Monitoring report form
(Version 03.2)

Monitoring report

Title of the project activity	Trueno River Hydroelectric Power Plant
Reference number of the project activity	4337
Version number of the monitoring report	9
Completion date of the monitoring report	15/05/2014
Registration date of the project activity	12/01/2011
Monitoring period number and duration of this monitoring period	First Monitoring Period first and last day included) 12/01/2011 to 31/12/2011
Project participant(s)	Hidroelectrica Trueno S.A.
Host Party(ies)	Chile
Sectoral scope(s) and applied methodology(ies)	Methodology AMS I.D, version 15 Scope: 1 – Renewable Energy
Estimated amount of GHG emission reductions or net anthropogenic GHG removals by sinks for this monitoring period in the registered PDD	**15,569[1] tCO_2**
Actual GHG emission reductions or net anthropogenic GHG removals by sinks achieved in this monitoring period	**13,809 tCO_2**
Actual GHG emission reductions or net anthropogenic GHG removals by sinks achieved during the period up to 31 December 2012(if applicable)	**13,809 tCO_2**
Actual GHG emission reductions or net anthropogenic GHG removals by sinks achieved during the period from 1 January 2013 onwards (if applicable).	NA

[1] Proportional estimated emission reductions for the number of days (353 days) considered in this monitoring period.

SECTION A. Description of project activity

A.1. Purpose and general description of project activity

Trueno River Hydroelectric Power Plant, located in the south central region of Chile, uses the water from the "Rio Trueno" river for renewable energy generation. The hydroelectric power plant has two identical francis turbines with an installed capacity of 2,840 kW each. The energy produced is injected into the country's largest electricity grid, called Central Interconnected System (SIC).

The operation of the project reduces green house gas emissions due to the displacement of non renewable energy sources connected to the electricity grid. These are represented by grid combined emission factor which is updated on a yearly basis.

The technology installed is[2]:

- Two Francis turbines (WKV manufactured) located in the power house. Their rated discharge is 2970 l/s and an average head of 107 meters each, while being able to operate with up to 108.9 meters.
- Two 3150 kVA generators (WKV manufactured), located in the power house.
- ION 8600B, class 0.2% Power Meter (Schneider electric make), located in the Dollinco Substation, used for monitoring the delivered net energy to the grid, considering the 39.6kms transmission line losses between the power station and the substation.

The hydroelectric power plant's first injection of energy to the grid was on June 6th 2010[3], and its official commissioning report is dated June 8th 2010. The plant has continuously operated during the monitored period with some specific detentions which are described in section B.1.

The actual Monitoring Report corresponds to the first CDM verification of the GHG displacements caused by the project's operation. The period considered comprehends the energy generation between the date of its registry under the CDM (January 12th, 2011) and December 31st, 2011. During this period, a calculated of **13,809** tCO_2 were reduced.

A.2. Location of project activity

- Host Country: Chile
- Region/State/Province: 9th region, Temuco
- Town: Vilcun
- Physical location:

The project activity is located at 55 kilometers of the city of Temuco (capital city of the IX Region) and 25 kilometers from the town of Vilcun, beside the route S-203.

The coordinates (DMS) for the power house are:

Latitude	Longitude
38°35'51.06"S	72° 2'40.07"W

Table 1 - Project coordinates

[2] See Annex 3 for a detailed technical description of the project.
[3] See the monthly operation statistics at: https://www.cdec-sic.cl/est_opera_privada.php

Figure 1 - General Location of the Project

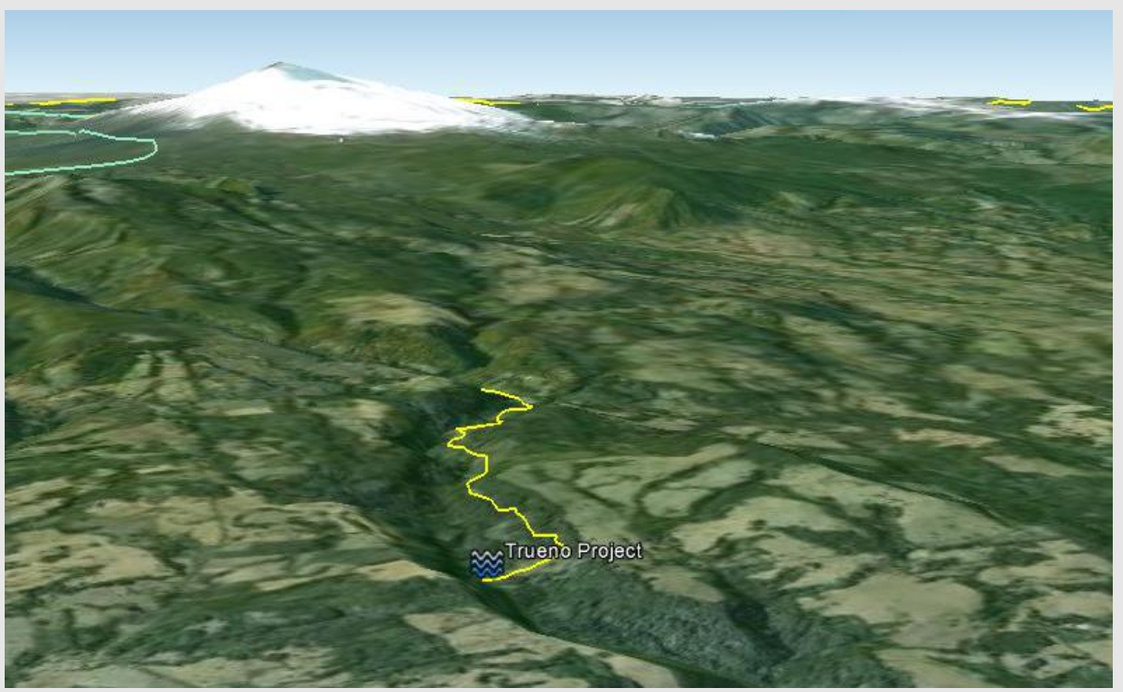

Figure 2 - Detailed location of the project

A.3. Parties and project participant(s)

Party involved ((host) indicates a host Party)	Private and/or public entity(ies) project participants (as applicable)	Indicate if the Party involved wishes to be considered as project participant (Yes/No)

Chile (host) *Ministerio del Medio Ambiente (DNA)*	Hidroelectrica Trueno S.A.	No

A.4. Reference of applied methodology

AMS ID: "Grid connected renewable electricity generation", version 15.

- Latest version of the "Tool to calculate the emission factor for an electricity system", version 02.2.1
- "Tool for the demonstration and assessment of additionality", version 05.2
- "Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion", Version 02

A.5. Crediting period of project activity

The crediting period is a renewable type. This monitored period is within the first crediting period of 7 years. The first crediting period goes from 12 January 2011 – 11 January 2018.

SECTION B. Implementation of project activity

B.1. Description of implemented registered project activity

The Trueno River Hydroelectric Power Plant started operating and injecting energy to the Central Interconnected System (SIC) grid on June 6th 2010. Under normal operational conditions the power station will generate power according to its water rights which is basically a concession over the amount of m^3/s provided by the government.

The technology installed has been described in section A.1, so to avoid repetition of information, please refer to such section for details.

The project has been fully implemented according to the description provided in the registered PDD, and has been continuously operated since its start-up with the following exceptions:

Events during the monitoring period

A series of events, preventive maintenance and failures were presented and the power plant was forced to stop its electricity generation. A detailed timeline of the events, their description and the periods of time in which they occurred are detailed on the next six pages.

Date	Unit Nº1			Unit Nº2			Internal	External	Responsible
	Start time	Ending Time	Total minutes disconnected	Start time	Ending Time	Total minutes disconnected			
17/01/11	10:39:00 AM	10:58:00 AM	19					x	/
17/01/11	6:43:00 PM	6:50:00 PM	7					x	/
19/01/11	7:29:00 AM	7:48:00 AM	19					x	FRONTEL
23/01/11	7:58:00 AM	8:19:00 AM	21					x	Transnet
25/01/11	2:14:00 PM	3:57:00 PM	103					x	Frontel
26/01/11	10:15:00 AM	10:39:00 AM	24					x	Frontel
26/01/11	8:28:00 PM	12:00:00 AM	212					x	Frontel
18/02/11	3:56:00 PM	4:22:00 PM	26					x	Frontel
18/02/11	4:56:00 PM	6:14:00 PM	78					x	Frontel
27/03/11				2:49:00 PM	3:18:00 PM	29		X	Transelec
31/03/11				7:20:00 PM	11:48:00 PM	268		X	/
07/04/11				8:58:00 AM	1:42:00 PM	284		X	SAESA
22/04/11				3:17:00 AM	5:30:00 AM	133		X	Frontel

22/04/11				6:00:00 AM	11:30:00 PM	330		X	Frontel
27/04/11	7:09:00 AM	6:40:00 PM	691	6:27:00 AM	6:45:00 PM	18	X		Trueno
11/05/11	11:00:00 AM	2:16:00 PM	196					X	Frontel
14/05/11	2:59:00 AM	5:37:00 AM	158					x	Frontel
07/06/11	10:44:00 AM	10:54:00 AM	10				x		C.H. Trueno S.A.
07/06/11				11:53:00 AM	12:11:00 PM	18	x		C.H. Trueno S.A.
07/06/11	1:26:00 PM	1:50:00 PM	24				x		C.H. Trueno S.A.
07/06/11				5:39:00 PM	5:44:00 PM	5	x		C.H. Trueno S.A.
13/06/11	8:42:00 PM	8:51:00 PM	9	8:42:00 PM	8:54:00 PM	12		X	/
15/06/11	5:52:00 PM	6:07:00 PM	15				X		C.H. Trueno S.A.
11/07/11	5:51:00 PM	6:04:00 PM	13				x		HTSA
14/07/11	9:51:00 AM	10:01:00 AM	10				x		HTSA
08/08/11				4:33:00 PM	4:49:00 PM	16	X		HTSA
08/08/11	4:51:00 PM	5:01:00 PM	10				X		HTSA
09/08/11				1:03:00 PM	13:18:00	15	X		HTSA
09/08/11				4:05:00 PM	4:31:00 PM	26	X		HTSA
10/08/11				1:43:00 PM	1:59:00 PM	16	X		HTSA
10/08/11	5:45:00 PM	6:03:00 PM	18				X		HTSA
19/08/11	11:49:00 AM	11:59:00 AM	10	11:37:00 AM	11:46:00 AM	9	X		HTSA
22/08/11	9:19:00 AM	9:28:00 AM	9	9:38:00 AM	9:47:00 AM	9	X		HTSA
24/08/11	9:36:00 AM	9:45:00 AM	9	9:20:00 AM	9:28:00 AM	8	X		HTSA
28/08/11	9:22:00 AM	9:30:00 AM	8	9:05:00 AM	9:13:00 AM	8	x		HTSA
30/08/11	8:36:00 AM	8:44:00 AM	8	8:20:00 AM	8:28:00 AM	8	x		HTSA
02/09/11	2:06:00 PM	8:08:00 PM	362	2:06:00 PM	8:03:00 PM	357		X	Frontel
02/09/11	8:25:00 PM	8:46:00 PM	21				X		HTSA
06/09/11	3:21:00 PM	3:31:00 PM	10	3:21:00 PM	15:28:00	7	X		HTSA
09/09/11	9:26:00 PM	9:34:00 PM	8	9:35:00 PM	9:43:00 PM	8	X		HTSA
16/09/11	9:28:00 PM	9:37:00 PM	9	9:13:00 PM	9:21:00 PM	8	X		HTSA
24/09/11	8:32:00 PM	8:43:00 PM	11	8:32:00 PM	8:44:00 PM	12		X	Frontel
28/09/11	3:38:00 PM	3:47:00 PM	9	3:21:00 PM	3:29:00 PM	8	X		HTSA
09/11/11	4:49:00 PM	4:52:00 PM	3					X	Frontel
10/11/11	9:38:00 AM	9:43:00 AM	5				X		C.H. Trueno
11/11/11	9:08:00 AM	9:17:00 AM	9				X		C.H. Trueno
16/11/11	7:39:00 PM	7:54:00 PM	15					x	S.I.C.
18/11/11	1:01:00 PM	3:10:00 PM	129					X	Frontel
24/11/11	7:33:00 AM	7:58:00 AM	25					x	Transnet
01/12/11	4:38:00 PM	6:59:00 PM	141					X	Frontel

Table 2 - Project timeline event details

Date	Short description of the event
17/01/11	Works in transmission line by CGE
17/01/11	Power switch close in S/E Lautaro by TRANSNET
19/01/11	Fuse activation close to S/E Dollinco
23/01/11	Disconnectors opening in S/E Lautaro
25/01/11	Inverse power protection activated in S/E Lautaro
26/01/11	Overload failure in Lautaro S/E
26/01/11	Feeder failure in Lautaro S/E

18/02/11	Transmission lines movement by telephone company
18/02/11	Feeder drop in Lautaro city control F4C
27/03/11	66kV Feeder failure in Temuco-Victoria. Leaves Trueno with no tension.
31/03/11	Short-circuit between phases B and C. Reconector operated in S/E Dollinco
07/04/11	Works in S/E Dollinco, Busching inspection on the transformer
22/04/11	Failure in the distribution system as the interrupter was activated in the Frontel distribution lines
22/04/11	Failure in the distribution system as the interrupter was activated in the Frontel distribution lines
27/04/11	Load chamber works. Cleaning the entry gate
11/05/11	No tension in the main line as works are done to the mid tension SODI N32 lines
14/05/11	No tension in the main line . Dollinco reconector open
07/06/11	Disconnection by regulation of maximum power in charge of Thomas S.
07/06/11	Disconnection by regulation of maximum power in charge of Thomas S.
07/06/11	Flow meter sensor calibration tests
07/06/11	Disconnection by regulation of maximum power in charge of Thomas S.
13/06/11	Transitory failure. No tension on the main line
15/06/11	High tension in Unit 1. Reactive are regulated
11/07/11	Unit 1 is disconnected due to high voltage
14/07/11	Oil sampling testing detention
08/08/11	Oil sampling unit 2
08/08/11	Oil sampling unit 1
09/08/11	Low water level in load chamber due to leaves
09/08/11	Low water level in load chamber due to leaves
10/08/11	Low water level in load chamber due to leaves
10/08/11	High tension, reactive unstable
19/08/11	Turbine cleaning procedure
22/08/11	Turbine cleaning procedure
24/08/11	Turbine cleaning procedure
28/08/11	Turbine cleaning procedure
30/08/11	Turbine cleaning procedure
02/09/11	Units are disconnected . No tension in the lines
02/09/11	Low water level
06/09/11	Turbine cleaning procedure
09/09/11	Turbine cleaning procedure
16/09/11	Turbine cleaning procedure
24/09/11	Power grid failure
28/09/11	Turbine cleaning procedure
09/11/11	Feeder disturbance drops unit 1
10/11/11	Low water level in load chamber due to leaves
11/11/11	Drop in reactive load at the moment of disconnecting unit 2
16/11/11	Electric storm causes drop in reactive power
18/11/11	Power station disconnection as Frontel performs emergency works
24/11/11	Power station disconnection due to transitory failure in the Temuco-Valdivia line
01/12/11	No tension in the power line. Reconector in the S/E Dollinco is operated

Table 3 - Project timeline event description

B.2. Post registration changes

B.2.1. Temporary deviations from registered monitoring plan or applied methodology

The only difference with the monitoring plan was in parameter $FC_{i.i.v}$, where the fuel amount used was done via a direct calculation using the specific consumption of the emergency generator and its operational hours, and instead of the diesel invoices, the guide orders were used to compare the calculated amount of fuel as a QA/QC procedure. This does not lead to an over estimation of CERs as they reflect the exact amount of fuel that was delivered by the fuel provider to the project and

used to run the auxiliary power generator. The fuel invoices show diesel and gasoline that was used in vehicles, so that information was not applicable to monitor the auxiliary power generator's emissions.

The reason for including this deviation as a temporary and not a definite one is because the PP has agreed to modify the monitoring procedures for this parameter in order to fit properly with the corresponding tool requirements. The duration of the difference in the monitoring procedure was present during the entire monitored period, i.e: 12/01/2011 to 31/12/2011. The Project Participant has not installed the meter up to the date of finishing this monitoring report (May 15 2014).

Given that the PP calculated the fuel consumption using the emergency generator's full load fuel consumption during the entire monitoring period for those hours when the equipment was being used, there is no need for previous approval of this deviation from the EB as stated in paragraph 2 of appendix 1 of the Project Standard.

B.2.2. Corrections

No corrections have been introduced.

B.2.3. Permanent changes from registered monitoring plan or applied methodology

The project was implemented with some permanent changes to the monitoring plan as to what was described in the first registered PDD. These changes were corrected in the PDD, and were validated by the DOE and approved by the EB on 18 February 2014. The changes were:

- The power meter indicated in the first PDD indicated a different name and location to what was implemented. Therefore, the PDD now shows the meter located at Dollinco substation, which directly measures the net electricity supplied to the grid (taking into account the transmission and distribution losses incurred) by the project activity as compared to the project owner's own measurement, which would have not taken into account the T& D losses.
- The first PDD said that the project was going to have a SCADA system, which was never implemented.
- The calibration frequency of the power meter in the original PDD was stated as "indicated by the equipment manufacturer", but the manufacturer stated that these meters do not require calibrations, and therefore the PDD was corrected to state that the calibration frequency will be every 3 years, as this is the maximum for small scale projects.
- The parameter associated with fuel consumption relating to project emissions (fuel consumed in the auxiliary power generator) is now being monitored directly instead of using the invoices and operating hours of the equipment to calculate the fuel usage. The corrected monitoring plan indicates a flow meter with a 2% accuracy. The invoices will be used to compare the measurements of the flow meter.
- The PDD was modified so that the VVS template is now used instead of the VVM format.

B.2.4. Changes to project design of registered project activity

No changes have been introduced.

B.2.5. Changes to start date of crediting period

No changes have been requested.

B.2.6. Types of changes specific to afforestation or reforestation project activity

Not applicable.

SECTION C. Description of monitoring system

Calculations for emission reductions were made considering guidance from the methodology AMS ID version 15, and the monitoring plan described below, which was made operational by the project developer.

Monitoring Plan

The monitoring plan consists in measure the amount of electricity produced in the project activity and to calculate the electricity grid's CO_2 emission factor in a yearly basis of the crediting period. The parameters needed for the calculation of the combined margin using the Simple Adjusted OM method for the calculation (guidance provided by the *"Tool to calculate the emission factor for an electricity system" version 4)* are included in the monitoring plan and are to be updated on an *ex-post* manner.

Hidroelectrica Trueno S.A. has been performing its own continuous measurements of the amount of energy produced parallel to the ones performed by the energy distribution company (SAESA) at the energy delivery point. For Quality Assurance and Control, these measurements can be compared taking into account the transmission losses from the power station to the substation.

The parameters for the calculation of the grid's emission factor were updated by carbon consultant using the Simple Adjusted OM method for the calculation. Hence, the Build Margin and Operation Margin were updated following the ex-post option stated in the Tool and PDD.

Own measurements can be compared with the data obtained from the entity which buys the energy as a quality assurance procedure. For this, the electricity and other meters, within the control of project owner, meet the relevant local standards at the time of installation. Before the installation of the meter, it was factory calibrated by the manufacturer and its calibration was assured by Compañía Americana de Multiservicios Ltda.

The source for the parameters that were used to calculate the Operating Margin and Build Margin was performed by CDEC-SIC, CNE and IPCC, and recovered by Hidroelectrica Trueno S.A. while the calculation procedure was assisted by the carbon consultant for the first verification. For later verifications the project participant will be able to calculate the EF or subcontract the carbon consultant for the task.

The recorded data will be kept for at least two years after the ending of the crediting period.

The information flow diagram is presented in the following organizational chart:

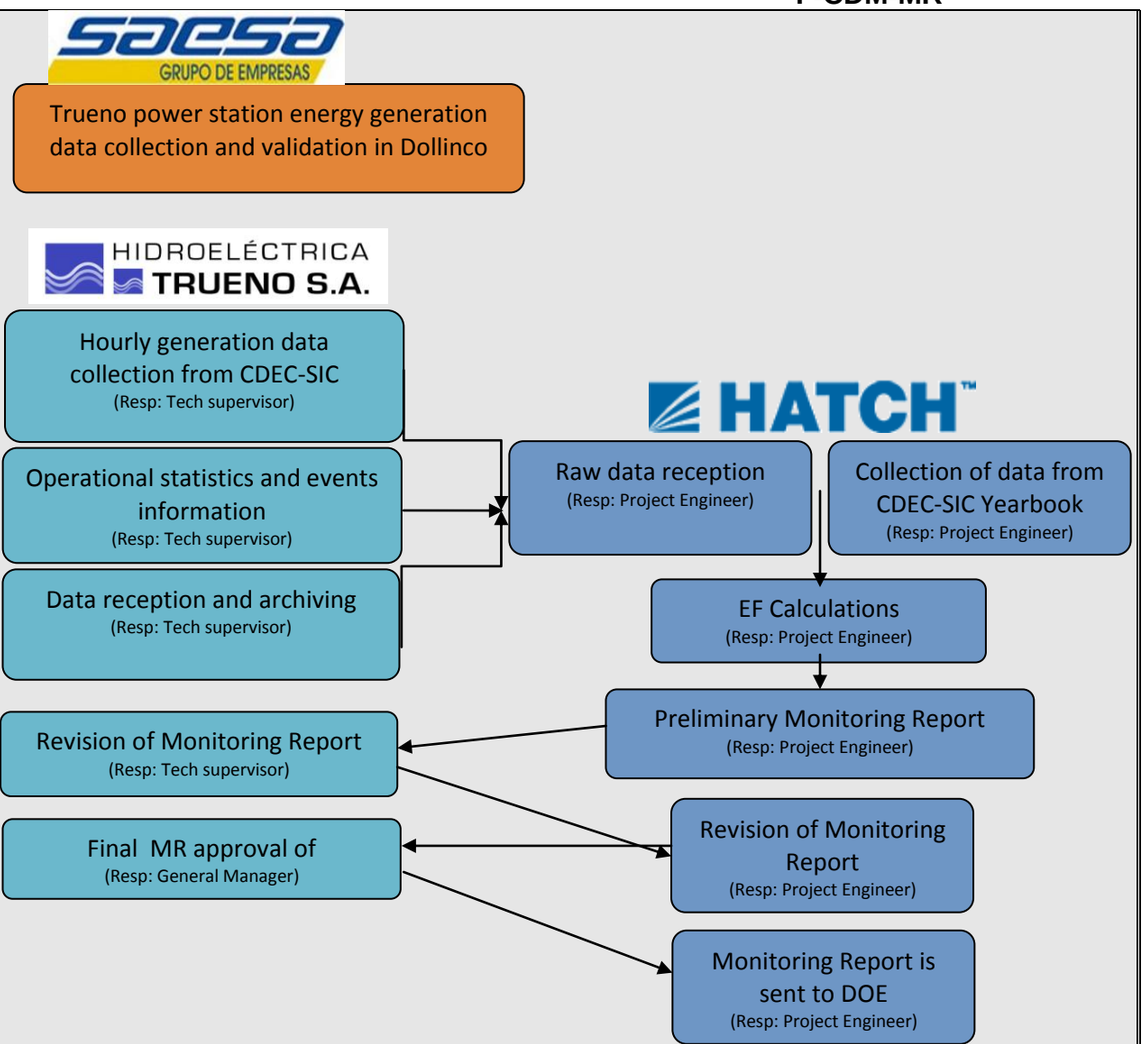

Figure 3 - Organizational Structure and Responsibilities

Monitoring

According to the registered PDD and the applied methodology, the following variables were monitored:

1. Electricity displaced by the project activity in year *y*: Measurements were performed SAESA, the power distribution company in the Dollinco substation. The measurement was carried out using a PowerLogic ION 8600B, class 0.2% meter. Data monitored for this parameter can be found in section D.2.

2. Amount of fossil fuel type *i* consumed by power plant *j* in the year *y*: According to the monitoring plan this parameter should recovered from the official information provided in the CDEC-SIC Operation Statistics Yearbook and CNE Node Prices Report. Therefore, the latest version of the yearbook was chosen which contains the operation statistics of year 2010 to calculate grids emission factor. Consequently, the emission factor was calculated for the year *y-1* for a fraction of the monitored period. Data monitored for this parameter can be found in section D.2.

3. Net electricity generated and delivered to the grid by power plant *j* in the year *y*. This variable's data vintage is the latest version of the CDEC-SIC Operation Statistics Yearbook. The latest version was published during the third trimester of 2011 containing 2010 information. Data monitored for this parameter can be found in section D.2.

4. The amount of hours in the year *y* for which the low-cost/must-run sources in the electricity grid are on the margin, divided by the hours of the year. The hourly power generation information to calculate this parameter were recovered from CDEC-SIC at request and is originally presented on daily worksheets containing the hourly generation for each power plant in the SIC system. The load duration curve graph and hours in which Low Cost Must Run power stations

are in the margin for 2010 can be found in section D.2.

5. Net calorific value of fossil fuel type *i* in the year *y*. *A*s stated in the PDD, the net heating value should be obtained from (a) Values provided by the fuel supplier of the power plants in invoices; (b) Regional or national average defaults; (c) IPCC default values at the lower limit of the uncertainty at a 95% confidence interval as provided in Vol. 2 (Energy) of the 2006 IPCC Guidelines on National GHG Inventories. Option (b) was applied as no fuel supplier information was available. However, information relating Petcoke was not available on the fore mentioned report and a second official information source[4] was used to obtain the net heating value of Petcoke. Information regarding these parameters is presented in section D.2.

6. CO_2 emission factor of fossil fuel type *i* in the year *y*: To convert the heating values to emission factors per unit of energy for each fuel, the 2006 IPCC Guidelines for National Greenhouse Inventories, table 2.2 values were applied. Information regarding these parameters is presented in section D.2.

7. Quantity of fuel consumed in the auxiliary power generator on year *y*. The amount of fuel consumed shall be monitored using a flowmeter with an accuracy of 2%. There was a temporary deviation from the registered monitoring plan, which it is described in section B.2.1. of this Monitoring Report and on the table of section D.2..

The following diagram shows the energy metering point for the power station. The other parameters related to the grid emission factor are monitored by the CDEC-SIC through its different sources and published annually in its operational statistics yearbook.

[4] Node Prices Report October 2004. available at: http://www.cne.cl/archivos_bajar/ITP_SIC_Abr04def.pdf

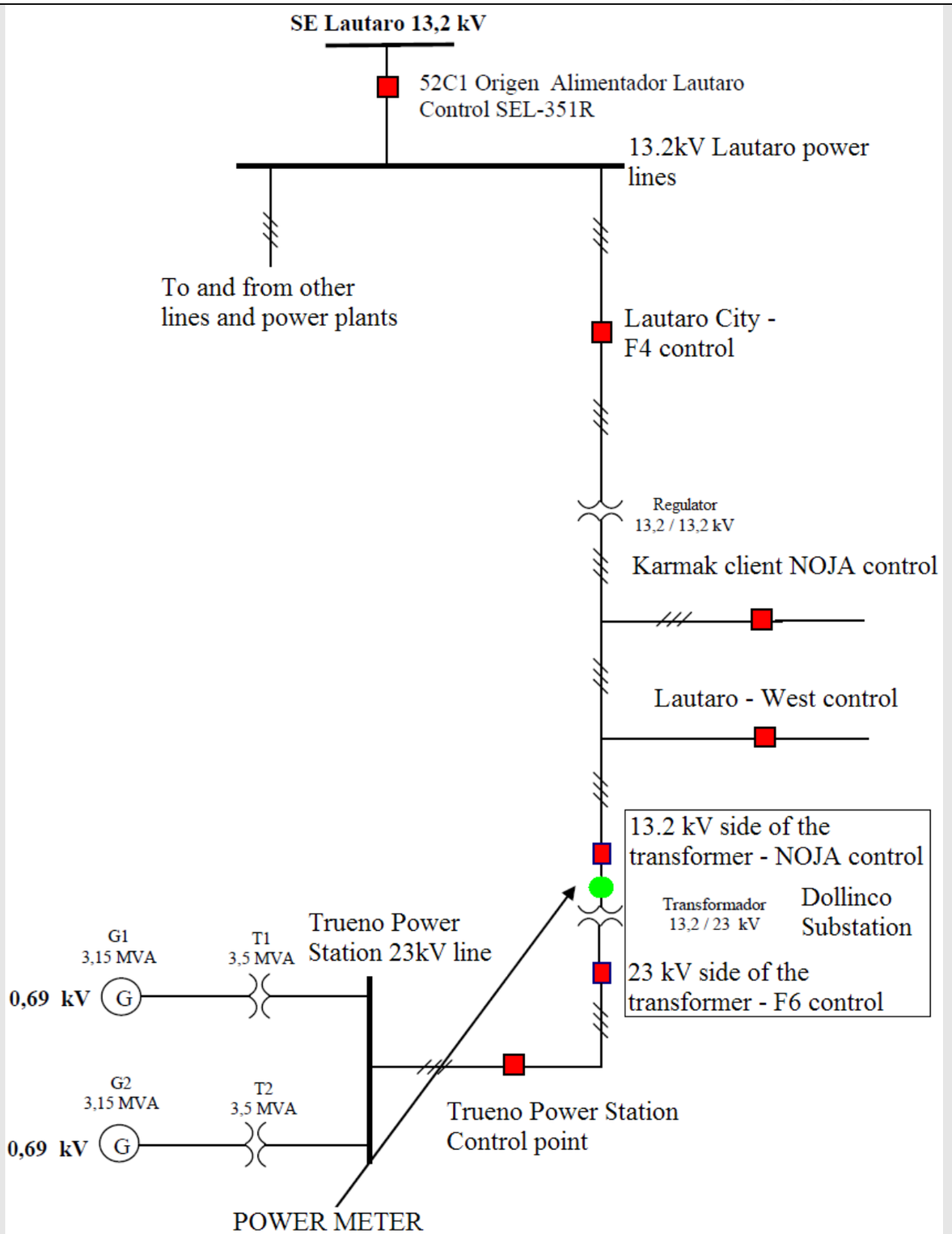

Figure 4 – Power meter location and connection point

SECTION D. Data and parameters

D.1. Data and parameters fixed ex ante or at renewal of crediting period

There are no fixed parameters. Even though the registered PDD repeats variables between sections B.6.2 and B.7.1, for transparency reasons, data for this project is monitored and calculated based on an ex-post method.

D.2. Data and parameters monitored

Data / Parameter:	$EG_{BL,y}$
Unit:	kWh
Description:	Electricity displaced by the project activity in year y
Measured/ Calculated / Default:	Measured
Source of data:	SAESA, the energy distribution company controlling the Dollinco substation in which the energy is injected and used for invoicing.
Value(s) of monitored parameter:	

Year	**Month**	**$EG_{BL,y}$ [kWh]**
2011	January	616,540
2011	February	487,772
2011	March	518,204
2011	April	1,418,248
2011	May	1,412,997
2011	June	3,306,051
2011	July	3,818,175
2011	August	4,040,164
2011	September	3,897,500
2011	October	2,541,230
2011	November	1,459,112
2011	December	715,172
Total		**24,231,166**

The hourly generation is presented in the calculation spreadsheet

Monitoring equipment:	Equipment: ION 8600B Class: 0.2 Serial number: PT-1002A747-01 Calibration frequency: 3 years maximum as per rules of SSC-CDM. This meter does not require calibrations as per manufacturer's specifications; therefore it's conservative to follow a 3 year frequency for verification of its metering accuracy. Last calibration: August 3rd 2010 Next calibration: August 2nd 2013
Measuring/ Reading/ Recording frequency:	Continuous data monitoring, recorded every 15 minutes and grouped and hourly.
Calculation method (if applicable):	

QA/QC procedures:	The procedures established in the PDD were followed as follows: • Information has been crosschecked with the invoices of electricity, which report the same amount of electricity that the energy distribution company, SAESA. • Information has been compared with the CDEC-SIC logs.
Purpose of data:	Baseline Emissions
Additional comment:	Data reported to Hidroelectrica Trueno and CDEC-SIC

Data / Parameter:	$FC_{i,j,y}$
Unit:	Tons of fuel per year
Description:	Amount of fossil fuel type *i* consumed by power plant *j* in the year *y*
Measured/ Calculated / Default:	Measured
Source of data:	• Fuel consumption: CDEC-SIC Operational Statistics Yearbook (2011), page 68 http://www.cdec-sic.cl/datos/anuario2011/ingles/index.html • Specific fuel consumption: Node Prices Report SIC: April (2011, 2010, 2007), October (2010, 2009, 2007)
Value(s) of monitored parameter:	Not possible since there is a large group of values. The details are presented in Annex 1, Table a
Monitoring equipment:	The data was obtained from official national sources.
Measuring/ Reading/ Recording frequency:	Monitored by each power plant owner and reported to official sources. Data read yearly to calculate the emission factor of the grid. Monitoring carried out by official national sources.
Calculation method (if applicable):	-
QA/QC procedures:	The CDEC-SIC is an official source and its data is publicly available. Information is collected from official sources; no QA/QC procedures will be applied by the project participants.
Purpose of data:	Baseline Emission
Additional comment:	-

Data / Parameter:	$NCV_{i,y}$
Unit:	Kcal/Kg or Kcal/m^3 (in the case of natural gas)
Description:	Net calorific value of fossil fuel type *i* in the year *y*
Measured/ Calculated / Default:	Default

Source of data:	**Fuel** / **Source** Coal: National Energy Balance 2008, National Energy Commission Diesel: National Energy Balance 2008, National Energy Commission Petcoke: Node Prices Report October 2004 IFO 180: National Energy Balance 2008, National Energy Commission Natural gas: National Energy Balance 2008, National Energy Commission
Value(s) of monitored parameter:	**Fuel** / **NHV [Kcal/Kg]** Coal: 6,650 Diesel: 10, 355 Petcoke: 6,650 IFO 180: 9,975 Natural gas: 8,407
Monitoring equipment:	The data was obtained from official national sources.
Measuring/ Reading/ Recording frequency:	Data read yearly to calculate the emission factor of the grid. Monitoring carried out by official national sources.
Calculation method (if applicable):	
QA/QC procedures:	The CDEC-SIC is an official source and its data is publicly available. Information is collected from official sources; no QA/QC procedures will be applied by the project participants
Purpose of data:	Baseline Emission
Additional comment:	-

Data / Parameter:	$EF_{CO2,i,y}$
Unit:	tCO_2/TJ
Description:	CO_2 emission factor of fossil fuel type *i* in the year *y*
Measured/ Calculated / Default:	Default
Source of data:	2006 IPCC Guidelines for National Greenhouse Inventories, table 2.2
Value(s) of monitored parameter:	**Fuel** / **EF [$KgCO_2/TJ$]** / **EF [tCO_2/TJ]** Coal: 87300 / 87.3 Diesel: 72600 / 72.6 Natural gas: 54300 / 54.3 Petcoke: 82900 / 82.9 IFO 180 (residual oil): 75500 / 75.5
Monitoring equipment:	The data was obtained from official sources.
Measuring/ Reading/ Recording frequency:	Data monitored by IPCC. Data read yearly by the PP to calculate the emission factor of the grid.
Calculation method (if applicable):	-

QA/QC procedures:	Information is collected from official sources; no QA/QC procedures will be applied by the project participants
Purpose of data:	Baseline emissions
Additional comment:	-

Data / Parameter:	$EG_{j,y}$
Unit:	MWh
Description:	Net electricity generated and delivered to the grid by power plant *j* in the year *y*
Measured/ Calculated / Default:	Default
Source of data:	CDEC-SIC "Operacion real annual" available at: https://www.cdec-sic.cl/est_opera_privada.php
Value(s) of monitored parameter:	Database is too large to show in this table. Please refer to (Annex 1, Table c)
Monitoring equipment:	The data was obtained from official national sources.
Measuring/ Reading/ Recording frequency:	Monitored by each power plant owner and reported to official sources. Data read yearly to calculate the emission factor of the grid. Monitoring carried out by official national sources and before each verification, the project participant retrieves the information from the official sources. In the case of the present monitoring report, this was carried out on a yearly basis, as the monitoring report covers 1 year. The data is considered as default, as it is obtained from official sources.
Calculation method (if applicable):	-
QA/QC procedures:	Information is collected from official sources; no QA/QC procedures will be applied by the project participants
Purpose of data:	Baseline emissions
Additional comment:	-

Data / Parameter:	λ_y
Unit:	% (dimensionless)
Description:	The amount of hours in the year *y* for which the low-cost/must-run sources in the electricity grid are on the margin, divided by the hours of the year (typically 8760)
Measured/ Calculated / Default:	Calculated
Source of data:	CDEC-SIC "Operacion real diaria" available at: https://www.cdec-sic.cl/est_opera_privada.php
Value(s) of monitored parameter:	0.65%, please see annex 1 Figure 1 and Table 4 for details

Monitoring equipment:	The data was obtained from official national sources.
Measuring/ Reading/ Recording frequency:	Monitored by official sources and read yearly by the PP to calculate the emission factor of the grid.
Calculation method (if applicable):	As per the guidance provided on the "Tool to calculate the emission factor for an electricity system", version 02.2.1
QA/QC procedures:	Information was collected from official sources; no QA/QC procedures will be applied by the project participants
Purpose of data:	Baseline emissions
Additional comment:	-

Data / Parameter:	$FC_{i,j,y}$
Unit:	Liters
Description:	Quantity of fuel consumed in the auxiliary power generator on year y
Measured/ Calculated / Default:	Calculated
Source of data:	Obtained by multiplying the generators specific fuel consumption by the monitored hours of operation of the equipment.
Value(s) of monitored parameter:	910.55
Monitoring equipment:	For this monitoring period, the hourmeter of the power generator is used to record the total time that the equipment was running. This way, by multiplying the hours of operation times the engine's specific fuel consumption, the total litres of diesel were obtained. No calibration required
Measuring/ Reading/ Recording frequency:	The hourmeter of the generator records continuously the operating hours of the equipment. These readings are recorded at the start and stop each time the equipment is used on the operational logbook of the emergency power generator.
Calculation method (if applicable):	The PDD states that this parameter is monitored directly using a flowmeter. The calculation method applied during this monitored period is described under additional comments.
QA/QC procedures:	Fuel specific consumption has been retrieved from the equipment manual. Fuel consumption was compared to the diesel guide orders.
Purpose of data:	Project emissions

Additional comment:	Besides the hourmeter readings, the specific time in which the generator starts and stops is recorded in a dedicated electronic logbook. The generator's specific fuel consumption is 16.47 litres per hour at 60kVA, as per the technical specifications of the Hyundai generator. The revised monitoring plan now presents a direct measurement procedure of the fuel consumed instead of a calculated amount, which was considered as a temporary deviation. Both procedures are conservative as the one used in this monitored period incorporates the maximum fuel consumption for the calculation when multiplying the hours of operation, while the revised monitoring period provides certainty that the direct measurement will account for the litres of fuel consumed in an accurate manner.

D.3. Implementation of sampling plan

No sampling plan was implemented.

SECTION E. Calculation of emission reductions or GHG removals by sinks

E.1. Calculation of baseline emissions or baseline net GHG removals by sinks

According to the methodology applied to the project (AMS I.D, version 15), the baseline is the energy produced in kWh by the project renewable power plant multiplied by the emission factor of the SIC grid, in kg CO2e/kWh.

$$BE_y = EG_{BL,y} * EF_{CO_2} \qquad [1]$$

Where:

BE_y: Baseline emissions for the year *y*.
$EG_{BL,y}$: Energy generated by the project activity in the year *y* (expressed in MWh).
EF_{CO2}: CO_2 emission factor of the electricity grid in the year *y*.

The emission factor is a measure of the amount of greenhouse gas emissions that will be displaced with the operation of the project activity. According to the "Tool to calculate the emission factor for an electricity system" the emission factor is calculated in a transparent and conservative manner following the next steps:

STEP 1. Identify the relevant electricity systems;

The power station is connected to the SIC system, which is the main power grid in the country, as described in the PDD. There are no imports from other electricity systems

STEP 2. Choose whether to include off-grid power plants in the project electricity system (optional);

Option I was followed considering only power plants connected to the SIC grid.

STEP 3. Select a method to determine the operating margin (OM);

The Operating Margin method chosen is the Simple adjusted OM, which according to the PDD must be recalculated on a yearly basis (ex-post option). The data vintage chosen is year y-1.

STEP 4. Calculate the operating margin emission factor according to the selected method;

The Simple adjusted OM is calculated as stated in equation 7 of the tool to calculate the emission factor for an electricity grid version 02.2.1 as follows:

$$EF_{grid,OM-adj,y} = (1-\lambda_y) * \frac{\sum_m EG_{m,y} * EF_{EL,m,y}}{\sum_m EG_{m,y}} + \lambda_y * \frac{\sum_k EG_{k,y} * EF_{EL,k,y}}{\sum_k EG_{k,y}} \quad [2]$$

Where:

$EF_{grid,OM-adj,y}$	Simple adjusted operating margin CO_2 emission factor in year y (tCO_2/MWh)
λ_y	The amount of hours in the year *y* for which the low-cost/must-run sources in the electricity grid are on the margin, divided by the hours of the year (typically 8760).
$EG_{m,y}$	Net quantity of electricity generated and delivered to the grid by power unit *m* in year *y* (MWh)
$EG_{k,y}$	Net quantity of electricity generated and delivered to the grid by power unit *k* in year *y* (MWh)
$EF_{EL,m,y}$	CO_2 emission factor of power unit *m* in year *y* (tCO2/MWh)
$EF_{EL,k,y}$	CO_2 emission factor of power unit *k* in year *y* (tCO2/MWh)
m	All grid power units serving the grid in year *y* except low-cost/must-run power units
k	All low-cost/must run grid power units serving the grid in year *y*
y	The relevant year as per the data vintage chosen in Step 3

Then, the following parameters of equation 2 are calculated following Option A1 of the Simple OM method (equation 2 of the tool). Note that the same formula was written twice by applying sub indexes *i* and *k* as stated in equation 2.

$$EF_{EL,m,y} = \frac{\sum_i FC_{i,m,y} * NCV_{i,y} * EF_{CO2,i,y}}{EG_{m,y}} \quad [3a]$$

$$EF_{EL,k,y} = \frac{\sum_i FC_{i,k,y} * NCV_{i,y} * EF_{CO2,i,y}}{EG_{k,y}} \quad [3b]$$

$EF_{EL,m,y}$	CO_2 emission factor of power unit m in year *y* (tCO_2/MWh)
$FC_{i,m,y}$	Amount of fossil fuel type *i* consumed by power plant m in the year *y*.
$FC_{i,k,y}$	Amount of fossil fuel type *i* consumed by power plant k in the year *y*.
$NCV_{i,y}$	Net calorific value of fossil fuel type *i* in the year *y*.
$EF_{CO2,i,y}$	CO_2 emission factor of fossil fuel type *i* in the year *y*.
$EG_{m,y}$	Net electricity generated and delivered to the grid by power plant *m* in the year *y*.
$EG_{k,y}$	Net electricity generated and delivered to the grid by power plant *k* in the year *y*.

λ_y is calculated using equation 8 of the tool as follows:

$$\lambda_y = \frac{Number\_of\_hours\_low-cost\_must-run\_sources\_are\_on\_the\_margin\_in\_year\_y}{8760\_hours\_per\_year} \quad [4]$$

STEP 5. Calculate the build margin (BM) emission factor;

The Build Margin is calculated as follows, using equation 12 of the tool, on an expost option (Option 2):

$$EF_{grid,BM,y} = \frac{\sum_m EG_{m,y} * EF_{EL,m,y}}{\sum_m EG_{m,y}} \quad [5]$$

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

Where the variables involved are analogous to the variables described above for the sample *m* of power plants; the sample is

defined as the power plant capacity additions in the Central Interconnected System that comprise 20% of the electricity generation and that have been built most recently. The selection between the last 5 power plants or the top 20% generation was done as the first option contributed fewer energy than the top 20% generation.

The steps followed to determine the sample group to be included in the Build Margin calculations is explained as follows:

The sample group of power units m used to calculate the build margin should be determined as per the following procedure, consistent with the data vintage selected above:

a) Identify the set of five power units, excluding power units registered as CDM project activities, that started to supply electricity to the grid most recently (SET5-units) and determine their annual electricity generation ($AEG_{SET\text{-}5\text{-}units}$, in MWh);

b) Determine the annual electricity generation of the project electricity system, excluding power units registered as CDM project activities (AEG_{total}, in MWh). Identify the set of power units, excluding power units registered as CDM project activities, that started to supply electricity to the grid most recently and that comprise 20% of AEG_{total} (if 20% falls on part of the generation of a unit, the generation of that unit is fully included in the calculation) (SET≥20%) and determine their annual electricity generation ($AEG_{SET\text{-}\geq 20\%,}$ in MWh);

c) From SET5-units and SET≥20% select the set of power units that comprises the larger annual electricity generation (SET_{sample});

As all power plants included in SET_{sample} are newer than 10 years old, then the following values were assigned to each parameter:

AEGSET-5units	8,035	MWh
AEGSET->20%	11,097,821	MWh
AEGtotal	44,586,259	MWh
SETsample	11,097,821	MWh

Table 4 – Build Margin parameter selection for sample m

The database used to calculate the Build Margin is the following:

All the data required for the calculation of the build margin is presented in the following Table 5.

Name	First year in service	Emissions [tCO2e]	Energy generated [MWh]	Accumulated %
Cabrero (Maisisa)	2010	0	1456	CDM project
Campanario Diesel 4	2010	0	2284	0.01%
Campanario Gas 3	2010	0	106	0.01%
Cem Bio Bio DIESEL	2010	0	0	0.01%
Cem Bio Bio IFO	2010	13210	4190	0.01%
Colihues U1 (IFO)	2010	14260	21982	0.06%
Colihues U2 (DIE)	2010	98	146	0.06%
Confluencia	2010	0	3935	CDM project
Salvador	2010	299	297	0.07%
El Tártaro	2010	0	754	0.07%
Emelda U1	2010	3488	1108	0.07%
Emelda U2	2010	245	78	0.07%
Guacolda 4	2010	792884	1036581	2.39%
Guayacán	2010	0	20180	CDM project
Juncalito	2010	0	1263	2.40%
Loma Los Colorados	2010	0	7825	CDM project
Los Corrales	2010	0	171	2.40%
Mariposas	2010	0	602	2.40%
Punta Colorada	2010	24850	7883	2.42%
Quidico	2010	0	43	2.42%
San Clemente	2010	0	7349	2.43%
Trueno	2010	0	19915	CDM project
Pelohuen (Victoria)	2010	0	0	2.43%
Biomar	2009	0	2	2.43%
Canela 2	2009	0	122611	CDM project
Chuyaca 2	2009	0	0	2.43%
Curanilahue (Trongol)	2009	0	52	2.43%
Curicó	2009	0	499	2.43%
Eagon	2009	0	15	2.43%
El Peñon	2009	38550	57734	2.56%
Guacolda 3	2009	1063920	1199068	5.25%
Lebu (Cristoro)	2009	0	6800	CDM project
Linares Norte	2009	0	142	5.25%
Los Espinos	2009	9547	14201	5.29%
Louisiana Pacific	2009	0	0	5.29%
Monte Redondo	2009	0	82791	CDM project
Multiexport I	2009	0	0	5.29%
Multiexport II	2009	0	0	5.29%
Newen Butano	2009	0	0	5.29%
Newen Diesel	2009	4622	600	5.29%
Newen Gas Natural	2009	0	29865	5.35%
Newen Mezcla Butano/Propano	2009	0	0	5.35%
Newen Propano	2009	0	8325	5.37%
Nueva Ventanas	2009	1811321	1998142	9.85%
Pehui	2009	0	7115	9.87%
Quintero DIESEL A	2009	12745	9950	9.89%
Quintero DIESEL B	2009	0	6807	9.91%
Quintero GNL A	2009	129635	99334	10.13%
Quintero GNL B	2009	0	146622	10.46%
Salmofood I	2009	0	0	10.46%
Salmofood II	2009	0	76	10.46%
San Gregorio	2009	187	265	10.46%
San Lorenzo de D. de Almagro U1	2009	554	235	10.46%
San Lorenzo de D. de Almagro U2	2009	0	75	10.46%
Tapihue	2009	0	1050	10.46%
Teno	2009	39116	58042	10.59%
Termopacifico	2009	14010	19786	10.64%
Tierra Amarilla	2009	2334	2181	10.64%
Totoral (eólica)	2009	0	84686	CDM project
Trapén	2009	28071	42690	10.74%
Truful Truful	2009	0	893	10.74%
Watts	2009	0	0	CDM project
Antilhue_TG	2008	58312	71742	10.90%

Name	First year in s	Emissions [tCO2e]	Energy generated [MWh	Accumulated %
Campanario Diesel 3	2008	0	11735	10.93%
Campanario Gas 2	2008	0	0	10.93%
Cenizas	2008	3097	26866	10.99%
Chiloé	2008	1	1	10.99%
Chuyaca	2008	4367	5465	11.00%
Colmito	2008	1039	1108	11.00%
Coya	2008	0	83304	11.19%
El Manzano	2008	0	27498	CDM project
FPC + FPC 2	2008	0	90548	CDM project
Hornitos	2008	0	195559	CDM project
Lircay	2008	0	121946	CDM project
Los Pinos	2008	115744	174311	11.58%
Nueva Aldea 3	2008	0	192853	12.01%
Ojos de Agua	2008	0	49805	CDM project
Olivos	2008	2865	4019	12.02%
Placilla	2008	0	1121	12.02%
Puclaro	2008	0	24379	CDM project
Quellón II	2008	10162	14396	12.06%
Quintay	2008	651	935	12.06%
San Isidro II GNL	2008	998120	2846343	18.44%
Santa Lidia	2008	40454	49516	18.55%
Skretting	2008	0	59	18.55%
El Totoral	2008	277	429	18.55%
Campanario Diesel 1	2007	20311	5596	18.57%
Campanario Diesel 2	2007	0	6243	18.58%
Campanario Gas 1	2007	0	0	18.58%
Canela	2007	0	28375	CDM project
Cañete	2007	598	730	18.58%
Casablanca 1	2007	172	221	18.58%
Chiburgo	2007	0	75847	18.75%
Collipulli	2007	445	643	18.75%
ConCon	2007	567	406	18.76%
Constitución 1	2007	1355	1887	18.76%
Curacautin	2007	1139	1545	18.76%
Curauma	2007	505	480	18.76%
Degan	2007	27504	41051	18.86%
El Rincón	2007	0	2447	18.86%
Esperanza 1	2007	1341	1020	18.86%
Esperanza 2	2007	0	804	18.87%
Esperanza TG	2007	0	15	18.87%
Eyzaguirre	2007	0	6686	18.88%
Las Vegas	2007	0	673	18.88%
Lebu	2007	0	56	18.88%
Los Sauces (Angol)	2007	755	1107	18.89%
Los Vientos TG	2007	44085	49180	19.00%
Maule	2007	393	647	19.00%
Monte Patria	2007	114	172	19.00%
Palmucho	2007	0	232351	19.52%
Punitaqui	2007	0	309	19.52%
Quilleco	2007	0	387240	CDM project
San Isidro II	2007	56498	16930	19.56%
San Isidro II Diesel	2007	0	87217	19.75%
Chufken (Traiguen)	2007	727	1105	19.76%
Ancud	2006	23287	834	19.76%
Nueva Aldea 2	2006	0	0	CDM project
Quellón	2006	2	758	19.76%
Candelaria 1	2005	139776	35217	19.84%
Nueva Aldea	2005	0	93909	CDM project
Horcones Diesel	2004	10290	6260	19.85%
Horcones TG	2004	575	313	19.85%
L.Verde TG (ex Indio TG)	2004	3254	4211	19.86%
Licantén	2004	0	21461	19.91%
Ralco	2004	0	2220597	24.89%
Total		**5,572,727**	**11,097,821**	

Build Margin [tCO2e/MWh]	0.502

Table 5 – Build Margin Calculations

The result of the calculation is presented in the table below:

	2010
Build Margin [tCO2e/MWh]	**0.502**

Table 6 – Build Margin

STEP 6. Calculate the combined margin (CM) emission factor.

as a combined margin (CM) defined as the combination of the operational margin (OM) and the built margin (OM) as defined on alternative (a) Weighted average CM:

$$EF_y = 0.5 * EF_{OM,y} + 0.5 * EF_{BM,y} \quad [6]$$

Where:

- $EF_{OM,y}$: Operating margin for the year *y*.
- $EF_{BM,y}$: Build margin for the year *y*.

All the data required for the calculation of the previous formulas, except for equation (4) is presented in Annex 1 (Table 1, Table 2, Table 3 and Table 4). The calculation resulting in the operating margin is presented in the table below:

	2010
Number of hours per which low-cost/must-run sources are on the margin	57
Lambda	0.0065
	2010
Low-cost/must-run EF [tCO2e/MWh]	0.000
Other power plants EF [tCO2e/MWh]	0.643
	2010
Simple adjusted OM [tCO2e/MWh]	0.638

Table 7 - Operation margin results

Considering the data exposed above and applying the equation 2, the combined margin is as follows:

	2010
Combined Margin [tCO2e/MWh] 50%-50%	**0.570**

Table 8 – Combined Margin

Now, according to the electricity measurements (Section D.2), the Energy generated by the project activity in the monitoring period was 24,195.8 MWh; now, applying the equation (1) the **emission reductions were 13,809 tCO2e** for the period.

E.2. Calculation of project emissions or actual net GHG removals by sinks

Project emissions associated to the use of an emergency power generator have been conservatively included in the project activity.

In this monitoring period, a total of **2.46 tCO2e** were accounted for 910.55 litres of diesel were used during 55.17 hours in which the generator was running.

The calculation procedure uses the total operating hours of the generator times its specific fuel consumption at 100% capacity.

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Diesel consumption

Diesel consumption @ 1500RPM** (60kVA on Gen)	
16.47	Lts/hour (@60kVA)

**Source: Technical specifications Hyundai generator "hyundai-baja.pdf"

$PE_{FC,j,y}$ [tCO2]	2.46
Weigh related to total ERs	0.0178%

E.3. Calculation of leakage

No leakage emissions are considered for this project

E.4. Summary of calculation of emission reductions or net anthropogenic GHG removals by sinks

Item	Baseline emissions or baseline net GHG removals by sinks ($t CO_2e$)	Project emissions or actual net GHG removals by sinks ($t CO_2e$)	Leakage ($t CO_2e$)	Emission reductions or net anthropogenic GHG removals by sinks ($t CO_2e$)
Total	13, 812	2.46	-	13,809

E.5. Comparison of actual emission reductions or net anthropogenic GHG removals by sinks with estimates in registered PDD

Item	Values estimated in ex-ante calculation of registered PDD	Actual values achieved during this monitoring period
Emission reductions or GHG removals by sinks ($t CO_2e$)	15,569[5]	13,809

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

There are no relevant differences between the values estimated in the PDD and the corresponding monitoring period or operation/implementation of the project. The variations are well within the acceptable limits of a hydro power station and the yearly variation of the grids emission factor.

E.7. Actual emission reductions or net anthropogenic GHG removals by sinks during the first commitment period and the period from 1 January 2013 onwards

Item	Actual values achieved up to 31 December 2012	Actual values achieved from 1 January 2013 onwards
Emission reductions or GHG removals by sinks ($t CO_2e$)	13,809	0

ANNEX 1
Central Interconnected System Grid Data and Parameters

[5] Proportional estimated emission reductions for the number of days (353 days) considered in this monitoring period.

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Name	Unit	Liquid fuels ['000 tones]	Coal ['000 tones]	Natural gas ['000,000 st m3]	Petcoke ['000 tones]
(1) Carbomet + Otros	(1) Carbomet + Otros	-	-	-	
Abanico	Abanico	-	-	-	
Aconcagua	Aconcagua	-	-	-	
Alfalfal	Alfalfal	-	-	-	
Ancud	Ancud	7.40	-	-	
Antilhue_TG	Antilhue_TG	18.53	-	-	
Antuco	Antuco	-	-	-	
Arauco	Arauco	-	-	-	
Biomar	Biomar	-	-	-	
Bocamina	Bocamina	-	81.99	-	
	Bocamina TG				
Cabrero (Maisisa)	Cabrero (Maisisa)	-	-	-	
Campanario	Campanario Diesel 1	6.45	-		
	Campanario Diesel 2				
	Campanario Diesel 3				
	Campanario Diesel 4				
	Campanario Gas 1			-	
	Campanario Gas 2				
	Campanario Gas 3		-		
Candelaria	Candelaria 1	26.81	-	28.99	
	Candelaria 1 Diesel				
	Candelaria 1 GNL				
	Candelaria 2				
	Candelaria 2 Diesel				
	Candelaria 2 GNL				
Canela	Canela				
	Canela 2				
Cañete	Cañete	0.19	-	-	
Canutillar	Canutillar	-	-	-	
Capullo	Capullo	-	-	-	
Casablanca I & II	Casablanca 1	0.05	-	-	
	Casablanca 2				
Cementos Bio Bio	Cem Bio Bio DIESEL	-	-	-	
	Cem Bio Bio IFO	4.19	-	-	
Cenizas	Cenizas	0.98	-	-	
Chacabuquito	Chacabuquito	-	-	-	
Chiburgo	Chiburgo	-	-	-	
Chiloé	Chiloé	0.00	-	-	
Cholguán	Cholguán	-	-	-	
Chuyaca	Chuyaca	1.39	-	-	
	Chuyaca 2				
Cipreses	Cipreses	-	-	-	
Colbun	Colbún	-	-	-	
Colihues	Colihues U1 (IFO)	4.70	-	-	
	Colihues U2 (DIE)	0.03	-	-	
Malleco (Collipulli)	Collipulli	0.14	-	-	
Colmito	Colmito	0.33	-	-	
ConCon	ConCon	0.18	-	-	
Confluencia	Confluencia	-	-	-	
Constitución	Constitución	-	-	-	
Constitución 1	Constitución 1	0.43	-	-	
Celco	Constitución A.	-	-	-	
Coya	Coya	-	-	-	
Curacautín	Curacautín	0.36	-	-	
Curanilahue	Curanilahue (Trongol)	-	-	-	
Curauma	Curauma	0.16	-	-	
Curicó	Curicó	-	-	-	
Curillinque	Curillinque	-	-	-	
D. Almagro	D. Almagro	0.19	-	-	
Degan	Degan	8.74	-	-	
Eagon	Eagon	-	-	-	
El Manzano	El Manzano	-	-	-	
El Peñon	El Peñon	12.25	-	-	
El Rincón	El Rincón	-	-	-	
El Salvador	El Salvador	0.10	-	-	
El Tártaro	El Tártaro	-	-	-	
El Toro	El Toro	-	-	-	
Emelda	Emelda U1	1.11	-	-	
	Emelda U2	0.08	-	-	
Esperanza	Esperanza 1	0.43	-	-	
	Esperanza 2				
	Esperanza TG				
Eyzaguirre	Eyzaguirre	-	-	-	
Florida	Florida	-	-	-	
Escuadron	FPC + FPC 2	-	-	-	
Guacolda	Guacolda 1	-	438.91	-	
	Guacolda 2	-	423.28	-	
	Guacolda 3	-	437.80	-	
	Guacolda 4	-	326.27	-	
Guayacán	Guayacán	-	-	-	
Horcones	Horcones Diesel	3.27	-	-	
	Horcones TG	0.11	-	0.12	
Hornitos	Hornitos	-	-	-	
Huasco TG	Huasco TG	0.62	-	-	
	Huasco TG IFO				
	Huasco TV	-	-	-	
Isla	Isla	-	-	-	
Juncalito	Juncalito	-	-	-	
Laguna Verde	L.Verde	-	-	-	
	L.Verde TG (ex Indio TG)	1.03	-	-	
La Higuera	La Higuera	-	-	-	
La Paloma	La Paloma	-	-	-	
Laja	Laja	-	-	-	
Las Vegas	Las Vegas	0.14	-	-	
Lebu	Lebu	0.01	-	-	
Lebu (Cristoro)	Lebu (Cristoro)	-	-	-	
Licantén	Licantén	-	-	-	
Linares Norte	Linares Norte	0.03	-	-	
Lircay	Lircay	-	-	-	
Loma Alta	Loma Alta	-	-	-	
Loma Los Colorados	Loma Los Colorados	-	-	-	
Los Corrales	Los Corrales	-	-	-	
Los Espinos	Los Espinos	3.03	-	-	
Los Molles	Los Molles	-	-	-	
Los Morros	Los Morros	-	-	-	
Los Pinos	Los Pinos	36.78	-	-	
Los Quilos	Los Quilos	-	-	-	

Name	Unit	Liquid fuels ['000 tones]	Coal ['000 tones]	Natural gas ['000,000 st m3]	Petcoke ['000 tones]
Los Sauces	Los Sauces (Angol)	0.24	-	-	
Los Vientos TG	Los Vientos TG	14.01	-	-	
Louisiana Pacific	Louisiana Pacific	-	-	-	
Machicura	Machicura	-	-	-	
Maitenes	Maitenes	-	-	-	
Mampil	Mampil	-	-	-	
Mariposas	Mariposas	-	-	-	
Maule	Maule	0.12	-	-	
Monte Patria	Monte Patria	0.04	-	-	
Monte Redondo	Monte Redondo	-	-	-	
Multiexport	Multiexport I	-	-	-	
	Multiexport II	-	-	-	
Nehuenco	Nehuenco	111.17			
	Nehuenco Diesel	-			
	Nehuenco GNL		-	39.75	
Nehuenco II	Nehuenco II	252.94			
	Nehuenco II Diesel	-			
	Nehuenco II GNL	-	-	139.76	
Nehuenco TG 9B	Nehuenco TG 9B	0.18	-	-	
	Nehuenco TG 9B Diesel	-	-	-	
	Nehuenco TG 9B GNL		-	1.58	
Newen	Newen Butano	-	-	-	
	Newen Diesel	1.47	-	-	
	Newen Gas Natural	-	-	-	
	Newen Mezcla Butano/Propano	-	-	-	
	Newen Propano	-	-	-	
Nueva Aldea	Nueva Aldea	-	-	-	
	Nueva Aldea 2	-	-	-	
	Nueva Aldea 3	-	-	-	
Nueva Renca	Nueva Renca	-	-	116.18	
	Nueva Renca Diesel	227.20	-	-	
Nueva Ventanas	Nueva Ventanas	-	745.35	-	
Ojos de Agua	Ojos de Agua	-	-	-	
Olivos	Olivos	0.91	-	-	
Palmucho	Palmucho	-	-	-	
Pangue	Pangue	-	-	-	
Pehuenche	Pehuenche	-	-	-	
Pehui	Pehui	-	-	-	
Petropower	Petropower	-		-	26.68
Peuchén	Peuchén	-	-	-	
Pilmaiquén	Pilmaiquén	-	-	-	
Placilla	Placilla	0.23	-	-	
Puclaro	Puclaro	-	-	-	
Pullinque	Pullinque	-	-	-	
Punitaqui	Punitaqui	0.09	-	-	
Punta Colorada	Punta Colorada	7.88	-	-	
Puntilla	Puntilla	-	-	-	
Quelllón	Quellón	0.00	-	-	
	Quellón II	3.23	-	-	
Queltehues	Queltehues	-	-	-	
Quidico	Quidico	-	-	-	
Quilleco	Quilleco	-	-	-	
Quintay	Quintay	0.21	-	-	
Quintero	Quintero DIESEL A	4.05	-		
	Quintero DIESEL B	-	-		
	Quintero GNL A			67.84	
	Quintero GNL B			-	
Ralco	Ralco	-	-	-	
Rapel	Rapel	-	-	-	
Renca	Renca	0.79	-	-	
Rucúe	Rucúe	-	-	-	
Salmofood I	Salmofood I	-	-	-	
Salmofood II	Salmofood II	-	-	-	
San Clemente	San Clemente	-	-	-	
San Fco. de Mostazal	San Fco. de Mostazal	0.28	-	-	
San Gregorio	San Gregorio	0.06	-	-	
San Ignacio	San Ignacio	-	-	-	
San Isidro	San Isidro	14.22			
	San Isidro Diesel	-			
	San Isidro GNL			437.27	
San Isidro II	San Isidro II	17.95			
	San Isidro II Diesel	-			
	San Isidro II GNL			522.33	
San Lorenzo	San Lorenzo de D. de Almagro U1	0.18	-	-	
	San Lorenzo de D. de Almagro U2	-	-	-	
Santa Lidia	Santa Lidia	12.86	-	-	
Sauce Andes	Sauce Andes		-	-	
Sauzal	Sauzal 50Hz	-	-	-	
	Sauzal 60Hz	-	-	-	
Sauzalito	Sauzalito	-	-	-	
Skretting	Skretting	-	-	-	
Taltal 1	Taltal 1	-	-	6.34	
	Taltal 1 Diesel	-	-	-	
	Taltal 1 GNL	-	-	-	
Taltal 2	Taltal 2	23.01	-	11.07	
	Taltal 2 Diesel	-	-	-	
	Taltal 2 GNL		-	-	
Tapihue	Tapihue	-	-	-	
Teno	Teno	12.43	-	-	
Termopacífico	Termopacífico	4.45	-	-	
Coronel	TG Coronel	16.60	-	3.21	
	TG Coronel Diesel	-	-	-	
Tierra Amarilla	Tierra Amarilla	0.74	-	-	
Totoral	Totoral	0.09	-	-	
Totoral (eólica)	Totoral (eólica)	-	-	-	
Traigen	Chufken (Traiguen)	0.23	-	-	
Trapén	Trapén	8.92	-	-	
Trueno	Trueno	-	-	-	
Truful Truful	Truful Truful	-	-	-	
Valdivia	Valdivia	-		-	
Ventanas 1	Ventanas 1	-	346.79	-	
Ventanas 2	Ventanas 2	-	450.45	-	
Victoria	Pelohuen (Victoria)	-	-	-	
Volcan	Volcán	-	-	-	
Watts	Watts	-	-	-	

Table a – Fossil Fuel Consumption ($FC_{i,j,y}$)

Net Heating Values

Fuel	GHV[Kcal/Kg]	NHV[Kcal/Kg]	NHV[TJ/10^3Ton]	Source
Coal	7,000	6,650	27.8	National Energy Balance 2008, National Energy Commission
Diesel	10,900	10,355	43.3	National Energy Balance 2008, National Energy Commission
Petcoke	7,000	6,650	27.8	Node Prices Report October 2004
IFO 180	10,500	9,975	41.8	National Energy Balance 2008, National Energy Commission

Fuel	GHV[Kcal/m3]	NHV[Kcal/m3]	NHV[TJ/10^6m3]	Source
Natural gas	9,341	8,407	35.1912834	National Energy Balance 2008, National Energy Commission

"The difference between NCV and GCV is the latent heat of vaporisation of the water produced during combustion of the fuel. As a consequence for coal and oil, the NCV is about 5 percent less than the GCV For most forms of natural and manufactured gas, the NCV is about 10 percent less."
2006 IPCC Guidelines for National Greenhouse Inventories vol 2 p.1.16

Table b – Heating Values ($NCV_{i,y}$)

HIDROELÉCTRICA TRUENO S.A.

SIC grid emission factor year 2010

Power plant @ 2010 Source: "SIC Power Plants and Main Characteristics" available at pg 30-32: https://www.cdec-sic.cl/contenido_en.php?categoria_id=4&contenido_id=000034		**Energy Generation [GWh]** Source: "Operacion real annual" available at: https://www.cdec-sic.cl/est_opera_privada.php	
		2010	Low-cost/must-run
Name	**Unit**		
(1) Carbomet + Otros	(1) Carbomet + Otros	51.71	NA
Abanico	Abanico	315.05	Y
Aconcagua	Aconcagua	367.95	Y
Alfalfal	Alfalfal	845.50	Y
Ancud	Ancud	0.83	N
Antilhue_TG	Antilhue_TG	71.74	N
Antuco	Antuco	1,448.33	Y
Arauco	Arauco	15.23	Y
Biomar	Biomar	0.00	N
Bocamina	Bocamina	215.77	N
	Bocamina TG		
Cabrero (Maisisa)	Cabrero (Maisisa)	1.46	Y
Campanario	Campanario Diesel 1	5.60	N
	Campanario Diesel 2	6.24	N
	Campanario Diesel 3	11.73	N
	Campanario Diesel 4	2.28	N
	Campanario Gas 1	-	N
	Campanario Gas 2	-	N
	Campanario Gas 3	0.11	N
Candelaria	Candelaria 1	35.22	N
	Candelaria 1 Diesel	48.57	N
	Candelaria 1 GNL	-	N
	Candelaria 2	41.19	N
	Candelaria 2 Diesel	46.56	N
	Candelaria 2 GNL	-	N
Canela	Canela	28.38	Y
	Canela 2	122.61	Y
Cañete	Cañete	0.73	N
Canutillar	Canutillar	1,162.42	Y
Capullo	Capullo	72.75	Y
Casablanca I & II	Casablanca 1	0.22	N
	Casablanca 2	0.00	N
Cementos Bio Bio	Cem Bio Bio DIESEL	-	N
	Cem Bio Bio IFO	4.19	N
Cenizas	Cenizas	26.87	N
Chacabuquito	Chacabuquito	136.62	Y
Chiburgo	Chiburgo	75.85	Y
Chiloé	Chiloé	0.00	N
Cholguán	Cholguán	81.61	Y
Chuyaca	Chuyaca	5.46	N
	Chuyaca 2	-	N
Cipreses	Cipreses	517.34	Y
Colbun	Colbún	1,542.40	Y

Colihues	Colihues U1 (IFO)	21.98	N
	Colihues U2 (DIE)	0.15	N
Malleco (Collipulli)	Collipulli	0.64	N
Colmito	Colmito	1.11	N
ConCon	ConCon	0.41	N
Confluencia	Confluencia	3.94	Y
Constitución	Constitución	51.55	Y
Constitución 1	Constitución 1	1.89	N
Celco	Constitución A.	30.94	Y
Coya	Coya	83.30	Y
Curacautín	Curacautín	1.55	N
Curanilahue	Curanilahue (Trongol)	0.05	N
Curauma	Curauma	0.48	N
Curicó	Curicó	0.50	N
Curillinque	Curillinque	621.36	Y
D. Almagro	D. Almagro	0.44	N
Degan	Degan	41.05	N
Eagon	Eagon	0.01	N
El Manzano	El Manzano	27.50	Y
El Peñon	El Peñon	57.73	N
El Rincón	El Rincón	2.45	Y
Salvador	Salvador	0.30	N
El Tártaro	El Tártaro	0.75	Y
El Toro	El Toro	1,784.25	Y
Emelda	Emelda U1	1.11	N
	Emelda U2	0.08	N
Esperanza	Esperanza 1	1.02	N
	Esperanza 2	0.80	N
	Esperanza TG	0.01	N
Eyzaguirre	Eyzaguirre	6.69	Y
Florida	Florida	118.66	Y
Escuadron	FPC + FPC 2	90.55	Y
Guacolda	Guacolda 1	1,138.23	N
	Guacolda 2	1,109.14	N
	Guacolda 3	1,199.07	N
	Guacolda 4	1,036.58	N
Guayacán	Guayacán	20.18	Y
Horcones	Horcones Diesel	6.26	N
	Horcones TG	0.31	N
Hornitos	Hornitos	195.56	Y
Huasco TG	Huasco TG	0.93	N
	Huasco TG IFO	0.14	N
	Huasco TV	-	N
Isla	Isla	488.23	Y
Juncalito	Juncalito	1.26	Y
Laguna Verde	L.Verde	0.28	N
	L.Verde TG (ex Indio TG)	4.21	N
La Higuera	La Higuera	168.76	Y
La Paloma	La Paloma	5.71	Y
Laja	Laja	44.72	Y
Las Vegas	Las Vegas	0.67	N
Lebu	Lebu	0.06	N
Lebu (Cristoro)	Lebu (Cristoro)	6.80	Y
Licantén	Licantén	21.46	Y

Linares Norte	Linares Norte	0.14	N
Lircay	Lircay	121.95	Y
Loma Alta	Loma Alta	270.33	Y
Loma Los Colorados	Loma Los Colorados	7.83	Y
Los Corrales	Los Corrales	0.17	Y
Los Espinos	Los Espinos	14.20	N
Los Molles	Los Molles	28.34	Y
Los Morros	Los Morros	17.35	Y
Los Pinos	Los Pinos	174.31	N
Los Quilos	Los Quilos	213.57	Y
Los Sauces	Los Sauces (Angol)	1.11	N
Los Vientos TG	Los Vientos TG	49.18	N
Louisiana Pacific	Louisiana Pacific	0.00	N
Machicura	Machicura	340.60	Y
Maitenes	Maitenes	129.72	Y
Mampil	Mampil	106.54	Y
Mariposas	Mariposas	0.60	Y
Maule	Maule	0.65	N
Monte Patria	Monte Patria	0.17	N
Monte Redondo	Monte Redondo	82.79	Y
Multiexport	Multiexport I	-	N
	Multiexport II	-	N
Nehuenco	Nehuenco	3.26	N
	Nehuenco Diesel	673.47	N
	Nehuenco GNL	196.50	N
Nehuenco II	Nehuenco II	213.24	N
	Nehuenco II Diesel	1,547.61	N
	Nehuenco II GNL	765.88	N
Nehuenco TG 9B	Nehuenco TG 9B	2.92	N
	Nehuenco TG 9B Diesel	0.58	N
	Nehuenco TG 9B GNL	3.70	N
Newen	Newen Butano	-	N
	Newen Diesel	0.60	N
	Newen Gas Natural	29.87	N
	Newen Mezcla Butano/Propano	-	N
	Newen Propano	8.33	N
Nueva Aldea	Nueva Aldea	93.91	Y
	Nueva Aldea 2	-	Y
	Nueva Aldea 3	192.85	Y
Nueva Renca	Nueva Renca	613.01	N
	Nueva Renca Diesel	1,300.01	N
Nueva Ventanas	Nueva Ventanas	1,998.14	N
Ojos de Agua	Ojos de Agua	49.80	Y
Olivos	Olivos	4.02	N
Palmucho	Palmucho	232.35	Y
Pangue	Pangue	1,630.70	Y
Pehuenche	Pehuenche	2,091.26	Y
Pehui	Pehui	7.12	Y
Petropower	Petropower	65.52	N
Peuchén	Peuchén	166.45	Y
Pilmaiquén	Pilmaiquén	263.13	Y
Placilla	Placilla	1.12	N
Puclaro	Puclaro	24.38	Y
Pullinque	Pullinque	209.84	Y

Punitaqui	Punitaqui	0.31	N
Punta Colorada	Punta Colorada	7.88	N
Puntilla	Puntilla	146.90	Y
Quellón	Quellón	0.76	N
Quellón II	Quellón II	14.40	N
Queltehues	Queltehues	357.69	Y
Quidico	Quidico	0.04	N
Quilleco	Quilleco	387.24	Y
Quintay	Quintay	0.94	N
Quintero	Quintero DIESEL A	9.95	N
	Quintero DIESEL B	6.81	N
	Quintero GNL A	99.33	N
	Quintero GNL B	146.62	N
Ralco	Ralco	2,220.60	Y
Rapel	Rapel	469.72	Y
Renca	Renca	2.65	N
Rucúe	Rucúe	943.17	Y
Salmofood I	Salmofood I	-	N
Salmofood II	Salmofood II	0.08	N
San Clemente	San Clemente	7.35	Y
San Fco. de Mostazal	San Fco. de Mostazal	0.62	N
San Gregorio	San Gregorio	0.26	N
San Ignacio	San Ignacio	122.23	Y
San Isidro	San Isidro	31.30	N
	San Isidro Diesel	43.62	N
	San Isidro GNL	2,161.27	N
San Isidro II	San Isidro II	16.93	N
	San Isidro II Diesel	87.22	N
	San Isidro II GNL	2,846.34	N
San Lorenzo	San Lorenzo de D. de Almagro U1	0.23	N
	San Lorenzo de D. de Almagro U2	0.07	N
Santa Lidia	Santa Lidia	49.52	N
Sauce Andes	Sauce Andes	6.33	Y
Sauzal	Sauzal 50Hz	423.94	Y
	Sauzal 60Hz	-	Y
Sauzalito	Sauzalito	72.40	Y
Skretting	Skretting	0.06	N
Taltal 1	Taltal 1	19.28	N
	Taltal 1 Diesel	34.90	N
	Taltal 1 GNL	1.66	N
Taltal 2	Taltal 2	36.51	N
	Taltal 2 Diesel	55.71	N
	Taltal 2 GNL	0.04	N
Tapihue	Tapihue	1.05	N
Teno	Teno	58.04	N
Termopacífico	Termopacifico	19.79	N
Coronel	TG_Coronel	29.04	N
	TG_Coronel Diesel	63.24	N
Tierra Amarilla	Tierra Amarilla	2.18	N
El Totoral	El Totoral	0.43	N
Totoral (eólica)	Totoral (eólica)	84.69	Y
Chufken (Traiguen)	Chufken (Traiguen)	1.11	N
Trapén	Trapén	42.69	N
Trueno	Trueno	19.91	Y

Truful Truful	Truful Truful	0.89	Y
Valdivia	Valdivia	225.09	Y
Ventanas 1	Ventanas 1	914.31	N
Ventanas 2	Ventanas 2	1,157.27	N
Victoria	Pelohuen (Victoria)	-	N
Volcan	Volcán	107.66	Y
Watts	Watts	-	N

Table c – Power Generation 2010 ($EG_{i,y}$)

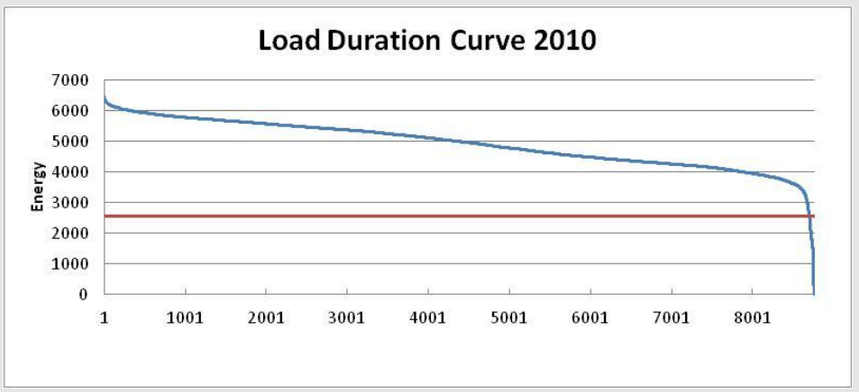


Figure a – Load duration curve ($\lambda_{,y}$)

	2010
Number of hours per which low-cost/must-run sources are on the margin	57
Lambda	0.0065
	2010
Low-cost/must-run EF [tCO2e/MWh]	0.000
Other power plants EF [tCO2e/MWh]	0.643

Table d – Low-Cost / Must-Run Power Station Information

ANNEX 2
Summary of Monitored Variables

Monthly summary $EG_{BL,y}$:

Year	Month	$EG_{BL,y}$ [kWh]	Accumulated Energy Monitoring Period [MWh]
2011	January	616,540	617
2011	February	487,772	1,104
2011	March	518,204	1,623
2011	April	1,418,248	3,041
2011	May	1,412,997	4,454
2011	June	3,306,051	7,760
2011	July	3,818,175	11,578
2011	August	4,040,164	15,618
2011	September	3,897,500	19,516
2011	October	2,541,230	22,057
2011	November	1,459,112	23,516
2011	December	715,172	24,231
Total		**24,231,166**	

Table a –Electricity Generation ($EG_{BL,y}$)

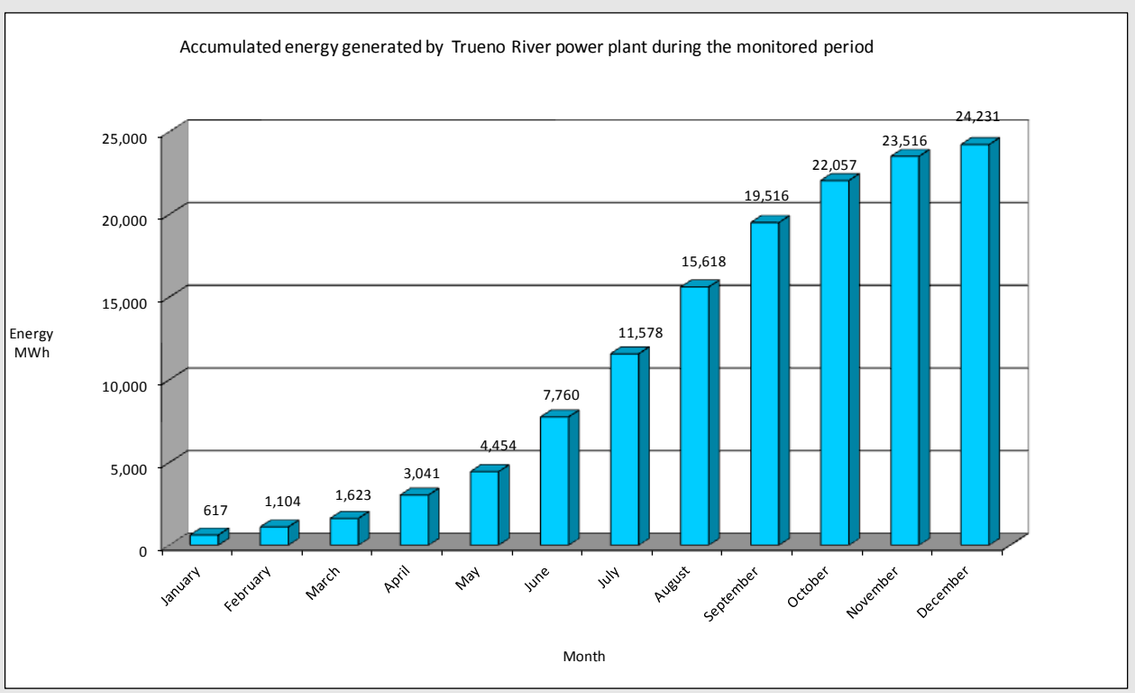


Figure a- Trueno River Power Plant accumulated electricity generation

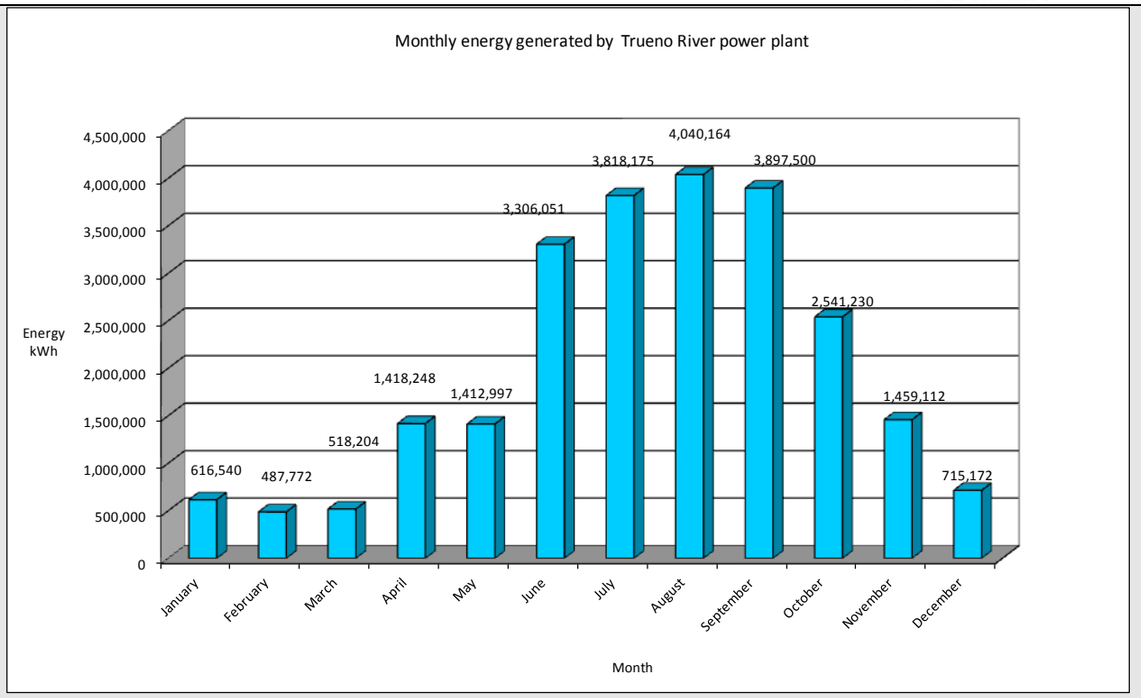


Figure b- Trueno River Power Plant monthly electricity generation

ANNEX 3
Technical description of the project

The Trueno River Hydroelectric Power Plant was designed to have an average power generation of 26.7 GWh per year. The energy produced is directly injected in the Central Interconnected System (SIC), being the country's largest electricity grid that provides energy to the 93% of Chilean population.

The project utilizes two identical German Francis turbines/generators with a combined rated power of 5.68 MW.

In the table below the most relevant technical information is presented:

Item	
Turbines	2 x Francis WKV / 2.84MW
Generators	2 x Horizontal axis WKV / 3150 kVA
Interconnection	39.6 kms of power line in 23kV to the substation Dollinco (energy selling point) from there the energy is injected to the 13,2kV grid of Lautaro
Water conduction	Open channel
Power transformer	3-phase transformer, CLEME make

Table a: General technical information

Equipment	Make	Model	Serial N°	Location	Administrated by (Saesa/Trueno)
2 x Turbines	WKV	FS-140-685 (2640kW)	n/a	Power House	TRUENO
2 x Generators	WKV	G11H-8 (3150kVA)	09-2104-01 & 09-2104-02	Power House	TRUENO
Power transformer	CLEME	3-Phase Transformer	54285 / 54286 / 54287	Transformer court	TRUENO

Power meter	Schneider Electric	ION8600B	PT-1002A747-01	Dollinco Substation	SAESA
Emergency generator	Hyundai	HY4105ZG	9078141	Outside power house	TRUENO
Interconnection	39.6 kms of power line in 23kV to the substation Dollinco (energy selling point) from there the energy is injected to the 13,2kV grid of Lautaro				

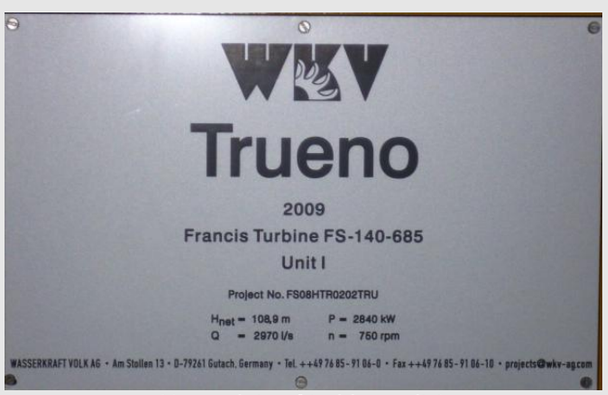
Table b: Specific technical information

Metering at the Dollinco substation provides third party monitoring capabilities (SAESA, energy distribution company) while accounting for net energy generated.

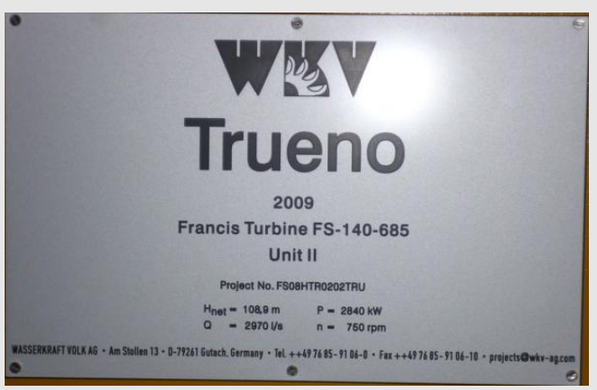
In Figure a below are presented the main project facilities and the electro mechanical plates with its characteristics.

External view of the power house

Inside view of the power house



Nameplate of turbine unit 1



Nameplate of turbine unit 2

Figure a: Photographs of the power station infraestructure

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Document information

Version	*Date*	*Description*
03.2	5 November 2013	Editorial revision to correct table in page 1.
03.1	2 January 2013	Editorial revision to correct table in section E.5.
03.0	3 December 2012	Revision required to introduce a provision on reporting actual emission reductions or net anthropogenic GHG removals by sinks for the period up to 31 December 2012 and the period from 1 January 2013 onwards (EB70, Annex 11).
02.0	13 March 2012	Revision required to ensure consistency with the "Guidelines for completing the monitoring report form" (EB 66, Annex 20).
01	28 May 2010	EB 54, Annex 34. Initial adoption.

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