CLEAN DEVELOPMENT MECHANISM
PROJECT DESIGN DOCUMENT FORM (CDM-SSC-PDD)
Version 03 - in effect as of: 22 December 2006

CONTENTS

Revision history of this document

Version Number	Date	Description and reason of revision
01	21 January 2003	Initial adoption
02	8 July 2005	• The Board agreed to revise the CDM SSC PDD to reflect guidance and clarifications provided by the Board since version 01 of this document. • As a consequence, the guidelines for completing CDM SSC PDD have been revised accordingly to version 2. The latest version can be found at <http://cdm.unfccc.int/Reference/Documents>.
03	22 December 2006	• The Board agreed to revise the CDM project design document for small-scale activities (CDM-SSC-PDD), taking into account CDM-PDD and CDM-NM.

SECTION A. General Description of small-scale project activity

A.1 Title of the small-scale project activity:

"San Clemente Hydroelectric Power Plant"
Version 7.1
28/07/2011

A.2. Description of the small-scale project activity:

The **San Clemente Hydroelectric Power Plant** (the Project), developed by Colbún S.A.[1], is a run-of-river hydroelectric power plant of 5.5 MW nominal capacity, that utilizes the water of the Sanatorio Brook. The project uses water from the Maitenes (or Taco General) irrigation system, which is conducted at the exit of the Maitenes tunnel. The water of the irrigation system is supplied by the Colbún Reservoir[2] through captation facilities downstream Petril Colorado.

The project will divert a nominal flow of 17 m^3/s to a Kaplan turbine and the turbinated water is returned to the Sanatorio Brook only 2 km downstream. A 66 kV transmission line delivers the energy production to the substation of Chiburgo Power Plant, which is integrated into the Grid, "Central Interconnected System" (Sistema Interconectado Central - SIC).

The project started operations in August 2010, when the energy started being delivered to the Grid, displacing energy partially generated by fossil fuel-fired power plants and reducing GHG emissions. The project will generate 28,470 MWh per year that will be supplied to the SIC, which provides electricity to 93% of Chilean population. The project displaces electricity generated by fossil fuel-fired power plants, avoiding GHG emissions estimated in 16,560 tCO_2e per year and 115,920 tCO_2e in the first crediting period.

The implementation of the project will contribute to sustainable development:

- Reducing the effects of the combustion of fossil fuels, both locally and globally.
- Being a source of employment in the geographical zone where it is located, contributing to the local sustainability (50% of the full workforce to be employed during the construction phase of San Clemente will be sourced locally, positively impacting the community of San Clemente, host of the project, which has a high level of rural population, poverty and unemployment compared to the national average). Resulting in an enhancement of the economic activity during both the construction period and the lifetime of the project.

[1] Colbún S.A. is a Chilean power generation company that operates hydroelectric and thermoelectric power plants in the SIC since 1986 (Colbún S.A. since 2001), it also has CDM hydroelectric projects in Chile (3 registered: 1052 "Chacabuquito Hydroelectric Power Project", 1265 "Quilleco Hydroelectric Project", and 1374 "Hornitos Hydroelectric Project").

[2] Upstream the project activity there is an existing reservoir named "Embalse Colbún", which was constructed for the operation of "Colbún Power Plant" (474 MW, operating since 1985). The reservoir has a capacity of 1,116,000 m^3, equivalent to 552,000 MWh. The regulation of the reservoir is made in order to optimize the power generation at "Colbún Power Plant" and has no relation with the project activity.

- Helping to satisfy the increasing demand of electricity in Chile using clean and renewable local resources, reducing the reliance on imported fossil fuels.
- Increasing commercial activity through clean and renewable source of power.
- Developing capacity building inside the company for future projects with similar characteristics and introducing and demonstrating environmentally-friendly power production techniques for the VII Region of Chile.
- Contributing to fiscal accounts though the payment of taxes (locally and nationally).
- Helping Chile to improve its hydrocarbon trade balance through reduction of oil derivates consumption used for electricity generation.
- Improving the commercial activity since the increase of the people/workers during construction and operation in the area will require more services like, food, transport, and others.
- Optimizing an existing hydropower scheme.

A.3. Project participants:

Name of Party involved (*) (host) indicates a host Party)	Private and/or public entity(ies) project participants (*) (as applicable)	Kindly indicate if the Party involved wishes to be considered as project participant (Yes/No)
Chile (host)	Colbún S.A.	NO

*In accordance with the CDM modalities and procedures, at the time of making the CDM-SSC-PDD public at the stage of validation, a Party involved may or may not have provided its approval. At the time of requesting registration, the approval by the Party (ies) involved is required.

Note: *When the PDD is filled in support of a proposed new methodology* at least the host Party (ies) and any known project participant (e.g. those proposing a new methodology) shall be identified.

A.4. Technical description of the small-scale project activity:

A.4.1. Location of the small-scale project activity:

A.4.1.1. Host Party (ies):

Chile

A.4.1.2. Region/State/Province etc.:

Region of Maule (VII Region) / province of Talca.

A.4.1.3. City/Town/Community etc:

San Clemente

A.4.1.4. Details of physical location, including information allowing the unique identification of this small-scale project activity:

The project is located in the San Clemente commune, Talca Province, VII Region of Maule, about 33km south east of the city of Talca, in an area known as Sanatorio, close to the north bank of the Maule River and downstream from the Colbún reservoir.

The project does not consider the development of new roads, as it will utilize the existing routes CH 115 (Talca - San Clemente – Colorado) and rol K721 (Perquín – Colorado).

The specific coordinates of the project are:

Table 1: Project Coordinates

	South	West
Intake	35° 35’ 48.1”	71° 20’ 15.7”
Adduction channel	35° 35’ 48.4”	71° 20’ 18.1”
Foreby tank	35° 35’ 50.5”	71° 21’ 42.2”
Power house	35° 35’ 50.7”	71° 21’ 20.2”
Penstock	35° 35’ 51.5”	71° 21’ 17.8”
Discharge channel	35° 35’ 50.4”	71° 21’ 20.8”

The location of the project activity is illustrated in the following figures:

Figure 1: Location of the Host Party

Figure 2: Location of the Region of Maule (VII Region)

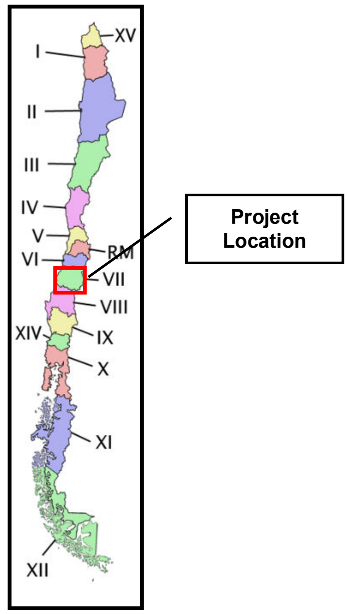
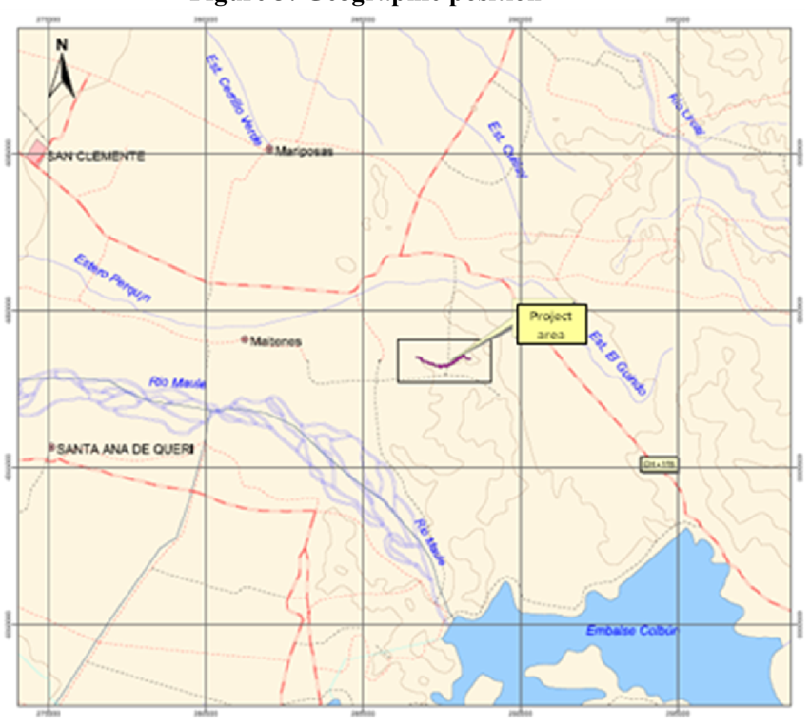


Figure 3: Geographic position



A.4.2. Type and category (ies) and technology/measure of the small-scale project activity:

According with the Decision 1/CMP.2 the definitions for small-scale clean development mechanism project activities are;

(a) Type I project activities shall remain the same, such that renewable energy project activities shall have a maximum output capacity of 15 MW (or an appropriate equivalent);

(b) Type II project activities or those relating to improvements in energy efficiency which reduce energy consumption, on the supply and/or demand side, shall be limited to those with a maximum output of 60 GWh per year (or an appropriate equivalent);

(c) Type III project activities, otherwise known as other project activities, shall be limited to those that result in emission reductions of less than or equal to 60 ktCO_2 equivalent annually;

Since the proposed project activity is a new renewable power plant connected to the grid with a nominal installed capacity of 5.5 MW [(3)], the project activity qualifies as a small-scale CDM activity Type category D:

- Type I: Renewable Energy Projects.
- Category D: Renewable electricity generation for a grid.

The technology to be used in the unit is a run-of-river hydropower generation technology, consisting of water intakes, adduction channel and penstocks leading to a vertical axe Kaplan turbine (5.5 MW) coupled with a vertical axe generator (6.3MVA). The unit also has a powerhouse and pipeline leading the water to the turbine where the electricity is generated.

The water is diverted immediately at the Maitenes tunnel exit. The water is driven through the adduction channel, to a penstock that leads the water to the powerhouse, which houses a Kaplan turbine and the associated generation equipment. The water is returned to the Sanatorio brook through a return channel.

There will be one (1) substation with a transformer that elevates the tension up to 66 kV for the project activity. Then, the electricity will be transmitted through a 7.2 km transmission line to Chiburgo Substation.

The specific characteristic of the hydropower unit are shown in the following table:

[3] Nominal power guaranteed by the manufacturer. According to Colbún experience, this kind of turbines could work with an overload of around 10%, which will be tested since the second year of operation. This margin corresponds to a security criteria of the manufacturer in cases where the turbine operates at its maximum flow. Achieving this overload is a very unlikely scenario, and in case of occurring, it would be only in isolated situations in the months of January and December. Furthermore, the operation of the unit will not rely on this extra power output in order to avoid any overload and equipment failure risk, so the project design and evaluation spreadsheets do not consider it.

Table 2: Technical characteristics of the project activity

<table>
<tr><td>Intake</td><td>- Nominal flow: 17 m^3/s
- Revetment: concrete
- Level at the exit of the tunnel: 358.55m.a.s.l.</td></tr>
<tr><td>Adduction channel</td><td>- Total Length: 1.656km.
- Section: trapezoidal type.
- Base width: 2.7 m and Height: 3.30 m.
- Channel slope: 0.03%.</td></tr>
<tr><td>Forebay tank</td><td>- Length: 35 m, Wide: 3.7m and Depth: 3.65-9.40 m.</td></tr>
<tr><td>Penstock</td><td>- Number of pipes: one
- Material: steel
- Total Length: 78.16 m
- Diameter: 2.2 m</td></tr>
<tr><td>Power house</td><td>- Length: 16.5 m, Wide: 15.35 m
- Equipment: turbine, safety valve and generator.
<table>
<tr><th colspan="2">Turbine</th><th colspan="2">Generator</th></tr>
<tr><td>Type:</td><td>Kaplan CAT</td><td>Axis:</td><td>Vertical</td></tr>
<tr><td>Axis:</td><td>Vertical</td><td>Capacity:</td><td>5,985 kW</td></tr>
<tr><td>Nominal flow:</td><td>17 m^3/s</td><td>Apparent capacity</td><td>6,300kVA</td></tr>
<tr><td>Nominal capacity:</td><td>5.5 MW (*)</td><td>Frequency</td><td>50 Hz</td></tr>
<tr><td>Net height of fall:</td><td>35.5 meters</td><td>Voltage:</td><td>6,600 kV</td></tr>
<tr><td></td><td></td><td>Speed</td><td>428.6 rpm</td></tr>
</table>
(*) During the different stages of the project (basic engineer, detailed engineer, request of environmental approval) there were minor modifications in the installed capacity. 5.5 MW corresponds to the definitive nominal value.</td></tr>
<tr><td>Discharge channel</td><td>- Length: 354.3m, Wide: 3.2m and High: 3.8m
- Section: drawer type
- Revetment: concrete.
- Channel slope: 0.01%.</td></tr>
<tr><td>Other facilities</td><td>- Discharge to evacuate in an emergency only the water from headrace chamber.
- Local dump: 26 m length
- Collector channel (wide: 2.5 m, slope: 0.5% and length: 26 m).
- Rapid discharge (length: 127.3 m and wide: 2.5 m).</td></tr>
</table>

Source: "Central Hidroeléctrica San Clemente Readecuación de Ingeniería Básica. Informe Final" (Final Report of Basic Engineer Modification), October 2008.

The technology utilized is a safe and sound clean technology with a minimal impact on the environment. The project construction and operation meets Chilean environmental standards (see section D). The turbine utilized in this project was imported from Italy and the generator was imported from Spain. Also, the technicians and engineers from the equipment supplier trained the operational and maintenance power plant staff.

A.4.3 Estimated amount of emission reductions over the chosen crediting period:

In accordance with the AMS – I.D, v.16 (EB 54) the implementation of the project in the Central Interconnected System (SIC) will reduce 16,560 tCO_2e/year. Based on this estimated annual CO_2e reduction of the project activity, the reduction over the first 7-year crediting period will be of 115,920 tCO_2e.

Estimated amount of emission reductions of CO_2 per year:

Years	**Estimation of annual emission reductions in tonnes of CO_2e**
2011 *	2,760
2012	16,560
2013	16,560
2014	16,560
2015	16,560
2016	16,560
2017	16,560
2018 **	13,800
Total estimated reductions (tonnes of CO_2e)	115,920
Total number of crediting years	**7**
Annual average of the estimated reductions over the crediting period (tonnes of CO_2 e)	16,560

* November – December ** January – October

The emission factor of the grid will be recalculated at the end of each crediting period of 7 years. For the second and third crediting periods, the estimated emission reductions will be recalculated taking into account any possible modification to the current baseline.

The average emissions factor of the grid was calculated with the approved "Tool to calculate the emission factor for an electricity system version02", as stated in the AMS – I.D, v.16, using the technical information of Chilean`s electrical sector and the data of generation and consumption of all the SIC power plants and units. This information has been provided by CDEC SIC[4] and CNE[5] for the years 2006, 2007 and 2008.

[4] "Centro de Despacho Económico de Carga del Sistema Interconectado Central" or "Dispatch Economic Center of the Central Interconnected System". https://www.cdec-sic.cl/

[5] "Comisión Nacional de Energía" or "National Commission of Energy". www.cne.cl/

A.4.4. Public funding of the small-scale project activity:

The project activity does not involve the use of public funding.

A.4.5. Confirmation that the small-scale project activity is not a debundled component of a large scale project activity:

According with Appendix C to the simplified modalities and procedures for the small-scale CDM project activities, a proposed small-scale project activity shall be deemed to be a debundled component of a large project activity if there is a registered small-scale CDM project activity or an application to register another small-scale CDM project activity:

(a) With the same project participants;

(b) In the same project category and technology/measure; and

(c) Registered within the previous 2 years; and

(d) Whose project boundary is within 1 km of the project boundary of the proposed small scale activity at the closest point.

Since these conditions are not met by the proposed project activity, it is not considered a debundled component and is eligible to use the simplified modalities and procedures for small-scale CDM project activities.

SECTION B. Application of a baseline and monitoring methodology

B.1. Title and reference of the approved baseline and monitoring methodology applied to the small-scale project activity:

The approved baseline and monitoring methodology used in this project activity is **AMS-I.D "Grid connected renewable electricity generation" version 16**, valid from Jun 10th 2010 onwards, approved in the EB54 meeting.

The usage of this methodology includes the use of:

- Tool to calculate the emission factor for an electricity system, Version 02.

B.2 Justification of the choice of the project category:

The Project falls into project category I.D. because:

– It is a hydropower plant that will supply renewable electricity to the Central Interconnected System (SIC). According to AMS-ID. "Grid connected renewable electricity generation" v.16, I.D. category comprises renewable energy generation units, such as photovoltaic, hydro, tidal/wave, wind, geothermal, and biomass that supply electricity to national or regional grid.

– The nominal capacity of the Project is 5.5 MW, which will not be increased beyond 15 MW over time. The Project will comply with CDM limits for small-scale project activities every year over its 21-year maximum crediting period.

The approved methodology AMS – I.D. v.16 is applicable to the proposed project activity since it can be applied to new run-of-river hydroelectric power plants with an installed capacity of less than 15 MW.

Even when there is an upstream reservoir belonging to the project developer, it is significantly far away and is not part of the project activity. The reservoir was constructed as part of "Colbún Power Plant" (474 MW, operating since 1985) and it is operated in order to optimize the power generation of that power plant; then, no changes in the facilities or its operation will be implemented due to the project activity (its operation is regulated by an external national electrical entity named CDEC – SIC).

B.3. Description of the project boundary:

According to AMS-I.D "Grid connected renewable electricity generation" version 16, the boundary is defined as:

The physical, geographical site of the renewable generation source.

As described in the section A.4.1., the project activity is located downstream "Colbún" dam, close to the north bank of the Maule River. The project boundary encompasses the power house, the forebay tank and the discharge channel.

B.4. Description of baseline and its development:

As the project activity is the installation of a new grid-connected renewable power plant, the baseline scenario is the electricity delivered to the grid by the project activity that otherwise would have been generated by the operation of grid-connected power plants and by the addition of new generation sources. The baseline emissions are the product of electrical energy baseline $EG_{BL,y}$ expressed in MWh of electricity produced by the renewable generating unit multiplied by the grid emission factor. The emission factor can be calculated in a transparent and conservative manner as:

(a) A combined margin (CM), consisting of the combination of operating margin (OM) and build margin (BM) according to the procedures prescribed in the 'Tool to calculate the emission factor for an electricity system' (version 02)

OR

(b) The weighted average emissions (in t CO_2/MWh) of the current generation mix."

For the present project activity, the calculation of the baseline emission factor will be done using option (a) of the methodology, and then the 'Tool to calculate the emission factor for an electricity system' version 02 will be applied. According with the tool, the baseline emission factor is defined as EF_y and is calculated as a combined margin (CM), consisting of the combination of operating margin (OM) and build margin (BM) factors. For the purpose of determining the build margin and the operating margin emission factors, a project electricity system is defined by the spatial extent of the power plants that can be dispatched without significant transmission constraints. All variables and parameters used for these calculations are presented in sections B.6. and B.7.

B.5. Description of how the anthropogenic emissions of GHG by sources are reduced below those that would have occurred in the absence of the registered small-scale CDM project activity:

CDM Consideration

The Project Developer has been developing CDM projects since 2005 (Chacabuquito Hydroelectric Power Project[6], registered in July 2007, number 1052) and has been increasing its zero emissions run of river capacity using CDM to overcome all the barriers or low economic attractiveness[7]. All the CDM know how is applied to any new project facing difficulties in its implementation.

The following milestones of the project reflect the serious CDM consideration of the project:

- May 29th, 2007: The environmental evaluations start. Presentation letter DIA to CONAMA[8]
- September 12th, 2007: The environmental evaluation is approved. Environmental Qualification Resolution (Resoluación de Calificación Ambiental – RCA)[9].
- January 29th, 2008: Board presentation confirming that the project will be submitted as a CDM project (Document submitted to the validation team).
- March 04th, 2008: Board of Director's Ordinary Session Act Nº 471/08 approving the investment in the project and confirming the necessity of CERs income due to the profitability conditions of the project.
- June 26th, 2008: Memorandum of Understanding to proceed with the contract to deliver project activity equiptments → Start date of the project activity.
- August 12th, 2008: Contract CHSC-50 "Delivery and Supervision of the Assembly and commissioning of the San Clemente Power Plant" ("Suministro y Supervisión al Montaje y Puesta en Servicio CH San Clemente").
- November 24th 2009: Contract with TÜV NORD to provides the validation services.

Additionality Assessment

In the paragraphs below it is demonstrated that the proposed project activity is additional as per options provided under attachment A to Appendix B of the simplified modalities and procedures for small-scale CDM project activities.

INVESTMENT BARRIER

[6] http://cdm.unfccc.int/Projects/DB/DNV-CUK1175238807.52/view

[7] Two other registered run of river projects: number 1265 "Quilleco Hydroelectric Project" (http://cdm.unfccc.int/Projects/DB/DNV-CUK1185438104.23/view); number 1374 "Hornitos Hydroelectric Project" (http://cdm.unfccc.int/Projects/DB/DNV-CUK1191820137.74/view).

[8] https://www.e-seia.cl/expediente/expedientesEvaluacion.php?modo=ficha&id_expediente=2171317

[9] Idem 8.

The financial indicator for this analysis is the Internal Rate of Return (IRR), which is the indicator commonly used to determine the investment decision. According the law of electricity in Chile (DFL 4 / 2006)[10], the suitable benchmark value for power projects is 10%, used too to determine node prices, transmission line and distribution investment.

The Project developer of the plant hydropower San Clemente will invest US$ 17,240,978 in engineering and inspection costs, civil works, and montage of the powerhouse and transmission lines.

As a result of an economic evaluation carried out at San Clemente Project the following results are obtained: an IRR of 8.78% excluding income from CERs, which makes it unprofitable for financing the investment; an IRR of 10.70% considering income of CERs, which shows the importance of the benefits of the CDM in order to achieve better performance to help to overcome its implementation.

The IRR is under the benchmark, excluding CER incomes, but their consideration increases the profitability of the project benefiting all financial indicators, strengthening the cash flow and reducing the risks of operating the small power plant. Therefore, the CDM income on the project helps to overcome the investment barrier.

The table below shows the parameters used to calculate the economic assessment[11]:

[10] http://www.cne.cl/cnewww/export/sites/default/08_Normativas/02_energias/descargable_sectorelectrico/DOC01_-_DFL_N4.pdf

[11] The starting date of the project was in an electric market with no law No 20,257 "Law for General Electric Services related to production of electric energy with non conventional renewable energy sources" ("Ley General de Servicios eléctricos respecto de la generación de energía eléctrica con fuentes de energía renovables no convencionales"), since this regulation was emitted on April 1st, 2008. The economic assessment was made in January 2008.

Table 3: parameters used for the economic assessment

Energy Production	28,470 MWh/year	
Total Investment (CAPEX)	17.2 MMUS$	
Energy Price (2009-2013) (US$ /MWh)	2009 2010 2011 2012 2013	148.6 118.6 80.1 64.3 49.9
Average Energy Price of long-term (2014 onward)	50 US$ /MWh	
Period of assessment	20 years	
CERs Price	20 US$/t$CO_2$	
O&M Costs	259.000 US$/year	
Firm Capacity	3.04 MW/month	
Firm Capacity Price (US$/kW-month)	2009 2010 2011 2012 2013 and on	8.07 7.66 7.28 6.92 6.92
IRR without CDM	8.78%	
IRR with CDM	10.70%	

The project was evaluated considering 100% equity because no debt was projected.

For the period 2009-2013 the project was evaluated with an energy price estimation based on the official projections of the Comisión Nacional de Energía (National Energy Commission) of the "Informe de Fijación de Precio Nudo October 2007" (Node Price Fixation Report, October 2007)[12]. From 2014 onward a fixed long term price based on coal fired power plants development was considered.

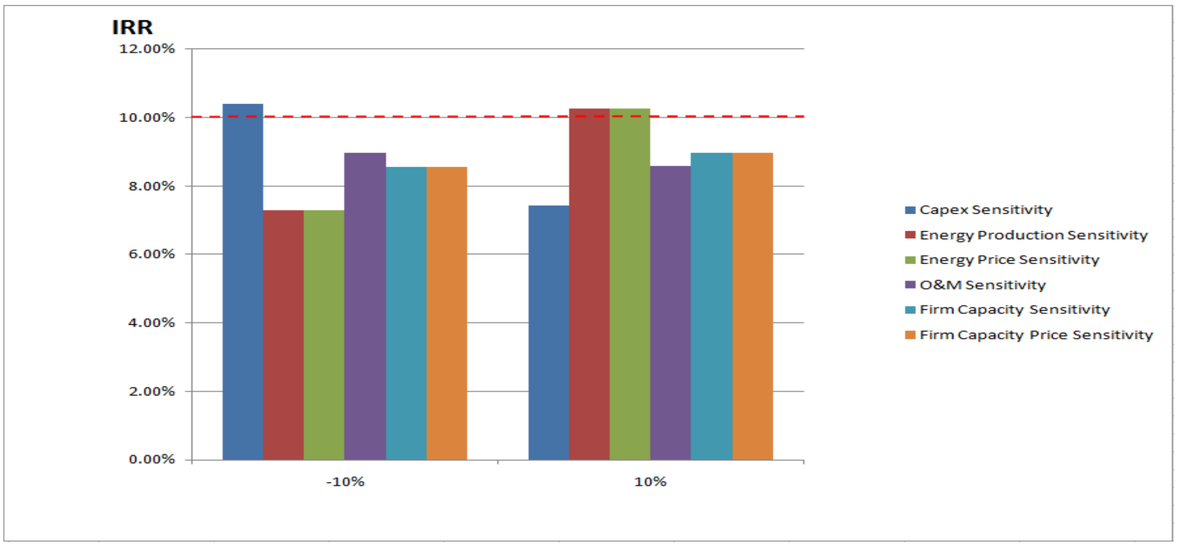
A sensitivity analysis was developed, including variables that constitute more than 20% of the income/cost (CAPEX, energy production and energy price) and also less significant variables for reference (O&M and firm capacity), with the following results:

-10% CAPEX: 10.41% IRR
+10% CAPEX: 7.44% IRR
-10% energy production: 7.30% IRR
+10% energy production: 10.25% IRR
-10% energy price: 7.30% IRR
+10% energy price: 10.25% IRR
-10% O&M cost: 8.98% IRR
+10% O&M cost: 8.57% IRR

[12] The information is available at http://www.cne.cl/cnewww/opencms/07_Tarificacion/01_Electricidad/Otros/Precios_nudo/otros_precios_de_nudo/octubre2007.html

-10% Firm capacity:	8.57% IRR
+10% Firm capacity:	8.98% IRR
-10% Firm capacity price:	8.57% IRR
+10% Firm capacity price:	8.98% IRR

The following graph summarizes the sensitivity analysis:



Graph 1: Sensitivity Analysis

10% overproduction of electricity: considering the 41 years of flow statistics before the project evaluation (and its associated energy generation) a 10% overproduction is very unlikely to happen (less than 15% of the considered years).

10% reduction of CAPEX: Colbún´s previous experience in hydroelectric projects suggests that final investment is not likely to differ from their original budget in more than 5%. As a reference the last two run of river hydro projects that the Company has developed (Hornitos and Chiburgo) presented a CAPEX variation of -1.81% and +5.44% respectively.

10% increase of energy price: this theoretical scenario gives a slightly over the benchmark IRR of 10.25%. This scenario is very unlikely since all variables and parameters were very conservatively estimated.

All the above evidence confirms that Colbun's decision of going forward with the project was definitely supported by the additional incomes of the Clean Development Mechanism (CDM).

PREVAILING PRACTICE

As it is shown in the paragraphs below, the construction of power plants similar to the project activity is not the prevailing practice, and the prevailing practice would have led to the implementation of fossil fuel-fired power plants, which have higher emissions than the project activity.

As it is shown in table below, there were 23 power plants under construction to be connected to the SIC; 16 of them were fossil fuel-fired power plants (2084.4 MW or 85.1% of the total installed capacity in construction), thus with higher GHG emissions than the project activity. There were seven '0 emissions' power plants under construction: 6 hydro and 1 wind power plant. Five of the '0 emissions' power plants are currently at some stage of CDM process (1 at validation and 4 registered).

It is important to mention that hydroelectric plant Coya-Pangal (not a CDM project activity), is not a new power plant, since before its connection to the SIC (April 2008), this facility supplied to the mine company El Teniente[13]. Therefore, none of the power plants under construction without CDM are similar to the project activity.

Table 5: Power Plants Under Construction

	CDM Status	Power Plants Under Construction	Power MW	
0 Emissions	-	Hydroelectric Power Plant Coya-Pangal	10.8	364.44
	Registered – Number 1267	Hydroelectric Power Plant Puclaro	5.6	
	Registered – Number 937	Hydroelectric Power Plant Ojos de Agua	9	
	Registered – Number 2417	Hydroelectric Power Plant Lircay	19.04	
	-	Wind Power Plant Punta Colorada	20	
	Registered – Number 248	Hydroelectric Power Plant La Higuera	155	
	At Validation	Hydroelectric Power Plant Confluencia	145	
Fossil		Diesel Power Plant Cenizas	17.1	2084.4
		Diesel Turbine Colmito	56	
		Diesel Turbine Espinos	70	
		Diesel Turbine Los Pinos	97	
		Diesel Power Plant Santa Lidia	131	
		Diesel Turbine Cardones 01	141	
		Diesel Turbine Campanario IV CA	42	
		Thermoelectric Power Plant Punta Colorada Fuel I	16.3	
		Diesel Turbine Newen	15	
		LNG Open Cycle Quintero I ope Diesel	240	
		Coal Power Plant Guacolda III	135	
		Diesel Turbine Campanario IV CC	60	

[13]Available in November 27th, 2009:

http://www.cne.cl/cnewww/export/sites/default/07_Tarificacion/01_Electricidad/Otros/Precios_nudo/otros_precios_de_nudo/archivos_bajar/abril2009/OBS_ITP_SIC_ABR09.pdf

		Coal Power Plant Ventanas III	240	
		Coal Power Plant Coronel I	343	
		Coal Power Plant Bocamina II	342	
		Coal Power Plant Guacolda IV	139	

Source: "Fijación de precio nudo, abril 2008", available at
http://www.cne.cl/cnewww/opencms/precio_nudo_abril2008/DOC_05_Informe_Precio_de_Nudo_SIC_Abr08d.rar

B.6. Emission reductions:

B.6.1. Explanation of methodological choices:

According to the selected approved methodology (AMS I.D. v. 16), referred to *Renewable energy technologies that supply electricity to a grid*, the procedures to determine the emission reductions attributable to the Project activity are described below:

Project Emissions (PE_y)

For new run-of river hydroelectric power plant the project emissions are cero (no reservoir is part of the project activity).

Baseline Emissions (BE_y)

The baseline emissions are the product of electrical energy baseline $EG_{BL,y}$ expressed in MWh of electricity produced by the renewable generating unit multiplied by the grid emission factor:

$$BE_y = EG_{BL,y} * EF_{CO_2,grid,y}$$

Where:

BE_y = Baseline emissions in year y (tCO_2).

$EG_{BL,y}$ = Quantity of net electricity supplied to the grid as a result of the implementation of the CDM project activity in year y (MWh)

$EF_{CO2,grid,y}$ = CO_2 emission factor of the grid in year y (tCO_2/MWh)

The Emission Factor is calculated using Option (a) of the methodology AMS I.D. version 16:

> A combined margin (CM), consisting of the combination of operating margin (OM) and build margin (BM) according to the procedures prescribed in the "Tool to calculate the Emission Factor for an electricity system" (version 02).

- **Calculation of the $EF_{CO2,grid,y}$**

According to the "Tool to calculate emission factor for an electricity system v. 02", Project Participants shall apply the following seven steps to the baseline calculation:

STEP 1 - Identify the relevant electricity systems.
STEP 2- Choose whether to include off-grid power plants in the project electricity system (optional).
STEP 3 - Select a method to determine the operating margin (OM).
STEP 4 - Calculate the operating margin emission factor according to the selected method.
STEP 5 - Identify the group of power units to be included in the build margin (BM).
STEP 6- Calculate the build margin emission factor.
STEP 7- Calculate the combined margin (CM) emissions factor.

STEP 1 - Identify the relevant electricity systems

For the purpose of determining the electricity emission factors, a project electricity system is defined by the geographic extent of the power plants that are physically connected through transmission and distribution lines to the project activity (e.g. the renewable power plant location or the place where electricity is being saved) and that can be dispatched without significant transmission constraints.

Similarly, a connected electricity system, e.g. national or international, is defined as an electricity system that is connected by transmission lines to the project electricity system. Power plants within the connected electricity system can be dispatched without significant transmission constraints but transmission to the project electricity system has significant transmission constraint.

As it was explained before, in Chile the project electricity system is defined by the spatial extent of the power plants that are physically connected through transmission and distribution lines in the "Sistema Interconectado Central" (SIC).

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

Project participants may choose between the following two options to calculate the operating margin and build margin emission factor:

Option I: Only grid power plants are included in the calculation.
Option II: Both grid power plants and off-grid power plants are included in the calculation

The Option I has been chosen.

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

The calculation of the operating margin emission factor ($EF_{grid,OM,y}$) is based on one of the following methods:

(a) Simple OM, or

(b) Simple adjusted OM, or

(c) Dispatch data analysis OM, or

(d) Average OM.

The selection of the appropriate calculation method depends, among other factors, on the characteristics of the electrical national grid and the available information about it. For the proposed project activity the Operating Margin has been calculated using the Simple Adjusted Method due to the following reasons:

- No publicly available information exists to allow the use of option (c) Dispatch Data Analysis OM. According to the methodology, the calculation of the OM emission factor, using option (c), is determined ex-post. In order to write the PDD, project developers may use models to estimate the reductions prior to validation. Such models should be able to simulate the operation of the hydroelectric project along with the other interconnected power plants during the crediting period, and, to achieve this, the data of many years of hydrological behavior are needed. The data on hydrology is not available.

- In Chile low-cost resources constitute more than 50% of the total generation of the national grid[14], which prevents from using option (a) Simple OM.

Then, the Simple Adjusted Method has been chosen, then $EF_{grid,OM\text{-}adj,y}$ = $EF_{grid,OM,y}$ for this project activity. This method involves the division of generation sources into low-cost/must-run and other sources feeding the national grid. Public official information is available for the separation of these Chilean generation resources (through the websites of CDEC-SIC, www.cdec-sic.cl).

Ex ante option has been chosen, so a 3-year generation .weighted average based on the most recent data available at the time of submission of the PDD to the DOE (2006, 2007, 2008) was used, considering that only grid power plants are included.

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

The simple adjusted operating margin emission factor ($EF_{grid,OM\text{-},adj,y}$ in tCO_2/MWh) is a variation on the simple operating margin, where the power sources (including imports) are separated in low-cost/must-run power sources (*k*) and other power sources (*m*). It is calculated based on the net electricity generation of each power unit and an emission factor for each power unit. The $EF_{grid,OM\text{-}adj,y}$ will be calculated in an ex-ante basis.

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

Where:

$EF_{grid,OM\text{-}adj,y}$ = Simple adjusted operating margin CO_2 emission factor in year *y* (t CO_2e/MWh).

[14] Source: "Statistics of Operation 1999/2008" - Center for Economic Load Dispatch / Central Interconnected System, page 41, 43, 45, 47, 49. (Estadística de Operación 1999/2008 – Centro de Despacho Económico de Carga / Sistema Interconectado Central (CDEC-SIC)), available at: http://www.cdec-sic.cl/datos/anuario2009/cdecesp/index_esp.htm

λ_y = Factor expressing the porcentage of time (number of hours) for which low-cost/must-run sources are on the margin in year *y*.

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

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

k = Refers to units which are either low-cost or are must-run.

m = Refers to the units that are not either low-cost or are must-run.

$EG_{k,y}$ = Net electricity generated and delivered to the grid by power units *k* serving the system in year *y* (MWh).

$EG_{m,y}$ = Net electricity generated and delivered to the grid by power units *m* serving the system, in year *y* (MWh).

y = the three most recent years for which data is available at the time of submission of the CDM-SSC-PDD to the DOE for validation since the calculation is ex ante (2008, 2007, 2006).

Net electricity imports are considered low-cost / must-run plants.

λ_y is defined as stated in the "Tool to calculate the emission factor for an electricity system v.02.".

Determination of $EF_{EL,m,y}$

If for a power unit m data on fuel consumption and electricity generation is available, the emission factor ($EF_{EL,m,y}$) should be determined as follows (Option A.1):

$$EF_{EL,m,y} = \frac{\sum_i FC_{i,m,y} \cdot NCV_{i,y} \cdot EF_{CO2,i,y}}{EG_{m,y}}$$

Where:

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

$FC_{i,m,y}$ = Amount of fossil fuel type *i* consumed by power unit m in year y (Mass or volume unit).

$NCV_{i,y}$ = Net calorific value (energy content) of fossil fuel type *i* in year *y* (GJ/mass or volume unit).

$EF_{CO2,i,y}$ = CO_2 emission factor of fossil fuel type *i* in year *y* (t CO_2e/GJ).

$EG_{m,y}$ = Net quantity of electricity generated and delivered to the grid by power unit *m* in year *y* (MWh).

m	=	All power units serving the grid in year *y* except low-cost / must-run power units
i	=	All fossil fuel types combusted in power unit *m* in year *y.*
y	=	The three most recent years for which data is available at the time of submission of the CDM-PDD to the DOE for validation (ex ante option): 2006, 2007, and 2008.

If for a power unit *m* only data on electricity generation and the fuel types used is available, the emission factor should be determined based on the CO_2 emission factor of the fuel type used and the efficiency of the power unit (Option A.2), as follows:

$$EF_{EL,m,y} = \frac{EF_{CO2,m,i,y} \cdot 3.6}{\eta_{m,y}}$$

Where:

$EF_{EL,m,y}$	=	CO_2 emission factor of power unit *m* in year y (t CO_2e/MWh).
$EF_{CO2,m,i,y}$	=	Average CO_2 emission factor of fuel type *i* used in power unit *m* in year y (t CO_2e/GJ).
$\eta_{m,y}$	=	Average net energy conversion efficiency of power unit *m* in year y (%).
y	=	Three most recent years for which data is available at the time of submission of the CDM-SSC-PDD to the DOE for validation (ex ante option): 2006, 2007, and 2008.

Where several fuel types are used in a power unit, the fuel type with the lowest CO_2 emission factor for $EF_{CO2,\ m,\ i,\ y}$. will be used.

The option A.3 is not applied because for all the plants of system exist data to implement the option A.1 or A.2

STEP 5 - Identify the group of power units to be included in the build margin

The sample group of power units *m* used to calculate the build margin consists of power units that comprises the larger annual generation, between the next options:

(a) The set of five power units that have been built most recently, or

(b) The set of power capacity additions in the electricity system that comprise 20% of the system generation (in MWh) and that have been built most recently.

Since the larger annual generation corresponds to the set of power capacity additions in the electricity system that comprise 20% of the system generation (in MWh) and that have been built most recently, option (b) is used.

In terms of vintage of data, Option 1 has been chosen: for the first crediting period the build margin is calculated *ex ante* based on the most recent information available on units already built for sample group *m* at the time of submission of the PDD for validation. For the second crediting period, the build margin emission factor will be updated based on the most recent information available on units already built at the time of submission of the request for renewal of the crediting period. For the third crediting period, the build margin calculated for the second crediting period will be used.

STEP 6 – Calculate the build margin emission factor

The build margin emissions factor is the generation-weighted average emission factor (t CO_2/MWh) of all power units m during the most recent year y for which power generation data is available. This emission factor will be calculated in an ex ante basis. The formula used is:

$$EF_{grid,BM,y} = \frac{\sum_m EG_{m,y} x EF_{EL,m,y}}{\sum_m EG_{m,y}}$$

Where:

$EF_{grid,BM,y}$ = Build margin CO_2 emission factor in year *y* (t CO_2e/MWh).

$EG_{m,y}$ = Net quantity of electricity generated and delivered to the grid by power unit *m* in year *y* (MWh).

$EF_{EL,m,y}$ = CO_2 emission factor of power unit *m* in year *y* (t CO_2e/MWh).

m = Power units included in the build margin.

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

The CO_2 emission factor of each power unit m ($EF_{EL,m,y}$) is determined as per the guidance in step 4 (a) for the simple OM in the Tool (options A.1 or A.2), using for "y" the most recent historical year for which power generation data is available, and using for "m" the power units included in the build margin.

If for a power unit *m* data on fuel consumption and electricity generation is available, the emission factor ($EF_{EL,m,y}$) should be determined using Option A.1 as follows:

$$EF_{EL,m,y} = \frac{\sum_i FC_{i,m,y}.NCV_{i,y}.EF_{CO2,i,y}}{EG_{m,y}}$$

Where:

$EF_{EL,m,y}$ = CO_2 emission factor of power unit *m* in year *y* (t CO_2e/MWh).

$FC_{i,m,y}$ = Amount of fossil fuel type *i* consumed by power unit *m* in year *y* (t).

$NCV_{i,y}$ = Net calorific value (energy content) of fossil fuel type *i* in year *y* (GJ/t).

$EF_{CO2,i,y}$ = CO_2 emission factor of fossil fuel type *i* in year *y* (t CO_2e/GJ).

$EG_{m,y}$ = Net quantity of electricity generated and delivered to the grid by power unit *m* in year *y* (MWh).

m = Power units included in the build margin.

i = All fossil fuel types combusted in power unit *m* in year *y*.

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

If for a power unit *m* only data on electricity generation and the fuel types used is available, the emission factor should be determined based on the CO_2 emission factor of the fuel type used and the efficiency of the power unit (Option A.2), as follows:

$$EF_{EL,m,y} = \frac{EF_{CO2,m,i,y} \cdot 3.6}{\eta_{m,y}}$$

Where:

$EF_{EL,m,y}$ = CO_2 emission factor of power unit m in year y (t CO_2e/MWh).

$EF_{CO2,m,i,y}$ = Average CO_2 emission factor of fuel type i used in power unit m in year y (t CO_2e/GJ).

$\eta_{m,y}$ = Average net energy conversion efficiency of power unit m in year y (%).

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

Where several fuel types are used in a power unit, the fuel type with the lowest CO_2 emission factor for $EF_{CO2,\, m,\, i,\, y}$. will be used.

The option A.3 is not applied because for all the plants of system exist data to implement the option A.1 or A.2

STEP 7 – Calculate the combined margin (CM) emissions factor

The combined margin emissions factor is calculated as follows:

$$EF_{grid,CM,y} = EF_{grid,OM,y} * w_{OM} + EF_{grid,BM,y} * w_{BM}$$

Where:

$EF_{grid,BM,y}$ = Build margin CO_2 emission factor in year y (t CO_2/MWh).

$EF_{grid,OM,y}$ = Operating margin CO_2 emission factor in year y (t CO_2/MWh).

w_{OM} = Weighting of operating margin emissions factor (%).

w_{BM} = Weighting of build margin emissions factor (%).

For projects that are not solar or wind power generation, w_{OM} = 0.5 and w_{BM} = 0.5 for the first crediting period, and w_{OM} = 0.25 and w_{BM} = 0.75 for the second and third crediting period, unless otherwise specified in the approved methodology which refers to the "Tool toCalculate the emission factor for an electricity system v.02".Project participants can submit alternative proposal, for revision of tool if the weighs do not reflect their situation with an explanation for the alternative weights for future crediting periods.

Leakage (L_y)

AMS I.D v.16 states that leakage is to be considered if the energy generating equipment is transferred from another activity. As the project activity will use new equipment, leakage is not considered.

Emission Reductions (ER_y)

The emission reductions are calculated as follows:

$$ER_y = BE_y - PE_y - LE_y$$

Where

ER_y = Emissions reductions in year y (t CO_2/y).

$BE_{,y}$ = Baseline emissions in year y (t CO_2/y).

PE_y = Project emissions in year y (t CO_2/y).

LE_y = Leakage emissions in year y (t CO_2/y).

The result of the application of the Equations is presented in section B.6.3.

B.6.2. Data and parameters that are available at validation:

Data / Parameter:	$NCV_{i,y}$
Data unit:	GJ /t
Description:	Net calorific value (energy content) of fossil fuel type *i* in year y.
Source of data used:	"BALANCE NACIONAL DE ENERGÍA 2008", Comisión Nacional de Energía. (National Energy Balance 2008, National Energy Commission), sheet "CUADROA2".
Value applied:	Data used is presented in the spreadsheet for Grid Emission Factor calculation. Fuel Oil = 43.93 Diesel = 45.61 Coal = 29.29 Petcoke = 29.29 Natural Gas = 39.08
Justification of the choice of data or description of measurement methods and procedures actually applied :	Values from the fuel supplier of the power plants are not available.
Any comment:	Data will be kept for two years after the end of the crediting period or the last issuance of CER´s for this project activity, whatever occurs later.

Data / Parameter:	$EF_{CO2,i,y}$
Data unit:	t CO_2e/GJ
Description:	CO_2 emission factor of fossil fuel type *i* in year y.
Source of data used:	IPCC default values at the lower limit of the uncertainty at a 95% confidence interval as provided in table 1.4 of Chapter1 of Vol. 2 (Energy) of the 2006 IPCC Guidelines on National GHG Inventories.
Value applied:	Fuel Oil = 0.0755 Diesel = 0.0726 Coal = 0.0895 Petcoke = 0.0829 Natural Gas = 0.0543
Justification of the choice of data or description of measurement methods and procedures actually applied :	Values are not provided by the fuel supplier of the power plants in invoices. There are no regional or national average default values.
Any comment:	Data will be kept for two years after the end of the crediting period or the last issuance of CER´s for this project activity, whatever occurs later.

Data / Parameter:	$EG_{k,y}$
Data unit:	MWh
Description:	Net electricity generated and delivered to the grid by power units *k* serving the system in year y.
Source of data used:	Data provided by CDEC-SIC and/or CNE.

Value applied:	Data used is presented in the spreadsheet for Grid Emission Factor calculation.
Justification of the choice of data or description of measurement methods and procedures actually applied :	Is official data.
Any comment:	Data will be kept for two years after the end of the crediting period or the last issuance of CER´s for this project activity, whatever occurs later.

Data / Parameter:	***$EG_{m,y}$***
Data unit:	MWh
Description:	Net electricity generated and delivered to the grid by power units *m* serving the system, in year y.
Source of data used:	Data provided by CDEC-SIC and/or CNE.
Value applied:	Data used is presented in the spreadsheet for Grid Emission Factor calculation.
Justification of the choice of data or description of measurement methods and procedures actually applied :	Is official data.
Any comment:	Data will be kept for two years after the end of the crediting period or the last issuance of CER´s for this project activity, whichever occurs later.

Data / Parameter:	***$FC_{i,m,y}$***
Data unit:	t
Description:	Amount of fossil fuel type *i* consumed by power unit *m* in year *y*.
Source of data used:	Data provided by CDEC-SIC and/or CNE.
Value applied:	Data used is presented in the spreadsheet for Grid Emission Factor calculation.
Justification of the choice of data or description of measurement methods and procedures actually applied :	Is official data.
Any comment:	Data will be kept for two years after the end of the crediting period or the last issuance of CER´s for this project activity, whichever occurs later.

Data / Parameter:	***$\eta_{m,y}$***
Data unit:	-
Description:	Average net energy conversion efficiency of power unit *m* in year k.
Source of data used:	Default values provided in Annex 1 of "Tool to calculate the emission factor for an electricity system v.02.".

Value applied:	Diesel Power Plants: 39.5% Fluidized Bed System 35.5%
Justification of the choice of data or description of measurement methods and procedures actually applied :	The diesel power plants for which only data on electricity generation and fuel type is available correspond to new (after 2000) open cycle power plants. The only plant with a fluidized bed system. For which only data on electricity generation and fuel type is available is old (before 2000).
Any comment:	Data will be kept for two years after the end of the crediting period or the last issuance of CER´s for this project activity, whatever occurs later.

B.6.3 Ex-ante calculation of emission reductions:

Ex-ante calculations of the emission reductions were made considering an estimate of the electricity generation of the power plant; this estimation was made by the project developer considering the historic hydrology and water flow from the exit of Maitenes tunnel.

According to the project developer is expected to deliver 28,470 MWh per year to the electricity grid.

The emission reductions, as well as the emission factor of the electricity grid were calculated as described in the section B.4 of this document and in the Annex 3.

No leakage was considered since the generating equipment is not transferred from another activity and there is no existing equipment (prior to the implementation of the project activity) that could be transferred to another activity.

The project activity is not expected to emit greenhouse gases during its operation; hence, no project emissions were considered.

Therefore, emission reductions are equivalent for this project to baseline emissions.

According to the selected approved methodology (AMS – I.D. v.16), the results of applying the steps and formulas to determine the emission reductions attributable to the Project activity are:

PROJECT EMISSIONS (PE_y)

$PE_y = 0$

BASELINE EMISSIONS (BE_y)

$$BE_y = EG_{BL,y} * EF_{CO_2,grid,y}$$

$BE_y =$ 28,470 MWh * 0.5817 tCO_2/MWh

BE_y = 16,560 tCO_2

Table 6: Baseline Emissions

Year	BE_y (tCO_2/yr)
2011 *	2,760
2012	16,560
2013	16,560
2014	16,560
2015	16,560
2016	16,560
2017	16,560
2018 **	13,800

* November - December ** January - October.

Calculation of the $EF_{grid,CM,y}$

Operating margin emission factor

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

As described in Annex 3, the following are the results for the parameters used for calculating the operating margin:

	2006	2007	2008	Total
λ	0.0065	0	0	
1 - λ	0.9935	1	1	
$\sum_m EG_{m,y} \times EF_{EL,m,y}$ (tCO_2)	7,798,275.3	13,851,548.3	13,977,380.8	35,627,204.4
$\sum_m EG_{m,y}$ (MWh)	11,701,976.0	19,106,577.8	17,389,372.1	48,197,925.9
	24.3%	39.6%	36.1%	
$\sum_k EG_{k,y} \times EF_{EL,k,y}$ (tCO_2)	0.0	0.0	0.0	0.0
$\sum_k EG_{k,y}$ (MWh)	28,634,100.0	22,923,012.6	24,471,522.6	76,028,635.2
	38%	30%	32%	

According with these values:

$(1-\lambda_y) * \frac{\sum_m EG_{m,y} * EF_{EL,m,y}}{}$ $\underline{0.9935*7,798,275.3*0.243 + 1*13,851,548.3*0.396 + 1*13,977,380.8*0.361}$

11,701,976.0 19,106,577.8 17,389,372.1

= 0. 7381 t CO2/MWh

$$\lambda_y * \frac{\sum_k EG_{k,y} * EF_{EL,k,y}}{\sum_k EG_{k,y}} = \frac{0.0065*0.0*0.38}{28,634,100.0} + \frac{0*0.0*0.3}{22,923,012.6} + \frac{0*0.0*0.32}{24,471,522.6}$$

= 0 t CO2/MWh

$EF_{grid,OM\text{-},adj,}$ = 0. 7381 t CO_2/MWh + 0 t CO_2/MWh

0. 7381 t CO_2/MWh

Build margin emission factor

$$EF_{grid,BM,y} = \frac{\sum_m EG_{m,y} x EF_{EL,m,y}}{\sum_m EG_{m,y}}$$

As described in Annex 3:

$\sum_m EG_{m,y} \times EF_{EL,m,y}$ = 3,706,193.0 t CO_2

and

$\sum_m EG_{m,y}$ = 8,716,106.8 MWh

then:

$EF_{grid,BM}$ = 0.4252 t CO_2/MWh.

Combined margin (CM) emissions factor $EF_{grid,CM,y}$.

$$EF_{grid,CM,y} = EF_{grid,OM,y} * w_{OM} + EF_{grid,BM,y} * w_{BN}$$

As stated in section B.6.1 w_{OM} and w_{BM} are 0.5. Considering the results presented above:

$EF_{grid,CM,}$ = 0. 7381 t CO_2/MWh*0.5 + 0.4252 t CO_2/MWh*0.5

$\boldsymbol{EF_{grid,CM,}}$ = 0.5817 t CO_2/MWh

LEAKAGE (L_y)

L_y = 0.

B.6.4 Summary of the ex-ante estimation of emission reductions:

Year	Estimation of project activity emissions (tCO_2e)	Estimation of baseline emissions (tCO_2e)	Estimation of leakage (tCO_2e)	Estimation of overall emission reductions (tCO_2e)
2011 *	0	2,760	0	2,760
2012	0	16,560	0	16,560
2013	0	16,560	0	16,560
2014	0	16,560	0	16,560
2015	0	16,560	0	16,560
2016	0	16,560	0	16,560
2017	0	16,560	0	16,560
2018 **	0	13,800	0	13,800
Total (tonnes of CO_2e)	**0**	**115,920**	**0**	**115,920**

* November – December ** January – October

B.7 Application of a monitoring methodology and description of the monitoring plan:

Methodology AMS-I.D. "Renewable electricity generation for a grid" Version 16 (EB 54), must be applied. The project meets all the applicability conditions of the methodology since it is a small scale hydroelectric plant supplying electricity grid, with an installed capacity lower than 15 MW.

B.7.1 Data and parameters monitored:

Data / Parameter:	$EG_{BL,y}$
Data unit:	MWh
Description:	Quantity of net electricity supplied to the grid as a result of the implementation of the CDM project activity in year *y*
Source of data to be used:	Measured at Chiburgo substation.
Value of data applied for the purpose of calculating expected	28,470

emission reductions in section B.5	
Description of measurement methods and procedures to be applied:	Data will be hourly collected from a bi-directional continuous meter (Class 0.2S), with monthly recording. Meter will be certified to national standards. Meter will register the electricity supplied to the grid, thus values does not include the internal electricity consumption of the power plant.
QA/QC procedures to be applied:	Measurement results will be cross-checked with records for sold electricity, which corresponds to the records from the electricity meter (Class 0.2S) used to inform the energy delivered to the grid to CDEC-SIC ("Centro de Despacho Económico de Carga del Sistema Interconectado Central" or "Dispatch Economic Center of the Central Interconnected System"). According to manufacturer specification both meters will be annually verified; if the accuracy does not comply with national standards the meter will be replaced.
Any comment:	Data will be archived electronically and kept at least for two years after the end of the crediting period or the last issuance of CER´s, whichever occurs later.

B.7.2 Description of the monitoring plan:

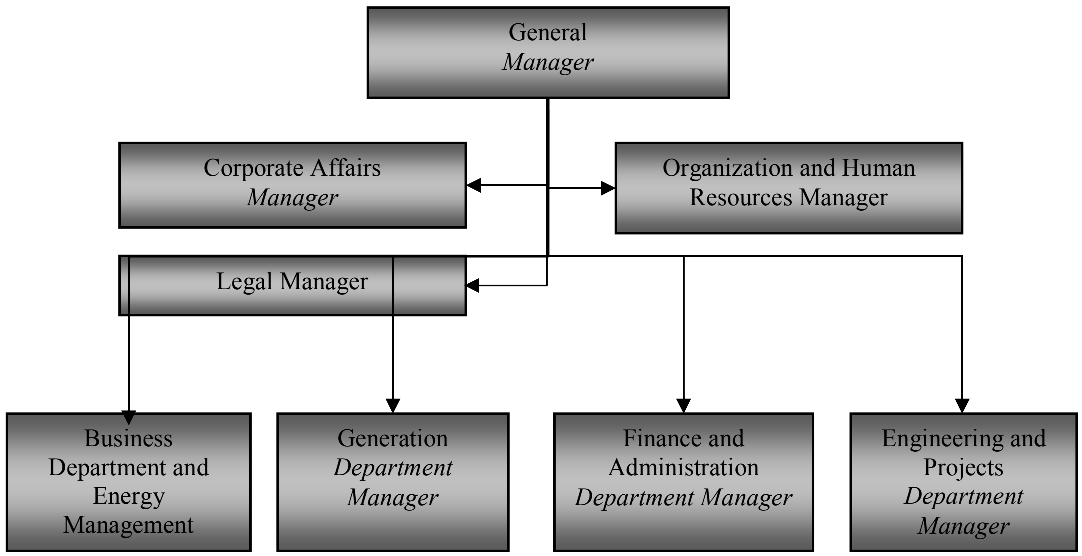
The monitoring consists of metering the net electricity supplied by the project activity to the grid.

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

1-. Operational and Management structure

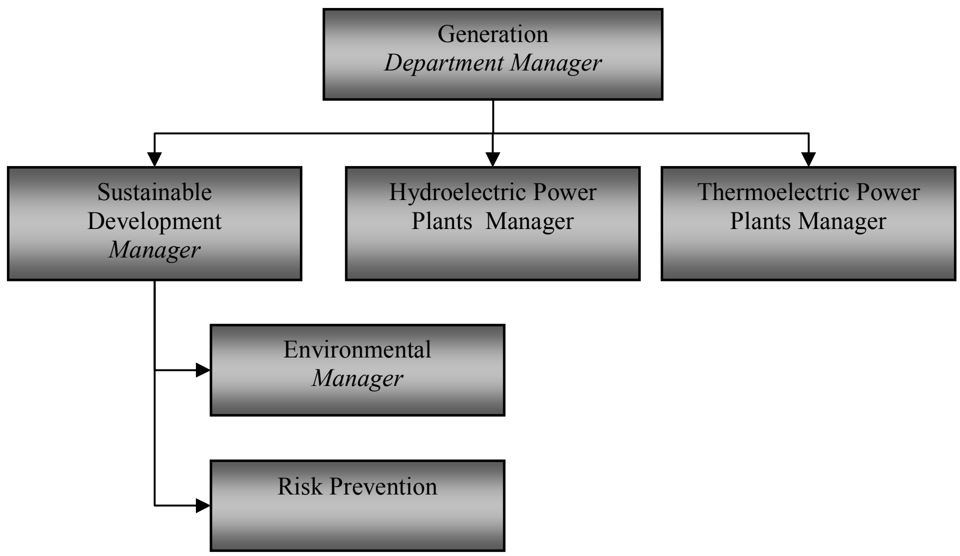
In order to fulfill the commitments established in the PDD, the Project participant has the following general management structure:

Figure 4: General Management Structure



In addition, Colbún S.A. has the following structure inside the Generation Department:

Figure 5: Generation Department structure



Under this structure, the Sustainable Development Manager has the responsibility, among other things, of managing the administrative and commercial aspects of the projects related to the carbon market (as San Clemente or other Colbún S.A. projects in different development stages), and ensuring the fulfillment of all applicable environmental and social obligations. Social aspects are also supported by Corporate Affairs Manager.

The Hydroelectric Power Plants Manager is responsible of ensuring the operation of San Clemente Power Plant, such as other hydroelectric power plants owned by the company, in accordance with the commitments acquired, which include the proper monitoring, data registration, audits and verifications.

Besides, Colbún S.A. will continue performing the necessary training to the operators in order to fulfill the tasks in an adequate and transparent manner.

2-. Monitoring Procedures

Data Capture Procedure for Energy Generation

Energy baseline ($EG_{BL,y}$) will be hourly collected from a bi-directional continuous meter (Class 0.2S), with monthly recording. This measurement will be cross-checked with the records from the electricity meter (Class 0.2S) used to inform the energy delivered to the grid to CDEC-SIC, acquired according to the following procedure:

Electrical energy measurement is made automatically through bi-directional electricity meter, which captures data from electric generation every 15 minutes, and by local interfaces feeds 2 independent services, one for the power plant operation: “SCADA”, and another for the commercial invoicing system to CDEC-SIC.

The SCADA system is fed directly from the electricity meter through a serial interface, and displays the electric energy measurement in the local operator screen.

The local operator reads every 2 hours the electrical energy measurement from the generator, and he transmits by phone the information to the operator of Colbún Operations Center, located in the Colbún’s main office in Santiago.

The operator of the Operation Center enters the electric generation data to the Operations database through the “OPERADOR” application, which is automatically uploaded to the CDEC-SIC Server via dedicated communications link.

On the other hand, commercial invoicing system consists in centralized meter reading software, which reads automatically from the meter, through dedicated Ethernet data link, the electric pulses measurements done by the local meter every 15 minutes, and stores them in the invoicing system database.

Once a month the Commercial Manager transfer the power plant energy generation data, from the invoicing system database to an Excel spreadsheet, and uploads it in the CDEC-SIC server via dedicated communications link, for purposes of invoicing by CDEC-SIC.

Electricity measurements from the two databases of both systems are cross checked in order to validate the information.

The figure 6 shows the data capture system as described above.

<u>Energy Measurement Equipment Periodic Verification Procedure</u>

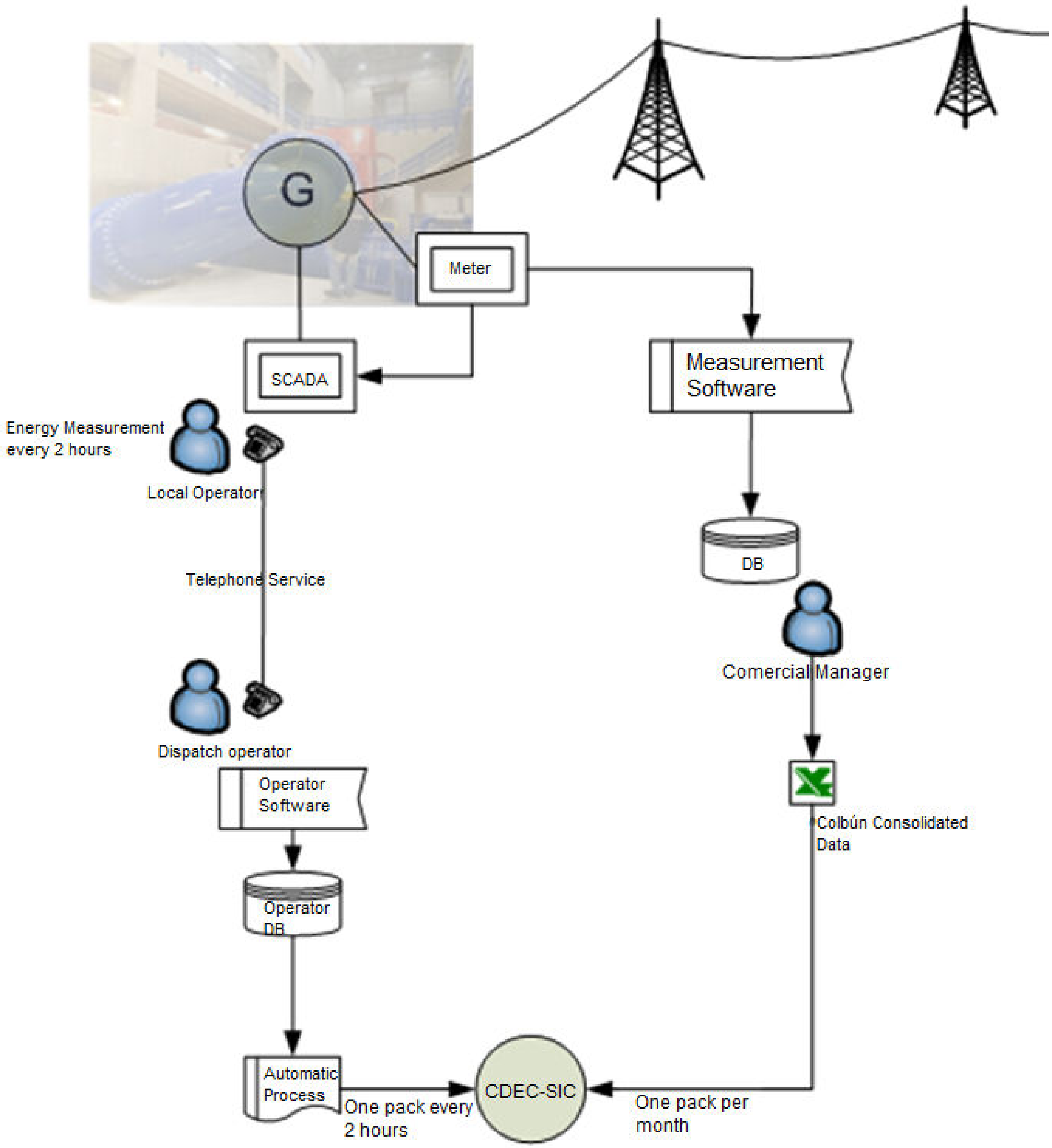
The Electricity Meters Management Department, together with the Power Plant Operation Department, arranges an annual verification of the electricity meter.

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(or equivalent in case of replacement) “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.

Figure 6: Data Capture and CDEC-SIC Upload



Source: Project Participant

B.8 Date of completion of the application of the baseline and monitoring methodology and the name of the responsible person(s)/entity(ies)

The baseline was completed in 28th of July 2011 by:

Cristián Mosella
Colbun S.A.
cmosella@colbun.cl
Telephone: (56-2) 460 42 80
Telephone: (56-2) 460 42 29
http://www.colbun.cl

SECTION C. Duration of the project activity / Crediting period

C.1 Duration of the project activity:

C.1.1. Starting date of the project activity:

The starting date of the CDM project activity is **26/06/2008**. In that date, the Memorandum of Understanding to proceed with the contract to deliver project activity equipments was signed. This has been established as the earliest real action for the implementation of the project activity.

The project activity will start its operations on March 2010.

C.1.2. Expected operational lifetime of the project activity:

The expected lifetime of the project activity is at least 65 years[15].

C.2 Choice of the crediting period and related information:

C.2.1. Renewable crediting period

C.2.1.1. Starting date of the first crediting period:

The expected starting date of the first crediting period is 01/11/2011, or after registration.

[15] It is expected that San Clemente Power Plant can operate during at least 65 years considering that this kind of facilities have a long lifetime: around the world (including Chile) there are run of river power plants that have been operating for even more than 65 years. (Source: Small Hydro Power, State of The Art and Applications, by C.Dragu, T. Sels, Member, IEEE and R. Belmans, Senior Member, IEEE). It is worth to mention that the aforementioned lifetimes are reached only if the corresponding expenditures or reinvestments, related to rehabilitations and spare parts in the generation equipments, channels or sand traps, are carried out on time.

C.2.1.2. Length of the first crediting period:

7 years and 0 months

C.2.2. Fixed crediting period:

C.2.2.1. Starting date:

Not applicable.

C.2.2.2. Length:

Not applicable.

SECTION D. Environmental impacts

D.1. If required by the host Party, documentation on the analysis of the environmental impacts of the project activity:

According with Chilean environmental law (Nº 19.300[16], article 10.c) power plants with more than 3 MW of installed capacity should formally analyze its environmental impacts through the Environmental Impact Assessment System ("Sistema de Evaluación de Impacto Ambiental", hereafter SEIA). This article also states that transmission lines must go through the SEIA if they are more than 23 kV.

Based on the nature of the projects or activities and its potential impacts, the analysis of the environmental impacts in SEIA could be trough an Environmental Impact Assessment ("Estudio de Impacto Ambiental", EIA) or an Environmental Impact Declaration ("Declaración de Impacto Ambiental", DIA), according with the requirements of law 19.300 (article 11) and Supreme Decree (SD) Nº 95[17] (Regulation of the SEIA, articles 4 to 11).

The environmental assessment process is coordinated by National Environmental Commission ("Comisión Nacional de Medio Ambiente", CONAMA) through its Executive Board or Regional Offices ("Comisión Regional de Medio Ambiente", COREMA). In the assessment process also participated all relevant governmental offices, who can request revisions and/or modifications to the project in order to comply with the specific regulations.

According to this legislation, environmental impact assessment, San Clemente Hydroelectric Power Plant was made using a DIA[18], which was evaluated by CONAMA Maule Region and approved by an Environmental Resolution Calification ("Resolución de Calificación Ambiental", RCA) Nº 270 on September 12th, 2007.

[16] Available at http://www.sinia.cl/1292/articles-26087_ley_bases.pdf

[17] Available at http://www.sinia.cl/1292/articles-37936_pdf_reglamento_seia.pdf

[18] Available at https://www.e-seia.cl/documentos/documento.php?idDocumento=2171321

It is noteworthy that during the development of basic engineering of the project (year 2008), minor adjustments[19] were made to the original design in search of technical and environmental optimization. Environmental optimization has allowed the reduction of forest area to intervene, decrease the impact area to the vegetation and flora, and removing a detour in the existing public road.

These changes were informed to and approved by the same environmental authority. Therefore, the environmental license or permit (RCA N^{o}. 270) was complemented by "Ord. COREMA Nº 660, from October 02nd, 2008".

D.2. If environmental impacts are considered significant by the project participants or the host Party, please provide conclusions and all references to support documentation of an environmental impact assessment undertaken in accordance with the procedures as required by the host Party:

As stated in section D.1, the project went through the Environmental Impact Assessment System by presenting a DIA. The main environmental effects analyzed in that document are as follows:

a) Building Stage

The building stage is the phase of the project that contributes to the generation of environmental impacts due to the construction of civil works, but since is a small run-of-river plant; the Project will have minor impacts on the environment.

The impacts will be related with the machinery to be used, the land movements and the workers activities on the area:

- Emissions of particulate matter, gases such as carbon monoxide, hydrocarbons and nitrogen oxides. The rural characteristics allow a high dispersion of the particular matter.
- The liquid effluents correspond to a domestic wastewater type generated by the staff. There is a modular treatment plant. The management of chemical toilets will be made by a company authorized and specialized.
- The solid waste will be mainly from domestic work of the workers' daily activities, will be stored in secure locations and eventually be disposed to a landfill by a certified company. Waste electrical components, among others which can not be reused by the company, will be sent to certified landfills.
- In the case of the environmental impact of noise, the level will increase by construction activities. This will implement specific measures that will allow the noise levels to meet the standards defined by the SD N° 146/97.
- Regarding the flora and fauna, it was anticipated not significant impact since there are few existing species sensitive to changes in the landscape and the area involved is small.
- Regarding the impact on human communities, no significant impacts are anticipated because the project is developed in areas that do not have large concentrations of people.

[19] There were changes in the number of turbines, adduction channel length, pressure pipe length, surface of the power house, return channel length, layout of public road and the area of intervened native forest.

All the safety measures during the building stage of the project will be taken according to the Chilean legislation.

b) Operation Stage

During this phase of the activity, no major environmental impacts will be produced inside the project boundaries.

- Only expected air emissions from vehicles travelling once a month from the station facilities.
- No wastewater will be neither generated, nor liquid industrial waste. Will be contracted chemical baths only when it is necessary to implement repairs that demand several hours of work.
- No solid waste is generated.
- Noise emissions will be produced primarily by the operation of the turbines inside the power house and discharge of water returned to the Sanatorium Brook. The technology used will generate low noise and vibration, and then noise will not exceed 10 dB (A) over the existing baseline noise average, thus complying with the requirements of the DS 146/97 (for recipients in rural areas).
- The equipment involved, such as electrical conductors, is designed to prevent the loss and dissipation of energy to the environment, so there will be no effects to the population.

Considering the remote-operation of the facilities, the operation of the project will not generate solid waste, sewage or industrial liquid waste.

c) Abandonment Stage

The project activity will have an operational lifetime of at least 65 years. At the end of its lifetime, there are two alternatives. The first is the dismantling of equipment and facilities, which could then be traded in the market. The second alternative is that the equipments are refurbished and upgraded and / or been removed to give space to new technology equipment. The authorities will be informed and all activities will comply with Chilean regulations.

It is clear that the proposed activity will not generate a significant impact on the area of influence, because the project is a small run –of –river plant.

SECTION E. Stakeholders' comments

E.1. Brief description how comments by local stakeholders have been invited and compiled:

According to the Environmental Impact Assessment System procedures, all the projects must be evaluated by the relevant authorities. As a publicity measure to maintain the community duly informed, the National or Regional Environment Commission, as corresponds, shall publish every month on the first working day, in the Official Newspaper and in a national or regional one, a list of the projects and activities that were submitted to the Chilean Environmental Impact Assessment System during the previous month. Additionally, the relevant Commission shall deliver a copy of the list to the municipalities of the places where the works or activities envisaged in the project under evaluation are to be carried out. The whole process can be follow by the web, through the link of the National Commission of the Environment (CONAMA) www.e-seia.cl.

As stated in Section D, the Project went through the Environmental Impact Assessment System (through a DIA), thus complied with the informative procedures mentioned before.

In addition to these procedures, the project developer held one meeting (June 28rd 2007) with members of the neighborhood council Sanatorio Alto, Parents Association and the Director of the local school, a representative of the association of potable water in the rural village and policemen, in order to inform about the project, it's environmental licensing process and receive their opinions. The invitation method was through invitation letters.

The agenda that was developed at the meeting held in June includes the following points:

- Company history.
- Current power plants under construction and projects.
- Responsibilities to communities and the environment, where they mention the Chacabuquito project, which was the first electric generator in the world to be registered as CDM project.
- Project San Clemente Hydroelectric Power Plant (location, justification, purpose, basic characteristics, benefits that will bring the central building of the community.
- Q&A.

All doubts and questions from the community held at the meeting were answered at the time; the specific requests made by the community were forwarded to the specifics Colbun's department in order to be assessed.
.

E.2. Summary of the comments received:

During the environmental evaluation no comments were received from the community. During the meeting held with the members of the Sanatorio Alto stakeholders, no negative comments of the project activity were made. The comments received were related with:

- Change of location of the board of neighbors of Sanatorio Alto to facility of the Christian community that is located in the chapel of the sector.

- Concern about risk of accidental fall into the discharge channel.
- Purchase of school supplies for the Leopoldo Guarda School.
- Concern about noise level during construction and operation phase
- Extend the potable water network in order to cover the demand in the community.

Also, the community to request that the project to supply free light, the representatives of the company Colbún explained that this situation could not give because they are not distributor company.

E.3. Report on how due account was taken of any comments received:

In relation with the requests of the members of Sanatorio Alto, the acts of the compromises made by Colbún were:

- September 10th, 2009. Relocation of Sanatorio Alto's neighborhood council's seat, (which includes the facilities and electricity supply, rural water, bathroom and kitchen).

- October 07th, 2009. Delivery of the school supplies to Leopoldo Guarda School, Sector Buenos Aires.

Other compromises:

- The discharge channel was cover to prevent any kind of danger.
- To a level of noise minimal during the construction phase will be installed mobile barriers and operation phase the machine house will be installed under the cota of the ground (underground).
- The company Colbún contracted local manpower through a construction company.
- The company Colbún extended the potable water network in order to supply water to sectors that before did not have access.

Annex 1

CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY

Organization:	Colbún S.A.
Street/P.O.Box:	Av. Apoquindo 4775, Piso 11
Building:	Torre Apoquindo
City:	Santiago
State/Region:	Metropolitana
Postfix/ZIP:	7580097
Country:	Chile
Telephone:	56-2-460-4000
FAX:	56-2-460-4005
E-Mail:	
URL:	www.colbun.cl
Represented by:	Represented by:
Title:	Operation Manager
Salutation:	Mr.
Last Name:	Donoso
Middle Name:	
First Name:	Enrique
Department:	Generation Division
Mobile:	56-96-2083659
Direct FAX:	56-2-460-4005
Direct tel:	56-2-460-4280
Personal E-Mail:	edonoso@colbun.cl

Annex 2

INFORMATION REGARDING PUBLIC FUNDING

There will be no public funding.

Annex 3

BASELINE INFORMATION

I. DETERMINATION OF GRID EMISSION FACTOR

a) Required information

A summary of the information sources of the variables and parameters used for the calculation of the Baseline Emission Factor is shown below.

Information Sources of variables and parameters for the calculation of Baseline Emission Factor

Variable	Unit	Source
Name	-	CDEC – SIC*
Fuel Consumption by power plant	Diesel = Mt Natural Gas = MM m^3 Coal = M t	CDEC – SIC*
Electrical Generation	MWh/year	CDEC – SIC*
Fuel Characteristics (CO_2 emission factor)	tCO_2/GJ	IPCC**
Fuel Characteristics (NCV)	GJ/ton	CNE***

* Dispatch Economic Center of the Central Interconnected System. Available at: https://www.cdec-sic.cl/
** Intergovernmental Panel on Climate Change (www.ipcc.ch)
*** Comisión Nacional de Energía (Energy National Commission) (https://www.cne.cl)

b) Procedure to determine the EF of the SIC (Combined Margin - CM)

Build Margin

To determine the most adapted option for the group *m* of power units, the criteria used in "Tool to calculate the emission factor for an electricity system v.02." indicates that the participants of the project activity must choose the group that includes the major annual generation of electricity. In this sense**:**

a) The five power units that have been built most recently,
= 78,075.4 MWh

b) The power units capacity additions in the electricity system that comprise 20% of the system generation (in MWh) and that have been built most recently

= 8,716,106.8 MWh

Project participants might choose from these two options the sample group that comprises the larger annual generation. In this case, that is option b).

Build Margin Power Units

Accumulated Generation (MWh)

Power Plant	Fuel	Start operation	Accumulated Generation (MWh)	Percentaje Accumulated Generation (%)	$EF_{EL.m,y}$ (tCO_2/ MWh)	EG x EF_{EL}
Quellón II	Diesel	2008	3,564.5	0.01%	0.68	2,417.0
Colmito	Diesel	2008	6,264.5	0.01%	0.66	1,786.5
Olivos	Diesel	2008	34,564.5	0.08%	0.75	21,322.6
Chiloé	Diesel	2008	34,675.4	0.08%	0.66	73.4
Coya (*)	Run-of-River	2008	78,075.4	0.19%		0.0
Totoral	Diesel	2008	81,447.2	0.19%	0.66	2,231.0
Quintay	Diesel	2008	84,637.6	0.20%	0.66	2,111.0
Placilla	Diesel	2008	87,598.6	0.21%	0.66	1,959.3
FPC (*)	Forest Biomass	2008	87,598.6	0.21%		0.0
Chuyaca	Diesel	2008	87,681.2	0.21%	0.66	54.7
Skretting	Diesel	2008	87,681.2	0.21%		0.0
Nueva Aldea III (*)	Black Liquor Steam	2008	87,681.2	0.21%		0.0
Hornitos (*)	Run-of-River	2008	87,681.2	0.21%		0.0
Ojos de Agua (*)	Run-of-River	2008	87,681.2	0.21%		0.0
Puclaro (*)	Run-of-River	2008	87,681.2	0.21%		0.0
Canela (*)	Wind	2008	87,681.2	0.21%		0.0
San Isidro II	Natural Gas [Diesel]	2007-2008	1,735,581.2	4.15%	0.58	955,445.6
Degan	Diesel	2007	1,803,881.2	4.31%	0.70	47,677.9
Los Vientos	Diesel	2007	2,184,681.2	5.22%	0.89	337,784.8
Campanario	Natural Gas [Diesel]	2007	2,424,681.2	5.79%	0.79	188,950.5
Esperanza	Diesel	2007	2,437,260.4	5.82%	0.66	8,323.3
Las Vegas	Diesel	2007	2,443,334.5	5.84%	0.66	4,019.0
Concón	Diesel	2007	2,450,515.9	5.85%	0.66	4,751.7
Curauma	Diesel	2007	2,456,370.0	5.87%	0.66	3,873.4
Casablanca	Diesel	2007	2,460,478.2	5.88%	0.66	2,718.3
Constitución 1	Diesel	2007	2,471,232.7	5.90%	0.65	7,019.2
Punitaqui	Diesel	2007	2,489,124.8	5.95%	0.72	12,879.7
Monte Patria	Diesel	2007	2,506,037.9	5.99%	0.75	12,614.8
Maule	Diesel	2007	2,511,223.2	6.00%	0.66	3,410.3

Cañete	Diesel	2007	2,515,858.2	6.01%	0.85	3,940.1
Lebu	Diesel	2007	2,520,327.6	6.02%	0.73	3,277.9
Angol (Los Sauces)	Diesel	2007	2,525,045.5	6.03%	0.72	3,410.3
Chufquen (Traiguén)	Diesel	2007	2,527,637.0	6.04%	0.74	1,920.4
Curacautín	Diesel	2007	2,533,915.8	6.05%	0.76	4,800.9
Collipulli (Malleco)	Diesel	2007	2,541,569.7	6.07%	0.74	5,628.6
Quilleco (*)	Run-of-River	2007	2,541,569.7	6.07%		0.0
Chiburgo (*)	Run-of-River	2007	2,541,569.7	6.07%		0.0
Palmucho (*)	Run-of-River	2007	2,766,645.7	6.61%		0.0
El Rincón (*)	Run-of-River	2007	2,769,182.1	6.61%		0.0
Eyzaguirre (*)	Run-of-River	2007	2,777,928.0	6.63%		0.0
Ancud	Diesel	2006	2,783,941.1	6.65%	0.74	4,469.8
Quellon	Diesel	2006	2,794,344.4	6.67%	0.73	7,549.0
Nueva aldea II (*)	Diesel [Natural Gas]	2006	2,794,344.4	6.67%	0.66	0.0
Nueva Aldea I (ex Itata)	Biomass-Fuel oil	2005	2,794,344.4	6.67%		0.0
Coronel	Natural Gas [Diesel]	2005	2,868,944.4	6.85%	0.75	55,938.3
Antilhue TG	Diesel	2005	3,110,044.4	7.43%	0.76	182,070.1
Candelaria	Natural Gas [Diesel]	2005	3,686,644.4	8.81%	0.88	505,662.9
Valdivia (*)	Black Liquor - Biomass-Fuel Oil	2004	3,686,644.4	8.81%		0.0
Licanten (*)	Black Liquor - Biomass-Fuel Oil	2004	3,699,662.8	8.84%		0.0
Horcones TG	Natural Gas	2004	3,706,462.8	8.85%	1.15	7,847.0
Laguna Verde TG	Diesel	2004	3,745,362.8	8.95%	0.83	32,447.5
Ralco (*)	Dam	2004	6,323,606.8	15.10%		0.0
Cholguán (*)	Biomass-Fuel Oil	2003	6,323,606.8	15.10%		0.0
Nehuenco II	Natural Gas	2003	8,716,106.8	20.82%	0.53	1,265,806.3
Total			**8,716,106.8**	**20.82%**		**3,706,193.0**

Source: Operation statistics 1999 / 2008, Economic Dispatch Center /Interconnected Central System, page 48, 49.
(*) Value obtained from CDEC-SIC (file 'Operación Real Anual').
Available at http://www.cdec-sic.cl/datos/anuario2009/cdecesp/index_esp.htm

The development of the equation of the Build Margin (BM) emission factor is:

$$EF_{grid,BM,y} = \frac{\sum_{m} EG_{m,y} x EF_{EL,m,y}}{\sum_{m} EG_{m,y}}$$

$$EF_{grid,BM,y} = \mathbf{0.4252\ t\ CO_2/MWh}$$

Operating Margin

The Simple Adjusted Method implies the following calculation for the prior 3 year previous to the presentation of the PDD.

Data 2008

Power plants with option A1:

Power Plant	Gen (MWh) (1)	NG (mm m^3) (2)	Diesel (m ton) (2)	Coal (m ton) (2)	Petcoke (m ton) (2)	$EF_{EL.m,y}$ (tCO_2/MWh)	EG x EF_{EL}
Ancud (*)	6,013.1		1.4			0.74	4,469.8
Antilhue TG	241,100.0		55.0			0.76	182,070.1
Bocamina	958,100.0		1.4	399.3		1.10	1,051,080.5
Campanario	240,000.0	5.3	54.5			0.79	188,950.5
Candelaria	576,600.0	11.7	147.2			0.88	505,662.9
Cañete (*)	4,635.0		1.2			0.85	3,940.1
Collipulli (*)	7,653.9		1.7			0.74	5,628.6
Constitución 1 (*)	10,754.5		2.1			0.65	7,019.2
Coronel	74,600.0	0.2	16.8			0.75	55,938.3
Curacautin (*)	6,278.9		1.5			0.76	4,800.9
D. Almagro	58,100.0		21.0			1.20	69,563.4
Degan	68,300.0		14.4			0.70	47,677.9
Guacolda 1	1,244,800.0			579.9		1.22	1,520,130.4
Guacolda 2	1,285,400.0			607.1		1.24	1,591,402.9
Horcones TG	6,800.0	0.0	2.4			1.15	7,847.0
Huasco TG	160,800.0		59.5			1.23	197,134.9
Huasco TV	0.0			0.0			0.0
Laguna Verde	247,400.0		9.8	171.4		1.95	481,734.2
Laguna Verde TG	38,900.0		9.8			0.83	32,447.5
Lebu (*)	4,469.4		1.0			0.73	3,277.9
Angol (Los Sauces) (*)	4,717.9		1.0			0.72	3,410.3
Los Vientos	380,800.0		102.0			0.89	337,784.8
Maule (*)	5,185.3		1.0			0.66	3,410.3
Monte Patria (*)	16,913.1		3.8			0.75	12,614.8
Nehuenco	312,200.0	0.0	50.8			0.54	168,197.1

Power Plant	Gen (MWh) (1)	NG (mm m^3) (2)	Diesel (m ton) (2)	Coal (m ton) (2)	Petcoke (m ton) (2)	$EF_{EL,m,y}$ (tCO_2/MWh)	EG x EF_{EL}
Nehuenco II	2,392,500.0	35.9	365.3			0.53	1,265,806.3
Nehuenco TG 9B	235,200.0	32.7	39.6			0.78	182,500.2
Nueva Renca	1,502,700.0	0.0	258.5			0.57	855,984.2
Olivos	28,300.0		6.4			0.75	21,322.6
Punitaqui (*)	17,892.1		3.9			0.72	12,879.7
Quellon (*)	10,403.3		2.3			0.73	7,549.0
Quellón II (*)	3,564.5		0.7			0.68	2,417.0
Renca	12,400.0		4.8			1.28	15,826.4
San Fco. de Mostazal	32,600.0		10.9			1.11	36,089.5
San Isidro	1,385,700.0	165.6	102.6			0.43	599,701.0
San Isidro II	1,647,900.0		288.6			0.58	955,445.6
Chufquen (Traiguén) (*)	2,591.5		0.6			0.74	1,920.4
Ventanas 1	941,600.0			350.7		0.98	919,333.9
Ventanas 2	1,633,600.0			607.1		0.97	1,591,481.5
Total	**15,807,472.4**					**Total**	**12,954,451.5**

Sources:
(1) Estadísticas de Operación 1999 / 2008, Centro de Despacho Económico de Carga / Sistema Interconectado Central. Pg 48,49 (2) Estadísticas de Operación 1999 / 2008, Centro de Despacho Económico de Carga / Sistema Interconectado Central. Pg 60, 61 (Operating statistics 1999/2008, Dispatch Economic Center of the Central Interconnected System, available at http://www.cdec-sic.cl/datos/anuario2009/cdecesp/index_esp.htm)
(*) Value obtained from CDEC-SIC (file 'Operación Real Anual')

Power plants with option A2:

Power Plant	Start Operation	Technology	Gen (MWh) (1)	Fuel type (2)	$EF_{EL,m,y}$ (tCO_2/MWh)	EG x EF_{EL}
Casablanca (*)	2007	Open cicle, new	4,108.2	Diesel	0.66	2,718.3
Colmito	2008	Open cicle, new	2,700.0	Diesel	0.66	1,786.5
Concón (*)	2007	Open cicle, new	7,181.4	Diesel	0.66	4,751.7
Curauma (*)	2007	Open cicle, new	5,854.0	Diesel	0.66	3,873.4
Chiloé (*)	2008	Open cicle, new	110.9	Diesel	0.66	73.4
Chuyaca (*)	2008	Open cicle, new	82.6	Diesel	0.66	54.7
Esperanza (*)	2007	Open cicle, new	12,579.2	Diesel	0.66	8,323.3
Las Vegas (*)	2007	Open cicle, new	6,074.1	Diesel	0.66	4,019.0
Nueva Aldea II	2006	Open cicle, new	0.0	Diesel	0.66	0.0
Petropower	1998	Flidized Bed System, old	493,900.0	Petcoke	0.84	415,209.9
Placilla (*)	2008	Open cicle, new	2,961.1	Diesel	0.66	1,959.3
Quintay (*)	2008	Open cicle, new	3,190.4	Diesel	0.66	2,111.0

Power Plant	Start Operation	Technology	Gen (MWh) (1)	Fuel type (2)	$EF_{EL,m,y}$ (tCO_2/MWh)	EG x EF_{EL}
Totoral (*)	2008	Open cicle, new	3,371.8	Diesel	0.66	2,231.0
Taltal 2 (Natural Gas) (*)	2000	Combined cycle, old	87,023.0	GN	0.42	36,981.0
Taltal 2 Diesel (*)	2000	Combined cycle, old	602,651.0	Diesel	0.57	342,410.6
Taltal 1 (Natural Gas) (*)	2000	Combined cycle, old	17,444.0	GN	0.42	7,412.9
Taltal 1 Diesel (*) (**)	2000	Combined cycle, old	332,668.0	Diesel	0.57	189,013.3
Total			**1,581,899.7**			**1,022,929.3**

Sources:
(1) Estadísticas de Operación 1999 / 2008, Centro de Despacho Económico de Carga / Sistema Interconectado Central. Pg 48,49 (2) Estadísticas de Operación 1999 / 2008, Centro de Despacho Económico de Carga / Sistema Interconectado Central. Pg 22,23 (Operating statistics 1999/2008, Dispatch Economic Center of the Central Interconnected System, available at http://www.cdec-sic.cl/datos/anuario2009/cdecesp/index_esp.htm)

(*) Value obtained from CDEC-SIC (file 'Operación Real Anual')

(**)Tal Tal 1 used only Natural Gas; then in 2008 it was converted to dual plant (diesel + natural gas)

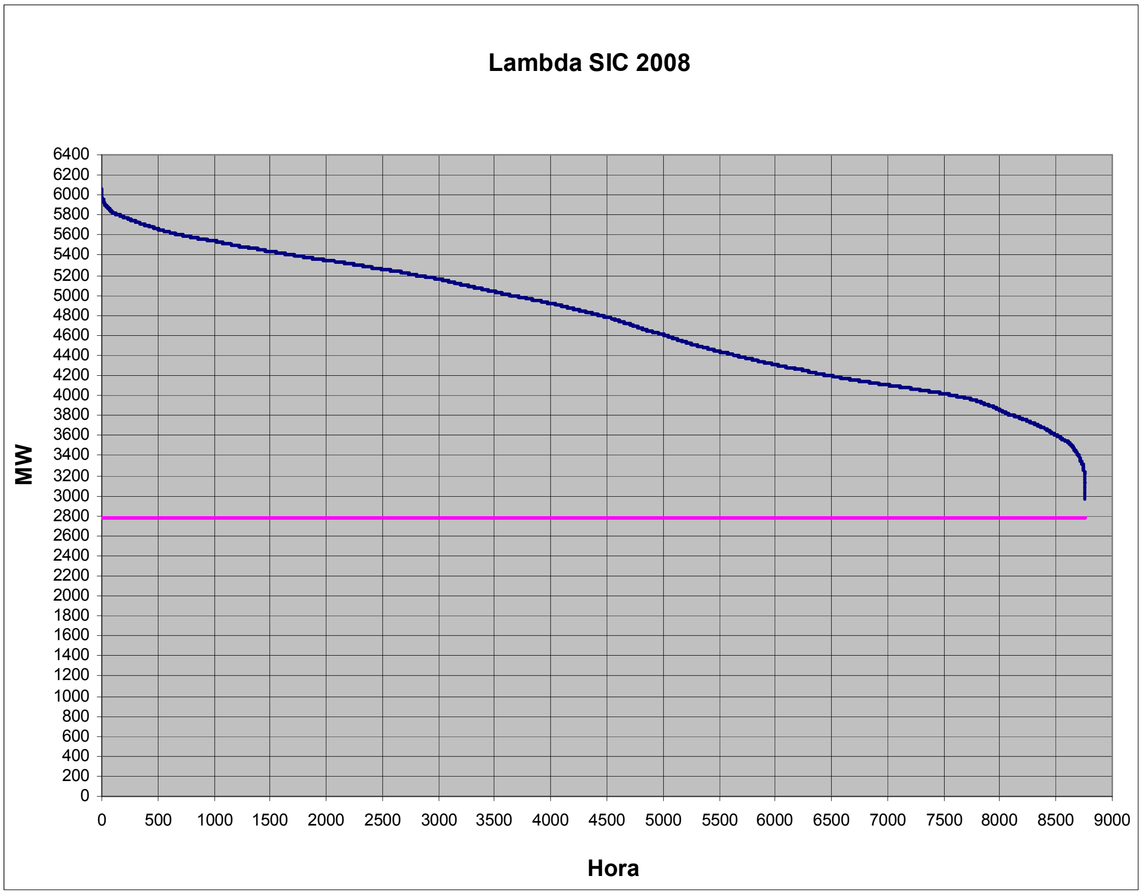
Total:

	Option A1	Option A2	TOTAL 2008
$\sum_m EG_{m,y} \times EF_{EL,m,y}$ (tCO_2)	12,954,451.5	1,022,929.3	13,977,380.8
$\sum_m EG_{m,y}$ (MWh)	15,807, 472.4	1,581,899.7	17,389,272.1

Lambda 2008

λ	=	0.000
1- λ	=	1.000

Lambda 2008



Annual Generation 2008

GEN (no Low Cost)	=	17,389,272	MWh
GEN (Low Cost)	=	24,471,523	MWh

Data 2007

OM with option A1:

Power Plant	Gen (MWh) (1)	NG (mm m^3) (2)	Diesel (m ton) (2)	Coal (m ton) (2)	Petcoke (m ton) (2)	$EF_{EL,m,y}$ (tCO_2/MWh)	EG x EF_{EL}
Antilhue TG (*)	347,200.0		82.4			0.79	272,724.3
Bocamina	1,008,700.0			393.2		1.02	1,030,790.6
Campanario	289,900.0	8.4	65.7			0.80	230,739.5
Candelaria	545,300.0	46.2	109.8			0.80	436,207.8
Coronel TG	187,400.0	16.5	26.9			0.61	115,092.0
D. Almagro	58,900.0		20.6			1.16	68,040.4
Degan	77,700.0		16.8			0.71	55,524.9
Guacolda 1	1,289,400.0			478.2		0.97	1,253,558.7
Guacolda 2	1,261,400.0			462.0		0.96	1,211,120.3
Horcones TG	61,200.0	5.7	15.6			0.99	60,616.6
Huasco TV	0.0						
Huasco TG	184,600.0		66.3			1.19	219,517.1
L.Verde	211,000.0			156.8		1.95	411,037.0
L.Verde TG	39,900.0		10.2			0.84	33,675.8
Los Vientos TG	418,800.0		110.7			0.88	366,577.0
Nehuenco	1,895,100.0	81.0	238.2			0.48	916,066.4
Nehuenco TG 9B	148,800.0	17.3	27.8			0.80	119,364.1
Nehuenco II	2,269,800.0	78.2	308.9			0.50	1,145,469.3
Nueva Renca	2,133,100.0	151.8	246.9			0.50	1,055,957.3
Renca	6,600.0		2.1			1.06	6,973.9
San Fco. Mostazal	24,300.0		7.4			1.01	24,524.3
San Isidro	2,045,100.0	139.3	242.4			0.50	1,021,158.6
San Isidro II	766,300.0		176.8			0.76	585,478.2
Ventanas 1	864,100.0			348.1		1.06	912,405.9
Ventanas 2	1,571,000.0			565.7		0.94	1,482,758.8
Total	**17,705,600.0**					**Total**	**13,035,379.0**

Sources: (1) Estadísticas de Operación 1999 / 2008, Centro de Despacho Económico de Carga / Sistema Interconectado Central. Pg 46, 47. (2) Estadísticas de Operación 1999 / 2008, Centro de Despacho Económico de Carga / Sistema Interconectado Central. Pg 60, 61. (Operating statistics 1999/2008, Dispatch Economic Center of the Central Interconnected System. Available at http://www.cdec-sic.cl/datos/anuario2009/cdecesp/index_esp.htm)

(*) This power plant was owned by Cenelca until November 2007. From December onwards it is owned by COLBUN. The generation presented is the sum of both periods (314.8 GWh between January and November, 32.4 GWh in December).

OM with option A2:

Power Plant	Start Operation	Technology	Gen (MWh) (1)	Fuel type (2)	$EF_{EL,m,y}$ (tCO_2/MWh)	EG x EF_{EL}
Cañete (*)	2007	Open cycle, new	4,418.5	Diesel	0.66	2,923.6
Ancud (*)	2006	Open cycle, new	7,437.4	Diesel	0.66	4,921.1
Angol (*)	2007	Open cycle, new	4,703.3	Diesel	0.66	3,112.0
Chufquen (*)	2007	Open cycle, new	3,629.6	Diesel	0.66	2,401.6
Collipulli (*)	2007	Open cycle, new	5,671.5	Diesel	0.66	3,752.7
Curacautin (*)	2007	Open cycle, new	7,521.5	Diesel	0.66	4,976.8
Lebu (*)	2007	Open cycle, new	4,641.4	Diesel	0.66	3,071.1
Quellon (*)	2006	Open cycle, new	14,366.0	Diesel	0.66	9,505.6
Casablanca (*)	2007	Open cycle, new	4,896.8	Diesel	0.66	3,240.1
Concón (*)	2007	Open cycle, new	8,395.9	Diesel	0.66	5,555.3
Curauma (*)	2007	Open cycle, new	6,569.0	Diesel	0.66	4,346.5
Las Vegas (*)	2007	Open cycle, new	6,984.3	Diesel	0.66	4,621.3
Constitución 1 (*)	2007	Open cycle, new	40,578.1	Diesel	0.66	26,849.3
Montepatria (*)	2007	Open cycle, new	8,306.0	Diesel	0.66	5,495.5
Punitaqui (*)	2007	Open cycle, new	6,397.5	Diesel	0.66	4,233.0
Esperanza	2007	Open cycle, new	4,600.0	Diesel	0.66	3,043.7
Nueva Aldea II	2006	Open cycle, new	9,900.0	Diesel	0.66	6,550.1
Petropower	1998	Open cycle, new	484,400.0	Petcoke	0.65	314,270.3
Taltal 2 (*)	2000	Combined cycle, old	59,147.0	NG	0.42	25,134.9
Taltal 2 Diesel (*)	2000	Combined cycle, old	538,474.0	Diesel	0.57	305,946.9
Taltal 1(*) (**)	2000	Combined cycle, old	169,940.0	NG	0.42	72,217.1
Total			**1,400,977.8**		**Total**	**816,169.2**

Sources: (1) Estadísticas de Operación 1999 / 2008, Centro de Despacho Económico de Carga / Sistema Interconectado Central. Pg 46,47. (2) Estadísticas de Operación 1999 / 2008, Centro de Despacho Económico de Carga / Sistema Interconectado Central. Pg 22,23. (Operating statistics 1999/2008, Dispatch Economic Center of the Central Interconnected System http://www.cdec-sic.cl/datos/anuario2009/cdecesp/index_esp.htm)

(*) Value obtained from CDEC-SIC (file 'Operación Real Anual')

(**)Tal Tal 1 used only Natural Gas; then in 2008 it was converted to dual plant (diesel + natural gas)

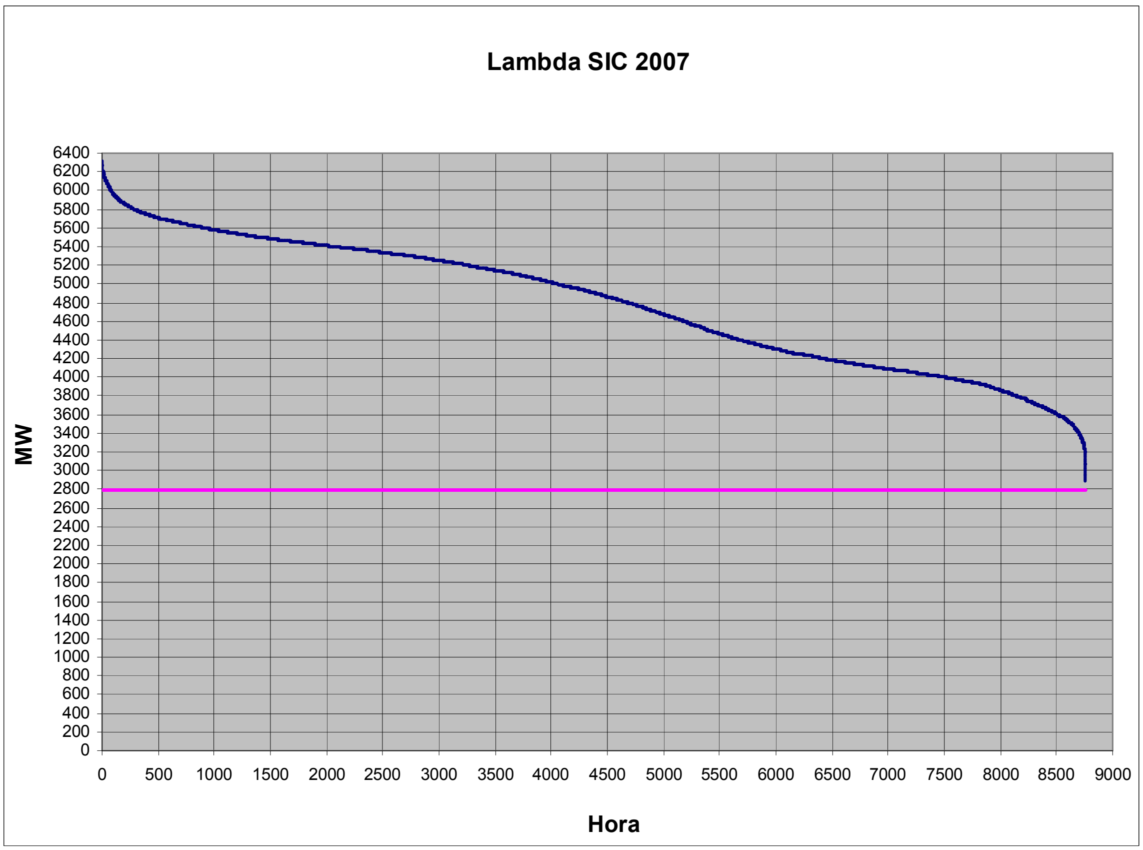
Total:

	Option A1	Option A2	TOTAL 2007
$\sum_m EG_{m,y} \times EF_{EL,m,y}$ (tCO_2)	**13,035,379.0**	816,169.2	13,851,548.3
$\sum_m EG_{m,y}$ (MWh)	17,705,600.0	1,400,977.8	19,106,577.8

Lambda 2007

λ	=	0.000
1- λ	=	1.000

Lambda 2007



Annual Generation 2007

GEN (no Low Cost)	=	19,106,578	MWh
GEN (Low Cost)	=	22,923,013	MWh

Data 2006

OM with option A1:

Power Plant	Gen (MWh) (1)	NG (mm m3) (2)	Diesel (m ton) (2)	Coal (m ton) (2)	Petcoke (m ton) (2)	$EF_{EL,m,y}$ (tCO_2/ MWh)	EG x EF_{EL}
Altihue TG	17,500.0		4.6			0.87	15,164.2
Bocamina	661,200.0			260.1		1.03	681,872.5
Candelaria	68,900.0	22.1	5.1			0.75	51,463.2
Campanario	4,600.0		1.3			0.93	4,271.1
Coronel TG	93,900.0	23.3	1.7			0.45	41,991.1
D.de Almagro	44,000.0		15.7			1.18	52,081.5
Guacolda 1	1,216,900.0			451.8		0.97	1,184,344.9
Guacolda 2	1,255,600.0			464.0		0.97	1,216,324.5
Horcones TG	6,300.0	2.4				0.61	3,831.8
Huasco TG	33,100.0		13.1			1.31	43,473.0
Huasco Vapor	0.0						
Laguna Verde	31,900.0			21.1		1.74	55,413.8
Laguna Verde TG	300.0		0.1			1.10	331.1
Nueva Renca	1,483,500.0	304.4	7.5			0.34	502,950.9
Nehuenco	889,400.0	152.7	20.5			0.35	307,531.9
Nehuenco 9B	31,400.0	9.8	1.1			0.61	19,061.9
Nehuenco II	2,126,000.0	424.8				0.31	667,068.5
Renca	0.0						
S. Fco. Mostazal	100.0		0.1			1.99	198.7
San Isidro	830,400.0	340.8	0.0			0.64	535,170.4
Ventanas 1	565,700.0			215.1		1.00	563,888.9
Ventanas 2	1,270,100.0			490.5		1.01	1,285,709.7
Total	**10,630,800.0**					**Total**	**7,232,143.7**

Sources: (1) Estadísticas de Operación 1999 / 2008, Centro de Despacho Económico de Carga / Sistema Interconectado Central. Pg 44,45. (2) Estadísticas de Operación 1999 / 2008, Centro de Despacho Económico de Carga / Sistema Interconectado Central. Pg 60, 61. (Operating statistics 1999/2008, Dispatch Economic Center of the Central Interconnected System, available at http://www.cdec-sic.cl/datos/anuario2009/cdecesp/index_esp.htm)

(*) Value obtained from CDEC-SIC (file 'Operación Real Anual')

OM with option A2:

Power Plant	Start Operation	Technology	Gen (MWh) (1)	Fuel type (2)	$EF_{EL.m,y}$ (tCO_2/MWh)	EG x EF_{EL}
Los vientos TG	2007	Open cycle, new	3,500.0	Diesel	0.66	2,315.8
Nueva Aldea II	2006	Open cycle, new	200.0	Diesel	0.66	132.3
Petropower	1998	Combined cycle, old	484,500.0	Petcoke	0.65	314,335.2
Taltal 2 (*)	2000	Combined cycle, old	217,603.0	NG	0.42	92,471.8
Taltal 2 Diesel (*)	2000	Combined cycle, old	11,233.0	Diesel	0.57	6,382.3
Taltal 1 (*) (**)	2000	Combined cycle, old	354,140.0	NG	0.42	150,494.1
Total			**1,071,176.0**		**Total**	566,131.6

Sources: (1) Estadísticas de Operación 1999 / 2008, Centro de Despacho Económico de Carga / Sistema Interconectado Central. Pg 44,45. (2) Estadísticas de Operación 1999 / 2008, Centro de Despacho Económico de Carga / Sistema Interconectado Central. Pg 22,23. (Operating statistics 1999/2008, Dispatch Economic Center of the Central Interconnected System, available at http://www.cdec-sic.cl/datos/anuario2009/cdecesp/index_esp.htm)

(*) Value obtained from CDEC-SIC (file 'Operación Real Anual')

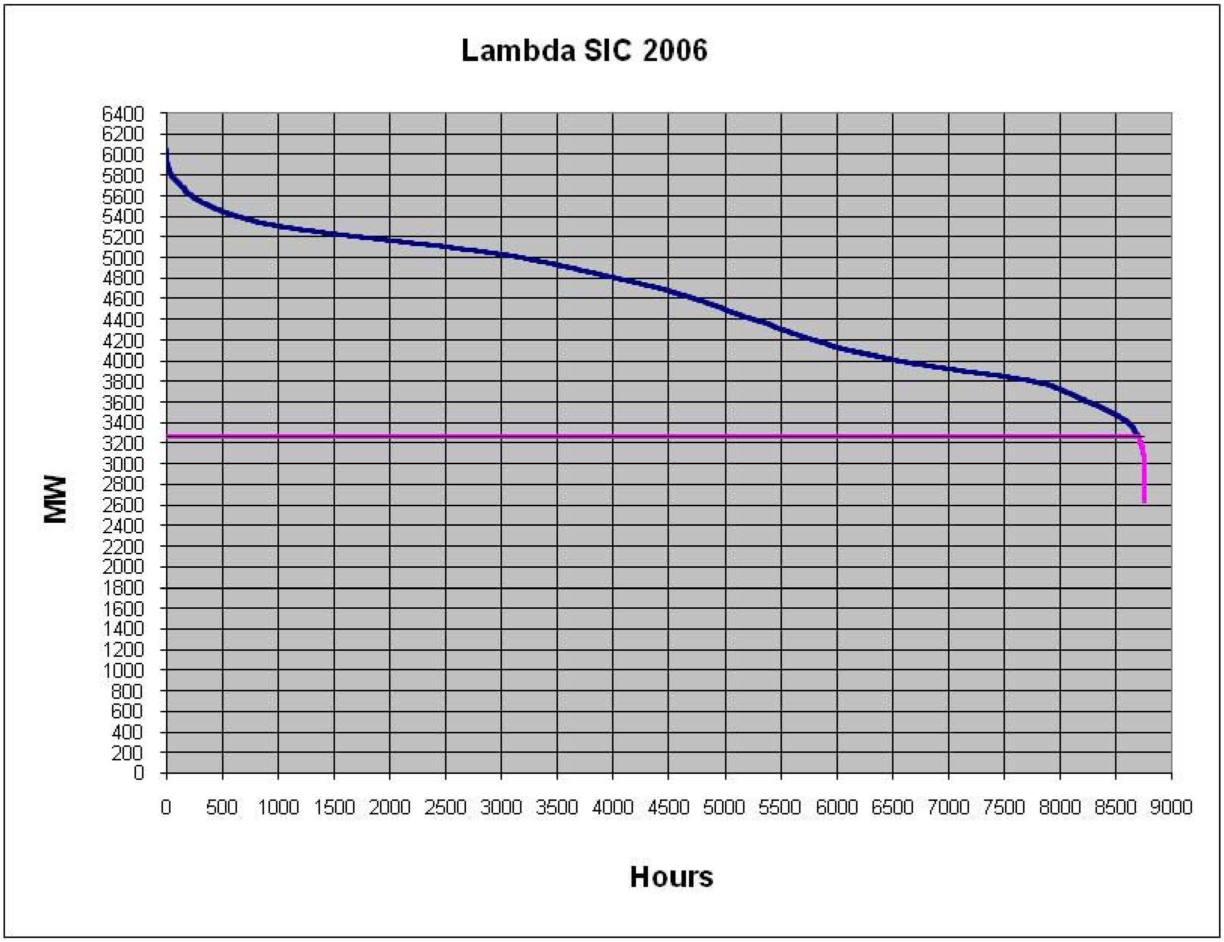
(**) Tal Tal 1 used only Natural Gas; then in 2008 it was converted to dual plant (diesel + natural gas)

Total:

	Option A1	Option A2	TOTAL 2006
$\sum_m EG_{m,y} \times EF_{EL,m,y}$ (tCO_2)	**7,232,143.7**	566,131.6	7,798,275.3
$\sum_m EG_{m,y}$ (MWh)	10,630,800.0	1,071,176.0	11,701,976.0

Lambda 2006

λ	=	0.00650684
1- λ	=	0.993493151



Annual Generation 2006

GEN (no Low Cost)	=	11,701,976	MWh
GEN (Low Cost)	=	28.634.100	MWh

The development of the equation of the Operating Margin (OM) emission factor is:

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

$$EF_{grid,OM-adj,y} = \mathbf{0.7381\ t\ CO_2e/MWh}$$

Emission factor of the grid EF SIC (Combined Margin)

The Emission Factor for the SIC is:

$$EF_{grid,CM,y} = EF_{grid,OM,y} * w_{OM} + EF_{grid,BM,y} * w_{BM} = \mathbf{0.5817\ t\ CO_2e\ /\ MWh}$$

II. REGULATIONS FULLFILED BY THE PROJECT (ENVIRONMENTAL ASSESMENT)

The following table list the environmental legislation met by San Clemente Project:

▪ Law Decree Nº 3,464. Political Constitution of the Republic (“Decreto de Ley Nº 3.464. Constitución Política de la República”).
▪ Law Nº 19,300: General Environmental Framework (“Ley Nº 19.300 Sobre Bases Generales Del Medio Ambiente”).
▪ Supreme Decree Nº 30, amended by S.D. Nº 95. Environmental Impact Assessment System Regulation (“Decreto Supremo Nº 30, modificado por D.S. Nº 95. Reglamento del Sistema de Evaluación de Impacto Ambiental”).
▪ Supreme Decree Nº144, which establishes rules to prevent emanations or air pollutants of any kind (“Decreto Supremo Nº144. Establece normas para evitar emanaciones o contaminantes atmosféricos de cualquier naturaleza”).
▪ Supreme Decree Nº 59, amended by Decree Nº 45, that establishes primary quality standards for respirable particulate matter PM10, in particular the values that define emergency situations (“Decreto Supremo Nº 59. Modificado por Decreto Nº 45. Establece norma de calidad primaria para material particulado respirable MP10, en especial de los valores que definen situaciones de emergencia”).
▪ Supreme Decree Nº 75. Sets Conditions for Cargo (“Decreto Supremo Nº 75. Establece Condiciones para el Transporte de Cargas que Indica”).
▪ Supreme Decree Nº 47 and modifications, article 5.8.3, General Ordinance of Urbanism and Construction (“Decreto Supremo Nº 47 y sus modificaciones. Artículo 5.8.3, Ordenanza General de Urbanismo y Construcciones”).
▪ Supreme Decree Nº 55, Emission standards for heavy motor vehicles (“Decreto Supremo Nº 55, Norma de Emisión Aplicable a vehículos motorizados pesados).
▪ Supreme Decree Nº 146. Sets emission standards for noise nuisance generated by fixed sources (“Decreto Supremo Nº 146. Establece Norma de Emisión de Ruidos Molestos Generados por Fuentes Fijas”).
▪ Supreme Decree Nº 594, amended by D.S. Nº 57. Regulation on basic sanitary and environmental conditions in the workplace (“Decreto Supremo Nº 594, modificado por D.S. Nº 57. Reglamento sobre condiciones sanitarias y ambientales básicas en los lugares de trabajo”).
▪ Decree Law Nº 725. Health Code (“Decreto con Fuerza de Ley Nº 725. Código Sanitario”).

▪ Supreme Decree Nº11. Chilean Norm 409, requirements of potable water ("Decreto Supremo Nº 11. Norma Chilena 409, Requisitos de Agua Potable").
▪ Supreme Decree Nº 594, amended by Supreme Decree No. 57, Regulation on basic sanitary and environmental conditions in the workplace ("Decreto Supremo Nº 594, modificado por DS Nº 57, Reglamento sobre condiciones sanitarias y ambientales básicas en los lugares de trabajo").
▪ Supreme Decree No. 148, Health Regulations on Hazardous Waste Management ("Decreto Supremo Nº 148, Reglamento Sanitario sobre Manejo de Residuos Peligrosos").
▪ Decree Law No. 1122, Water Code, Water Use Rights ("Decreto con Fuerza de Ley Nº 1.122, Código de Aguas, Derechos de Aprovechamiento de Aguas").
▪ Decree Law Nº 3,557, contains provisions on agriculture protection ("Decreto Ley Nº3.557. Establece disposiciones sobre Protección Agrícola").
▪ Supreme Decree No. 4363, Endorses Final Text of the Forest law ("Decreto Supremo Nº 4363, Aprueba Texto Definitivo de la Ley de Bosques").
▪ DL No. 2565, replaces Decree Law No. 701 of 1974, forest land subject to the provisions noted ("DL Nº 2565, Sustituye Decreto Ley Nº 701 de 1974, que somete los terrenos forestales a las disposiciones que señala").
▪ Law No. 17,288 and D.S. No. 484. National Monuments Law and its Regulations ("Ley Nº 17,288 y D.S. Nº 484. Ley sobre Monumentos Nacionales y su Reglamento").
▪ Supreme Decree Nº 158, establishes maximum weight of vehicles in public roads ("Decreto Supremo Nº 158, Fija el peso Máximo de los Vehículos que pueden Circular por Caminos Públicos").
▪ NSEG.5 E.N. 71, Electrical Installations of strong currents (Internal Rules of the Superintendency of Electricity and Fuels ("NSEG.5 E.n. 71, Instalaciones Eléctricas de Corrientes Fuertes (Norma Interna de la Superintendencia de Electricidad y Combustibles)").
▪ Decree-Law No. 1 Approves Amendments to DFL No. 4 of 1959, General Electric Services Law, related to electric energy ("Decreto con Fuerza de Ley Nº 1, Aprueba Modificaciones al DFL Nº 4 de 1959, Ley General de Servicios Eléctricos, en materia de energía eléctrica").
▪ Resolution Nº1, establishes maximum size of vehicles ("Resolución Nº 1. establece dimensiones máximas a vehículos que indica").
▪ Resolution No. 133, establishes quarantine regulations for the entry of wood packaging ("Resolución Nº133, Establece regulaciones cuarentenarias para el ingreso de embalajes de madera").

Annex 4

MONITORING INFORMATION

There is no additional information.