee. A Excel Macros has been created to compile the daily files in one Excel sheet. The result of the Excel Macros is the "OP-Energy" sheet.	https://www.cdec-sic.cl/index_es.php
Pri-Priority		CDEC-SIC	yyyyy-mm-dd.xls	One file per week. Files can be downloaded with a subscription fee. A Excel Macros has been created to compile the weekly files in one Excel sheet. The result of the Excel Macros is the "Pri-Priority" sheet.	https://www.cdec-sic.cl/index_es.php
Power Plants	Max. Power (MW)= Ai	CDEC-SIC	empresas_generadoras.xls	Publicly available.	https://www.cdec-sic.cl/norma_calidad_y_seguridad/capitulo9/inf_tca_sic/empresas_generadoras.xls
		CDEC-SIC	pequenos_medios_generacion.xls	Publicly available.	https://www.cdec-sic.cl/norma_calidad_y_seguridad/capitulo9/inf_tca_sic/pequenos_medios_generacion.xls
	Max. Power Data Year	CDEC-SIC		Year of "Max. Power Data", for updating purposes only.	
	OperationStarting Date	CDEC-SIC	OPddmmyy.xls	For EFBM selection of 20%. Main sources indicate only the year of operation. When power unit is near the 20%, real operation data from CDEC-SIC is used to establish operating start date. If not, January 1st is used.	https://www.cdec-sic.cl/index_es.php
	SFCi (kg/MWh or m3/MWh)	CNE	Informe Tecnico Definitivo.	Specific fuel consumption from "ChartN°6" from last CNE node price report.	http://www.cne.cl/cnewww/opencms/07_Tarificacion/01_Electricidad/Otros/Precios_nudo/otros_precios_de_nudo/precios_de_nudo.html
	Tool Efficiency	Assumption	-	Only applied for EFBM calculation if no information on fuel consumption is available. Efficiency is considered to be zero. Risk free assumption.	-
	CEF (tCO2/GJ)	IPCC	2006 IPCC Guidelines for National Greenhouse Gas Inventories	Volume 2. Energy. Chapter 1. Table 1.4.	http://www.ipcc-nggip.iges.or.jp/public/2006gl/vol2.html

Sheet	AM0026 v2 Parameter	Entity Source	Name File	Comment	Web link
	Oxid	IPCC	2006 IPCC Guidelines for National Greenhouse Gas Inventories	Volume 2. Energy. Chapter 1. Table 1.4. The value considered is 1.	http://www.ipcc-nggip.iges.or.jp/public/2006gl/vol2.html
	NCVi (GJ/kg or GJ/m3)	CNE	Balance Nacional de Energía 2007. Cuadro A2.	Lower calorific value of CNE multiplied by: 0,9 for gas and 0,95 for liquid and solid fuels. Units conversion from Kcal to GJ.	http://www.cne.cl/cnewww/export/sites/default/06_Estadisticas/Documentos/BNE2007.xls
	Energy Year	CDEC-SIC		Year of "Energy data", for updating purposes only.	
	Yearly Generation (MWh/y)	Calculation		Sum of energy per power unit from "OP-Energy" Excel Macros.	
	Fuel Consumption (kg/y or m3/y)	CDEC-SIC	cdec-esp.pdf	If available, Annual Fuel Consumption per power unit from Official Annual Report by CDEC-SIC 2008, divided by total energy generation per power unit from "OP-Energy" is used. Otherwise, specific fuel consumption from CNE is used.	https://www.cdec-sic.cl/contenido_es.php?categoria_id=11&contenido_id=000034
	CDM Reg	UNFCCC		From UNFCCC website.	http://cdm.unfccc.int/Projects/projsearch.html
Energy Trans				In order to match energy generated with priority of each power unit, a common name per power unit is established. This is the "common name" asignment for Energy.	
Priority Trans	-			In order to match energy generated with priority of each power unit, a common name per power unit is established. This is the "common name" asignment for Priority.	
Calc Example		□	-	This sheet explains step by step how the methodology is applied.	
Hornitos EF OM 2008				This is the result of hourly 2008 OM calculation of the Access Tool.	
HornitosGen 2008	-	□		This is the energy generation of Quilleco from 01/01/2008 to 08/07/2008.	
EF BM (i)				This is the result of the build margin calculation.	
EF BM (ii)	Installed Capacity (MW)	CNE	Informe Tecnico Definitivo Abril		http://www.cne.cl/cnewww/opencms/07_Tarificacion/01_Electricidad/Otros/Precios_nudo/otros_precios_de_nudo/precios

Sheet	AM0026 v2 Parameter	Entity Source	Name File	Comment	Web link
			2008.		_de_nudo.html
	SFCi (kg/MWh or m3/MWh)	CNE	Informe Tecnico Definitivo Abril 2008.	Specific fuel consumption from "ChartN°6".	http://www.cne.cl/cnewww/opencms/07_Tarificacion/01_Electricidad/Otros/Precios_nudo/otros_precios_de_nudo/precios_de_nudo.html
	CEF (tCO2/GJ)	IPCC	2006 IPCC Guidelines for National Greenhouse Gas Inventories	Volume 2. Energy. Chapter 1. Table 1.4.	http://www.ipcc-nggip.iges.or.jp/public/2006gl/vol2.html
	NCVi (GJ/kg or GJ/m3)	CNE, IPCC	Balance Nacional de Energía 2007. Cuadro A2.	Lower calorific value of CNE multiplied by: 0,9 for gas and 0,95 for liquid and solid fuels. Units conversion from Kcal to GJ.	http://www.cne.cl/cnewww/export/sites/default/06_Estadisticas/Documentos/BNE2007.xls
	Yearly Generation (MWh/y)	CDEC-SIC		Calculated from OP-Energy.	
Hornitos EF CM			-	This is the result of the Combined Margin calculation.	

d. Project emission (PEy)

The consumption of diesel of the generating set was the following:

Table 8: Consumption of diesel

Month	Diesel consumption (Lt /month)
February	90
March	90
April	829
May	90
June	68
July	1737
Total	**2,904**

The Project emission equation is:

$PEy = FE_{diesel}$ x NCV_i X Density x total consumption

Where:

FE_{diesel} = diesel oil emission factor = 0.0741 $tonCO_2/GJ$ (2006 IPCC Guidelines for national greenhouse gas inventories). http://www.ipcc-nggip.iges.or.jp/public/2006gl/pdf/2_Volume2/V2_1_Ch1_Introduction.pdf

NCVi = diesel net calorific value= 0.04333 GJ/Kg (Balance nacional de energía 2007, Lower calorific value of CNE multiplied by 0,95 for liquid and solid fuels. Units conversion from Kcal to GJ.) (http://www.cne.cl/cnewww/opencms/06_Estadisticas/Balances_Energ.html)

Density diesel= 0.84 ton/m^3 =0.84 kg/lt (Balance Nacional de energía, TableA2.(http://www.cne.cl/cnewww/opencms/06_Estadisticas/Balances_Energ.html)

Then,

PE_y = 0.0741 x 0.04333 x 0.84 x 2,904

PE_y = 7.832 $tonCO_2$

The project emissions correspond to 0.012% of the reduction emissions (BEy), and they are discounted from baseline emissions in order to calculate emission reductions.

e. Combined Margin

Emission factor build margin with option (i) is used, because is lower by more than 20% than the value of EF_{BM} estimated using option (ii).

Table 9: Combined Margin (CM)

	Hornitos
EF BM (i)(tCO2/MWh)	0.385
EF BM (ii)(tCO2/MWh)	0.503
W BM	0.500
EF OM (tCO2/MWh)	0.674
W OM	0.500
CM	0.530
Total Gen (MWh) Jan 10th to Jul 8th	125,139.63
Bey (tCO2)	**66,326**

f. Emission reductions

Baseline emissions Bey (tCO2)	66,326
Project emissions PEy (tCO2)	8
Emission Reductions ERy (tCO2)	**66,318**

g. Comparison of results

	PDD	Hornitos MR vs 01	Hornitos MR vs 06
Period	1 year	From dec 4th, 2007 to Jul 8th , 2008	From Jan 10th, 2008 to Jul 8th , 2008
EF BM (i)(tCO2/MWh)	0.298	0.397	0.385
EF BM (ii)(tCO2/MWh)	Not calculated	Not calculated	0.503

	PDD	Hornitos MR vs 01	Hornitos MR vs 06
W BM	0.500	0.500	0.500
EF OM (tCO2/MWh)	0.517	0.517	0.674
W OM	0.500	0.500	0.500
CM	0.408	0.457	0.530
Total Gen (MWh)	270,000	129,496	125,139.63
Bey (tCO2)	**110,160**	**59,165**	**66,326**
ERy (tCO2)	**110,160**	**59,165**	**66,318**

The ex-ante energy generation declared in the PDD was of 270,000 MW/year. According to period from January 10th 2008 to July 8th 2008, the energy generated was 125,139.63 MW which is consistent with the ex-ante energy generation of the PDD.

Additionally, the ex-ante combined emission factor was 0.408 tonCO_2/MWh, and the ex-post combined emission factor is 30% higher, resulting in 0.53 tonCO2/MWh. This is because the ex-ante emission factor considered an average of five years (from 2002 to 2006) and the ex-post emission factor considers only the year 2007.

The difference of BM EF between the first and the third version of the monitoring report, is due to updates in the Fuel Oxidation Factor (changed from IPCC1996 to IPCC2006), and updates in the yearly generation data for each power plant in the CDEC-SIC.