CLEAN DEVELOPMENT MECHANISM
PROJECT DESIGN DOCUMENT FORM (CDM-PDD)
Version 03 - in effect as of: 28 July 2006

CONTENTS

Annexes

SECTION A. General description of project activity

A.1. Title of the project activity:

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Chile: Quilleco Hydroelectric Project
Version 2.2
Version date: 05/10/2012

A.2. Description of the project activity:

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The Quilleco Hydroelectric Project consists of a run-of-river power plant of 70 MW effective installed capacity[1] (71.76 MW turbines nameplate installed capacity) run-of-the-river hydropower plant that utilizes the water discharged by the Rucúe hydropower plant (130m3/sec). The project will generate approximately 422 GWh per year and will inject 47 MW of firm power to the SIC electric grid (Sistema Interconectado Central). The estimates are based on long-term observations of water conditions of the Laja River.

The project's construction time is approximately 30 months. The project Feasibility Study can be found in the project file.

The project developer and operator is Colbún S.A., the second largest electric holding company in Chile, with a total installed capacity of 2364 MW, from which 48% are hydraulic power units. In the third quarter of 2005 Colbún acquired Cenelca S.A. and Hidroeléctrica Guardia Vieja S.A. (HGV). The latest company was one the first private companies worldwide to submit hydroelectric projects under the Kyoto Protocol CDM, this is the case of the Chacabuquito 26 MW power plant, operating since 01/07/2002. HGV still operates as a subsidiary of Colbún and will be acting as the project sponsor, representing Colbún S.A. for all CDM activities.

Quilleco uses well-proven technologies for run-of-river power generation. The project design considers a 4.4 km concrete channels, 3.2 km aqueduct tunnel, 105 m pressure penstock of 59.4 m height, a power house with two sets of 35.88 MW vertical Francis turbines/generators, 13.8/220 kV power transformer and 300 m of a 220 kV double circuit line connected to the existing 220 kV double circuit transmission line to the high voltage Charrúa substation in the Central Interconnected System (SIC).

The project construction costs are about US$ 79.6 million including taxes and 10% contingencies (mainly due to the tunneling risks), but without financing charges. Of this investment amount, US$ 58.2 million correspond to the civil works and related equipment costs and US$ 2.4 million to the expansion of the current 220KV transmission lines.

This project contributes to the sustainable development in Chile through:

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[1] The effective installed capacity reflects the power which is actually delivered to the grid at the connection point by the project activity, while the turbines nameplate reflects the nominal capacity of the turbine before converting the mechanical power to electricity through the power generator and the high voltage transformer.

- Use of local renewable energy resources (small hydro) to displace coal and natural gas thermal power generation in the SIC.
- Increased commercial activity through clean and renewable source of power.
- Employment generation in the 8th Region where the project is located, improving economic benefits it the surrounding communities such as Tucapel, Antuco and Quilleco.

The Project's local environmental and socio-economic benefits are summarized in Table A.1.

Table A.1: Domestic and local benefits

Area	Description
Local environmental benefits	• The project will contribute with clean energy for the Central Interconnected System of Chile, contributing to national development.
Socio-economic benefits	• The project will allow the 8h Region to exploit its significant economic potential. • A total of 579 local jobs will be created during the construction phase of Quilleco, positively impacting the surrounding communities of Antuco, Quilleco, Tucapel, Los Angeles and Huepil, which have a high level of rural population, poverty and unemployment compared to national average. • Economic activity during the construction period and also during all of its lifetime
Capacity building	• Extensive pre-negotiations consultations have been carried out and a Post-negotiations workshop communicating the lessons learned from the project design and implementation.
Technology transfer	• Introduction and demonstration of environmentally friendly power production techniques for the 8th Region is an explicit objective of the project. • The demonstration that emission reductions obtained from renewable energy can earn additional income and the introduction of CDM know-how is expected to raise environmental awareness
Environmental Impact Assessment (EIA)	• A full EIA has been carried out in accordance with Chilean law 19.300 and approved by CONAMA in 26/12/2000. • Colbún S.A. has set up an Environmental Project Committee in charge of the management and coordination of the environmental aspects of the Quilleco Hydroelectric Project in accordance with procedures of the ISO 14001 certified Environmental Management System of Colbún S.A. Environmental impacts of the Quilleco Hydroelectric Project are well defined and were adequately assessed by environmental and sector authorities. • World Bank safeguard policies were applied as part of the detailed project design; the WB - Project Appraisal Document (PAD) was completed and approved on April 2006. Typically, small scale run-ofriver hydropower projects have very limited environmental impacts.

A.3. Project participants:

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Table A.2: Project Participants

Name of Party involved ((host) indicates a host Party)	Private and/or public entity(ies) project participants (as applicable)	Kindly indicate if the Party involved wishes to be considered as project participant (Yes/No)
Chile (host)	• Hidroeléctrica Guardia Vieja S.A.	No
Government of Netherlands	• International Bank for Reconstruction and Development (IBRD) as Trustee of the Netherlands Clean Development Mechanism Facility (NCDMF)	Yes
United Kingdom of Great Britain and Northern Ireland	• Electrabel NV/SA	No

A.4. Technical description of the project activity:

A.4.1. Location of the project activity:

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A.4.1.1. Host Party(ies):

>>
Chile

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

>>
8th Region

A.4.1.3. City/Town/Community etc.:

>>
Los Ángeles, Comuna de Quilleco

A.4.1.4. Details of physical location, including information allowing the unique identification of this project activity (maximum one page):

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Quilleco Hydroelectric Project is located in the 8th region of Bío-Bío of Chile, at about 35 km east from Los Angeles city and 500 km south from Santiago. All project facilities are sited on the south bank of a

branch of the Laja River, 8 km downstream of existing Rucúe power plant, receiving the waters from this plant in hydraulic series.
The road from Los Angeles to Antuco is the main road in the entire area. Secondary and rural roads connect the communes of Quilleco and Tucapel.

Table A.3: Project Coordinates

	Latitude	Longitude
Power house	37°20'10"S	71°56'59"W
Intake	37°21'26"S	71°52'39"W

The location of the project activity is illustrated in Figure A.1

Figure A.1.a - Project Location. Geographic position

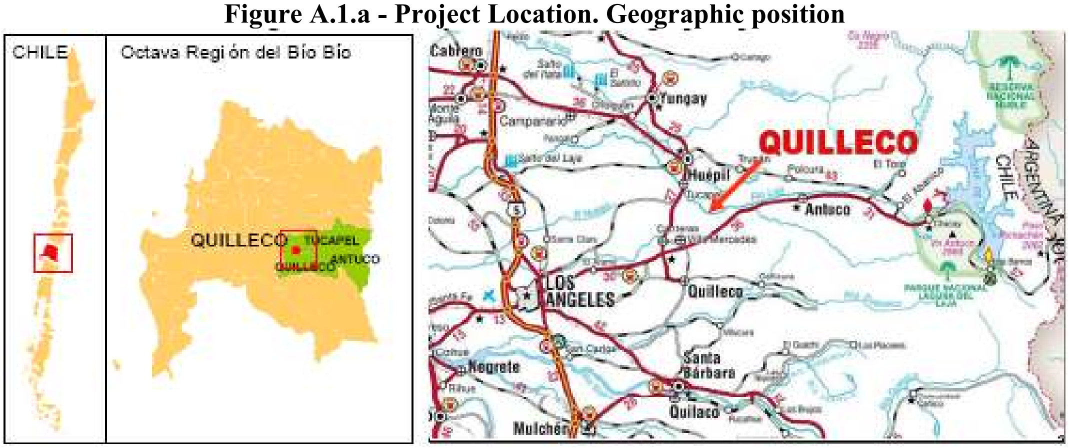
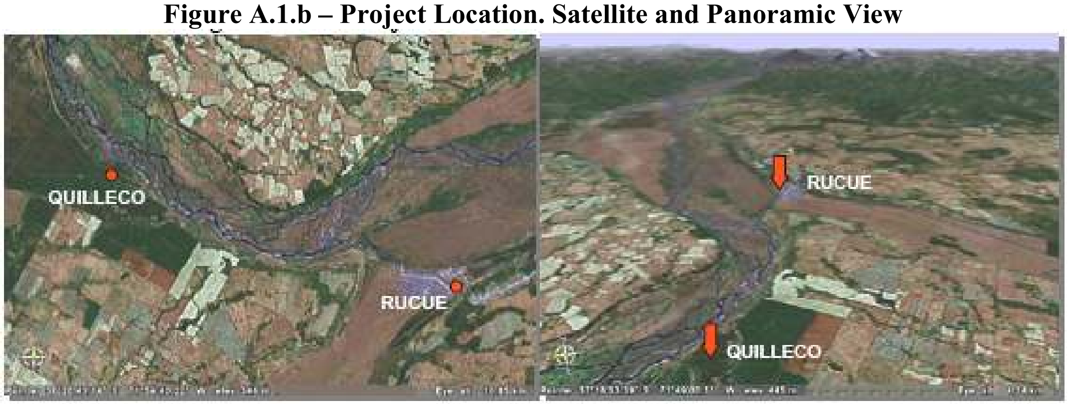


Figure A.1.b – Project Location. Satellite and Panoramic View



A.4.2. Category(ies) of project activity:

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The Quilleco Hydroelectric Project falls into:

Scope number: 1

Scope: Renewable Energy, Run-of-River Hydropower

A.4.3. Technology to be employed by the project activity:

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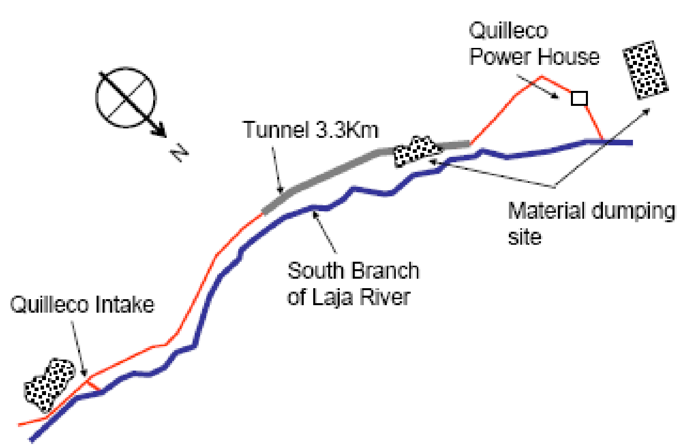
The technical design of the Quilleco Hydroelectric Project uses a simple layout and technologies well proven in Chile and worldwide and used in other Colbún operating power units. The Table A.4 below shows a brief description of the project technology.

Table A.4: Project Details

PHYSICAL INFRASTRUCTURE	POWER PLANT
• 4.4 km of open channel • 3.2 km aqueduct tunnel • 59.4 m pressure penstock • 2 sets of vertical Francis turbines and generators • 0.5 km 220 KV transmission line • Design flow: 130 m^3/s	• Effective installed Capacity: 70 MW • Turbines nameplate installed capacity: 71.76 MW • Average Net Generation: 422 GWh/year • Located 35 km east from Los Angeles city and 500 km south from Santiago • Construction time: 30 months • Estimated cost: US$ 79.6 million including 5% contingencies and VAT

Figure A.2: Project Design



A.4.4. Estimated amount of emission reductions over the chosen crediting period:

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

The OM will depend on the actual generation data from the SIC. The dispatch data, to be provided expost by the Economic Dispatch Center (CDEC-SIC), will conclusively indicate the type of generation displaced by the addition of Quilleco in the generation mix in the SIC. The monitoring and verification plan for the project utilizes the data provided by CDEC-SIC.

The BM emission factor will be determined in an ex-post basis as the generation-weighted average emission factor (tCO_2/MWh) of the most recent 20% capacity added to the SIC.

The estimates of emission reduction are provided to facilitate evaluation of emission reduction from the project. The total estimated emission reduction to be achieved by the project is about 3.6 million tons of CO_2 over 21 years (i.e. during three renewable seven-year crediting periods). This is approximately 172,176 tCO_2e per year.

Table A.5: Estimated amount of emission reductions during the First Crediting Period

Years	Annual Estimation of emission reductions in tonnes of CO_2e
2008 (from 01/07/2008)	86,088
2009	172,176
2010	172,176
2011	172,176
2012	172,176
2013	172,176
2014	172,176
2015 (until 30/06/2015)	86,088
Total Estimated Reductions (tonnes of CO_2e)	**1,205,232**
Total number of crediting years	**3 x 7 = 21**
Annual average over the crediting period of estimated reductions (tonnes of CO_2e)	**172,176**

A.4.5. Public funding of the project activity:

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No public funding is involved in the project activity. The fund used to financing is not diversion of ODA.

SECTION B. Application of a baseline and monitoring methodology

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

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AM0026 (v.2): "Baseline Methodology for zero-emissions grid-connected electricity generation from renewable sources in Chile or in countries with merit order based dispatch grid", together with the "Tool for the demonstration of additionality" (version 3)

B.2. Justification of the choice of the methodology and why it is applicable to the project activity:

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The proposed methodology has been specifically tailored for the Chile Power sector

The project meets every condition stated in the approved methodology.

The project:

- is connected to the central grid of Chile;
- is run-off-river hydro power plant with no reservoirs
- uses renewable sources to generate electricity; and
- fulfills all the legal obligations for this kind of projects, such as water rights, electric license, and environmental regulations.

B.3. Description of the sources and gases included in the project boundary:

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

Table B.1: Emission Sources

	Source	Gas	Included?	Justification/Explanation
Baseline	SIC thermal dispatch	CO_2	Yes	Emission due to thermal power plant dispatch
		CH_4	No	
		N_2O	No	
Project Activity	SIC thermal dispatch	CO_2	Yes	
		CH_4	No	
		N_2O	No	

B.4. Description of how the baseline scenario is identified and description of the identified baseline scenario:

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Identification of the Baseline Scenario

In a centrally planned system, such as Chile, the baseline scenario can be determined on the basis of the least cost expansion and operation of the electric grid as defined by the planning authority. In Chile there is no central planning for expansion of power facilities. However, the National Energy Commission

(CNE) prepares an indicative expansion plan, which is used to calculate system energy and power node prices. This calculation is based on the most plausible scenario for least cost capacity additions on the grid. However, sector investments come from private investors who are free to choose the projects they want to develop and base their decisions regarding investments and operation of plants on their own perception of the market, where the CNE node price determination is a key factor.

Consequently, the baseline for the purpose of estimating emission reductions prior to their actual generation, should be determined as the most likely scenario of capacity additions and generation private investors and plant operators would choose on the basis of demand projections, node and spot prices, investment costs, available technology for capacity expansions and expected price of fuels. Thus, the baseline scenario consists of the current power plants in the relevant system grid for the Quilleco Hydroelectric Project boundary (which is the Central Interconnected System or SIC in Spanish) plus the projected capacity expansion and including the generation pattern in the SIC as it occurs in the absence of the generation of this CDM project.

Description of the identified Baseline Scenario

The baseline scenario for the Project is the continuing operation of the existing and future power plants, without the Quilleco electricity generation, to meet the actual electricity demand. In the project scenario the same electricity demand is met with the Quilleco generation dispatched in the base load displacing the generation from existing power plants and future power developments. Because the project uses renewable sources to produce electricity, there are no additional emissions from the project activity and the emissions reductions are generated by the displaced generation from the Central Interconnected System. Chile has four different grids and there are no interconnections between them. Therefore, each grid defines the geographical and system boundaries for proposed projects located within it (see map below).

The Northern Interconnected Grid (SING) compromises the regions 1 to 3 and accounts 34 percent of the total capacity. The Central Interconnected Grid (SIC), where the Quilleco Hydroelectric Project is immersed, compromises the regions 3 to 10 and accounts 64 percent of the total capacity. The Aysen and Magallanes grids are located in the 11 and 12 regions, respectively, and accounts less than one percent of the total capacity.

The relevant system grid for the Quilleco Hydroelectric Project boundary is the SIC, which its generation mix capacity comprises of 60% hydroelectric generation, 30% combine cycle gas turbines (fired with natural gas most of the time, but also diesel recently), and the remainder from coal, diesel, petcoke, and cogeneration. At present there are no electricity imports or exports of the SIC grid to other national or international grid, however future system expansion may include interconnection to the SING grid or Argentina grid (SADI).

Figure B.1: Project Boundary

Chile Electric Grids

Sistema Interconectado Central – SIC

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 CDM project activity (assessment and demonstration of additionality):

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How the anthropogenic GHG emissions are to be reduced

The project activity is a grid connected run-of-river hydropower project. It does not involve switching from fossil fuels and the grid's geography and system boundaries are explicit and characteristics are readily available through CNE and CDEC-SIC.

The Project activity will reduce emissions by displacing electric energy generated from fuel-based power plants. The electric energy generated by the project is produced using renewable energy with zero emission to the atmosphere associated with its operations.

The following steps are used to demonstrate Quilleco's additionality. These are based on the latest Tool for the demonstration and assessment of additionality (version 3).

Step 1) Identification of alternatives to the project activity, based on the Chilean national authority indicative expansion plan; this step shows that the Quilleco Hydroelectric Project is not the only alternative for the expansion of the system and nor the least cost alternative, which are combined cycle natural gas fired power plants and hydro dams (non run-of-river). Step 2) Investment analysis shows that the project is not the most financially attractive scenario. The analysis is based on the Chilean official optimization model (OSE2000), conducting a cost analysis in the system with and without the project activity, as indicated on AM0026 (v.2) substeps i), ii), and iii). Finaly, Step 4) With a common practice analysis, other projects similar to Quilleco were searched for, showing that there are no similar activities observed in the SIC, with the exception of those projects that have been submitted under, or are seeking, carbon finance under the CDM.

The step 3) Barrier analysis has been intentionally omitted to simplify the additionality assessment, even though Quilleco does face several identifiable barriers, as many hydro power projects in the Chilean sytem do.

Additionality Assessment

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

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

  $$Min\ \{\Sigma Investment + Op\ \&\ MantCosts + VariablesCosts - \mathrm{Re}\ sidualValue\ \}$$

  The effective CNE Node Price Report at the time the project was considered as an investment option is the April 2004 report, and thus, the one that impacted on the investment decision. It is then the relevant report to test the additionality of the Quilleco Hydroelectric Project. The following table shows the expansion plan from that report (**www.cne.cl**).

Table B.2: CNE Indicative Expansion Plan for the SIC – April 2004

Month	Year	Project	Capacity
April	2006	Exp. Coya and Pangal Hydro Power Plants (Run of River)	25
October	2007	V Region Hydro Power Plant (Run of River)	65
October	2007	Combined Cycle Natural Gas Plant # 1 (VIII Region)	385.1
January	2008	La Higuera Hydro Power Plant (Run of River)	155
April	2008	Combined Cycle Natural Gas Plant # 2 (VIII Region)	385.1
April	2009	Calabozo Geothermal Plant Stage 1	100
April	2009	Combined Cycle Natural Gas Plant # 3 (VIII Region)	381
January	2010	Confluencia Hydro Power Plant (Run of River)	155
April	2010	Calabozo Geothermal Plant Stage 2	100
January	2011	Combined Cycle Natural Gas Plant # 4 (VIII Region)	381
April	2011	Neltume Hydro Power Plant (Reservoir)	400
April	2011	Calabozo Geothermal Plant Stage 3	100
January	2013	Combined Cycle Natural Gas Plant # 5 (VIII Region)	379.4
October	2013	Combined Cycle Natural Gas Plant # 6 (VIII Region)	379.4

Source: Node Price Report April 2004 **www.cne.cl**

As shown above, the least cost alternative for the expansion of the SIC are combined cycle natural gas fired power plants and hydro dam called Neltume (400 MW, 2011). The rest of the projects are renewable energy CDM projects such as Hornitos in the fifth region, La Higuera and Calabozo geothermal Plant. The 25 MWn indicated in Coya and Pangal hydro power plants

corresponds to a capacity expansion project based on the renewal of hydro tubines operating since 1911 and 1921 respectively.

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

Macro analysis:

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

Table B.3 Projected Investment and costs

In million USD	2004-05	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12	2012-13	2013-14
Baseline Scenario										
Generation	197,1	227,8	277,6	337,6	363,2	405,5	498,0	578,1	723,6	774,2
Unserved Energy	2,1	9,7	10,5	21,6	9,7	11,3	13,2	12,8	38,4	41,0
TOTAL	**199,3**	**237,6**	**288,0**	**359,2**	**372,9**	**416,8**	**511,2**	**590,9**	**762,1**	**815,2**
Including Project										
Generation	197,1	227,9	277,6	331,8	354,1	395,9	488,5	567,5	713,8	764,5
Unserved Energy	2,1	9,7	10,5	19,3	7,7	7,1	9,0	8,8	34,1	37,0
Project Investment	-	-	-	110,2	-	-	-	-	-	-76,8
Project O&M costs	-	-	-	0,5	1,5	1,5	1,5	1,5	1,5	1,5
TOTAL	**199,3**	**237,6**	**288,0**	**461,8**	**363,3**	**404,5**	**498,9**	**577,9**	**749,4**	**726,1**

Table B.4 Investment Analysis

In million USD (*)	
Baseline Scenario	
Generation	2.630,8
Unserved Energy	98,8
TOTAL	**2.729,6**
Including Project	
Generation	2.594,8
Unserved Energy	85,0
Project Investment	50,2
Project O&M costs	5,3
TOTAL	**2.735,3**
Generation+Unserved	**-49,8**
Project Costs	**55,5**
Cost Difference	**5,7**
Investment Cost (apr-04)	**79,6**
Commissionig date	**Sep-07**
Annua Discount rate	**10%**
Annual O&M costs	**1,0**

(*) As of April 2004

The 10% discount rate is the official rate for the Chilean electric sector, used by the CNE to determine sytem prices with the expansion model

The previous table shows the proposed CDM project has the following economic impact on the overall system:

- savings in the system operation cost of US$ 36.0 million (US$ 2,594.8 - US$ 2,630.8);
- savings in expected shortage of US$ 13.8 million (US$ 85.0 – US$ 98.8); and
- US$ 55.5 million of additional investment and maintenance and operation of the Project

The overall outcome is US$ 5.7 millions of additional cost for serving the same energy demand.

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

Therefore, according to the investment analysis, the Project would be additional.

Micro analysis:

At the project level, the Quilleco Hydroelectric Project had all its legal procedures accomplished since year 2000, after the approval of the EIA by Conama (the National Environmental Agency). However the project did no reach the company's board approval for implementation until mid 2004, due to the low expected rate of return, and explained by the Argentinean natural gas effects on the local generation market.

Before its implementation the project developer submitted this project to the World Bank seeking for additional funding from the Emissions Reductions generated by the project. On 22/09/2004 Colbún S.A., through its subsidiary HGV, and the World Bank, acting as a trustee of the Netherlands Clean Development Mechanism Facility (NCDMF), signed a Letter of Intent for the purchase of Emissions Reductions; in 31/08/2005 the Government of Chile endorsed the project for the purpose of the Article 12 of the Kyoto Protocol; and in 27/04/2006, an Emission Reduction Purchase Agreement (ERPA) was signed, reflecting what was originally agreed in the Letter of Intent. Therefore, the CDM was seriously considered before the start of the construction of the project (2005) and the expected revenues from the CDM component of the project and the NCDMF as buyer were crucial for the investment decision.

- ***Step 4. Common practice analysis.***

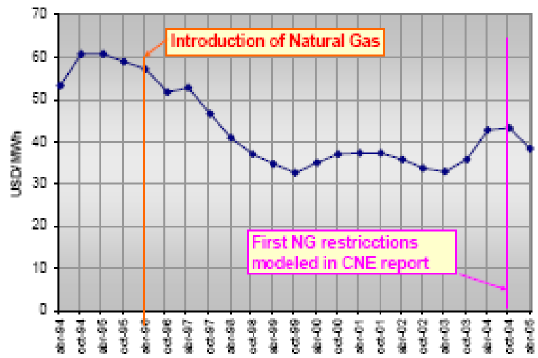
    - **Sub-step 4a Analyze other activities similar to the proposed activity:**

    Since natural gas was introduced as a resource to Chile in 1996, which changed completely the business environment in both main grids, all other available technologies, such as renewable resources, became non-competitive, with the exception of big hydro dam power projects. Since 1996, only few hydro run-of-the-river power projects were built in the Chilean interconnected central grid (Loma Alta in 1997 and Peuchen - Mampil projects in 2000). The Chacabuquito hydro project was built in 2001. However this is a CDM project activity, thus additional to the baseline.

The Chilean Central Interconnected System (SIC), natural gas requirements are based on the installed capacity of combined cycle (CC) natural gas power plants, conformed by Electrica Santiago S.A. (Nueva Renca CC. power plant), Colbun S.A. (Nehuenco I and Nehuenco II CC power plants and Nehuenco III open cycle power plant) and San Isidro S.A. (San Isidro CC power plant).

The following figure shows SIC's historic energy price variations. It can be clearly identified an energy price reduction in the system after natural gas introduction.

Figure B.2: CNE Node Price Fixations (in real USD as of Oct-2006)



Source: CNE price reports (**www.cne.cl**) and US CPI index (**www.bls.gov**)

In 2004, Chilean natural gas supply from Argentina started to suffer restrictions imposed by Argentinean internal policies. However, the end of 2004, and even in 2005, previous historical restriction information from Argentina gas imports was not significant enough to foresee a deeper restriction scenario in the future that could affect the electric system. (Further sector analisys and the natural gas restriction effects in the Chilean grid can be found in Annex 3).

As indicated previously, Quilleco Hydroelectric Project investment decision was taken only after seeking additional funding from carbon credits, as at that time the competition coming from natural gas-based projects, prevented the project developer from undertaking the investment. As evidenced on Annex 2, Quilleco investment decision was made before the natural gas restriction had important effects in the system.

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

There are no similar activities observed in the SIC being carried at the time the project initiated its construction, with the exception of those projects that have been submitted under, or are seeking, carbon finance under the CDM (ex Chacabuquito HPP and La Higuera).

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

B.6. Emission reductions:

B.6.1. Explanation of methodological choices:

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

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

The BM emission factor will be determined as option (i) in AM0026, i.e., following the BM emission factor estimation process described in ACM002 (v.6) Option 2, which is calculated on an *ex-post* basis as the generation-weighted average emission factor (tCO2/MWh) of the most recent 20% capacity added to the SIC.

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

Data / Parameter:	Fuel Carbon Content
Data unit:	tC/TJ
Description:	Determination of carbon content for different fuels
Source of data used:	IPCC revised guidelines
Value applied:	Diesel: 20.2 tC/TJ Natural Gas: 15.30 tC/TJ Coal: 25.8 tC/TJ Petcoke: 27.134 tC/TJ (following IPCC 2006 revised emission factor)
Justification of the choice of data or description of measurement methods and procedures actually applied :	No other data is publicly available. For estimating emission factor for different fuel based generation technologies, IPCC guidelines have been used in a conservative manner.
Any comment:	

Data / Parameter:	Combustion efficiency
Data unit:	%
Description:	Determination combustion efficiency of different fuel based generation technologies
Source of data used:	IPCC revised guidelines
Value applied:	Diesel: 99.0% Natural Gas: 99.5% Coal: 98.0% Petcoke: 98.0%
Justification of the choice of data or description of measurement methods and procedures actually applied :	No other data is publicly available. For estimating emission factor for different fuel based generation technologies, IPCC guidelines have been used in a conservative manner.
Any comment:	

Data / Parameter:	CO_2 conversion factor
Data unit:	%
Description:	Molecular weight of carbon dioxide relative of that of carbon
Source of data used:	IPCC revised guidelines
Value applied:	44/12 = 3.67
Justification of the choice of data or description of measurement methods and procedures actually applied :	For estimating emission factor for different fuel based generation technologies, IPCC guidelines have been used in a conservative manner.
Any comment:	

B.6.3. Ex-ante calculation of emission reductions:

>>

AM0026 (v.2) calculates *ex-post* the emission factor for the operating margin by observing actual dispatch data, the generation from the power plants and the merit order. The emission factor for the operating margin is determined by the generation that would be dispatched in the absence of this CDM Project.

Setp 1) The Emission Factor of the Operating Margin – OM

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

Where,

EFj,h Operating margin Emission factor for proposed CDM project 'j' for hour 'h', expressed in tCO_2/MWh,

$Generation_{j,h}$ Generation of proposed CDM project 'j' during hour 'h', expressed in MWh,

H Total number of hours of the year 'y'.

The emission factor for the proposed CDM project 'j', in a system with N CDM projects, for a hour 'h' is based on identification of the marginal plant(s) that would be operated to meet the electricity supplied by the proposed CDM project 'j'. The identification of marginal plant(s) displaced by proposed CDM project 'j' is based on the "first-built first served" principle. "Date of built" is defined as the date when the plant begins the dispatch of energy to the grid. In the case of the Quilleco Hydroelectric Project, it will be the second power plant in operation in the SIC as a CDM project activity, after Chacabuquito26 MW power plant.

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

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

Where,

D(j,i) Energy displacement of the marginal plant 'i' due to the proposed CDM project 'j', expressed in MWh,

Di Emission factor of the marginal plant 'i', expressed in tCO_2/MWh,

M M is the total number of marginal plants that would be dispatched if the system is operated without the N CDM projects.

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

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

Where,

A_i Maximum energy generation of the marginal plant 'i' expressed in MWh/h (equivalent to plant capacity in MW)

B_i Actual Energy generation of the CDM marginal plant 'i' expressed in MWh/h

C_j Energy generation of the CDM project *'j'* expressed in MWh/h

N Total number of CDM projects in the system

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

Where,

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

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

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

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

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

Where,

SFC_i Is the specific fuel consumption of i^{th} marginal power plant, expressed as (ton of fuel or TJ)/MWh,

$CEF_{OM,i}$ Is the CO_2 emission factor of fuel used in ith marginal power plant, expressed as tCO_2/(ton of fuel or TJ),

$Oxid_i$ Is fraction of carbon in fuel, used in ith marginal plant, oxidized during combustion.

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

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

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

Step 2. Calculation of the Build Margin – BM

As described in AM0026, the emission factor for the build margin for each crediting period can be calculated based on the most recent 20% of capacity added to the grid (Option 2 for Build Margin Calculation of ACM002).

$$EF_{BM} = \frac{\sum_{i=1}^{L} EF_{BM,i} \bullet Gen_{BM,\ i}}{\sum_{i=1}^{L} Gen_{BM,i}} \qquad \textbf{(f5)}$$

Where,

L Group of electricity generation plants that compromise 20% of the system generation (in MWh) and that have been built most recently. Power plant capacity additions registered as CDM project activities should be excluded from the sample group ***L***.

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

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

$$EF_{BM,i} = SFC_{BM,i} \bullet CEF_{BM,i} \bullet Oxid_i \qquad \textbf{(f6)}$$

Where,

$SFC_{BM,i}$ Specific fuel consumption of the i^{th} electricity generation plant, expressed in ton of fuel /MWh or TJ of fuel/MWh. The data shall be taken from published data of electricity regulatory authority,

$CEF_{BM,i}$ CO_2 content of fuel used in i^{th} electricity generation plant, expressed as tCO_2/(ton of fuel or TJ of fuel),

$Oxid_i$ Fuel oxidation factor, expressed as fraction.

For the first crediting period, the EFBM will be updated annually *ex-post* for the year in which actual project generation and associated emissions reductions occur, as defined in option **i** of AM0026, based on ACM002 calcualtions.

Step 3. Project Emission Reductions

The combined emission factor for the proposed Quilleco Hydroelectric Project, according to AM0026 (v.2), is calculated with the weighted average for both the Operating Margin (OM) and the Build Margin (BM) as follows:

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

Where,

EF_{OM},y Emission factor for operating margin power generation sources, in tCO_2/MWh,

w_{OM} 0.5 Weight for operating margin emission factor,

EF_{BM} Emission factor for build margin power generation sources, in tCO_2/MWh,

w_{BM} 0.5 Weight for build margin emission factor.

The baseline emissions for the project are calculated as follows:

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

Where,

EF_y Baseline emission factor, in tCO_2/MWh

$Generation_y$ Electricity generated by the proposed CDM Project in year y (in MWh).

Finally, the project mainly reduces CO_2 emissions through substitution of power generation supplied by the existing generation sources connected to the grid and likely future additions to the grid. The emission reduction (*ERy*) by the project activity during year *y* is equal to the Baseline Emissions. Since the Quilleco Hydroelectric Project consists of a hydro power plant, there are no Project Emissions (*PEy*). Additionally, as per AM0026 (v.2), no leakage was identified for this project activity. The emission reduction can be expressed as follows:

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

The Baseline emission reductions calculation requires an overwhelming amount of data, considering all hourly dispatch and weekly merit order. All detailed system data can be obtained from CDEC-SIC's web page at **www.cdec-sic.cl**, with a subscription fee of 300 USD/year. Also, node price reports, used to calculate thermal plant emission factors, can be obtained from national's authority energy commission CNE at **www.cne.cl**.

The calculation of the baseline will be provided *ex-post* with real data according the approved methodology; hence, the data used in the PDD for the calculation of the current baseline for registration is only for estimation purposes with rough calculations. The detailed data required to calculate the EF_OM and EF_BM will be provided *ex-post*.

For estimation purposes within the PDD, the information of CDEC-SIC real dispatch data from 2002 to 2006 has been used in order to determine the real emission factor of each year and average emission factor of the period:

SIC Baseline Emission Reductions in Tonnes CO_2e/GWh

	2002	**2003**	**2004**	**2005**	**2006**	**Avg.**
EF_{BMy}	282	364	363	263	220	298
EF_{OMy}	428	726	555	587	290	517
EF_y	**355**	**545**	**459**	**425**	**255**	**408**

Source: Preliminary Colbun estimations based on CDEC-SIC data and Greenhouse Assesment Handbook

The following table provides information and data used to determine baseline emissions

Table B.5: Summarized Data to Calculate the Baseline Emissions

Variable	Value	Data source
$EF_{OM, y}$ (tCO_2e/GWh)	517	Estimated using an average of CDEC-SIC real dispatch data from 2002 to 2006 and IPCC manual
$EF_{BM, y}$ (tCO_2e/GWh)	298	Estimated using option ii) of ACM002 using an average of expost data of SIC dispatch and IPCC manual (2002 to 2006)
EF_y (tCO_2e/GWh)	408	Combined Margin result (f7)
EG_y (GWh/year)	422	Average project generation
$BE_y = ER_y$ (tCO_2e/year)	≈172,176	Calculated

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

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For an estimation purpose, the following table summarizes the emissions reductions of the first three years of operation and the expected emissions reductions:

Table B.6: Estimation of Emission Reductions for the First Crediting Period

Year	Estimation of project activity emissions (tonnes of CO_2e)	Estimation of baseline emissions (tonnes of CO_2e)	Estimation of leakage (tonnes of CO_2e)	Estimation of overall emission reductions (tonnes of CO_2e)
2008 (from 01/07/2008)	0	86,088	0	86,088
2009	0	172,176	0	172,176
2010	0	172,176	0	172,176
2011	0	172,176	0	172,176
2012	0	172,176	0	172,176
2013	0	172,176	0	172,176
2014	0	172,176	0	172,176
2015 (until 30/06/2015	0	86,088	0	86,088
Total (tonnes of CO_2e)	**0**	**1,205,232**	**0**	**1,205,232**

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

B.7.1 Data and parameters monitored:

Data / Parameter:	***$Generation_h$***
Data unit:	Energy in MWh
Description:	Energy Generation of the Project for each hour ***h***
Source of data to be used:	On-site metering system (same data submitted to CDEC-SIC)
Value of data applied for the purpose of calculating expected emission reductions in section B.5	422,000 MWh
Description of measurement methods and procedures to be applied:	Electronic measurement system each 15 minutes. Verification procedures shall be applied based on redundant energy meters.
Monitoring frequency	Hourly measurement
QA/QC procedures to be applied:	Meter should have a maximum error of 0.2% and be calibrated periodically according to local standards for electricity transactions in CDEC-SIC. Metering data is sent regularly to CDEC-SIC where a balance is made for energy transactions between power generators.
Any comment:	

Data / Parameter:	***$COEF_{i,y}$***
Data unit:	tCO_2 per mass or volume
Description:	CO_2 emission factor of each plant by fuel type used, taking into account the carbon content of the fuels used by relevant power sources ***i*** and percent of oxidation of fuel in year ***y***
Source of data to be used:	IPCC Guidelines and CNE Node Price Reports
Value of data applied for the purpose of calculating expected emission reductions in section B.5	Average for Coal powered units = 2,572 tCO_2 per 1000 tons of coal Average for diesel powered units = 2,701 tCO_2 per 1000 liters of diesel Average for natural gas powered units = 2.173 tCO_2 per cubic liter
Description of measurement methods and procedures to be applied:	Calculation based on official data from CNE's Node Price Report. Verification procedure shall be applied based on hystorical data per fuel type.
Monitoring frequency	Yearly or twice a year
QA/QC procedures to be applied:	Internal validation check should be performed contrasting historical data for existing plants. For new plants, validation should be accomplished through fuel type normal emission factors form similar plants.
Any comment:	***i*** refers to the power sources delivering electricity to the grid, not including low operating cost and must run power plants, and including imports to the grid.

Data / Parameter:	EF_y
Data unit:	tCO_2e/MWh
Description:	CO_2e Emission factor of the displaced energy from the grid
Source of data to be used:	Calculated based on formula **f7**
Value of data applied for the purpose of calculating expected emission reductions in section B.5	0,408 tCO_2e/MWh
Description of measurement methods and procedures to be applied:	Calculation based on official data from CNE's Node Price Report and AM0026 procedures.
Monitoring frequency	Annually
QA/QC procedures to be applied:	Automatic calculation procedure through a revised worksheet
Any comment:	

Data / Parameter:	$EF_{OM,y}$
Data unit:	tCO_2e/MWh
Description:	Operating Margin Emission Factor
Source of data to be used:	Calculated based on formula **f1** using CDEC-SIC data
Value of data applied for the purpose of calculating expected emission reductions in section B.5	0,517 tCO_2e/MWh
Description of measurement methods and procedures to be applied:	Calculated using CDEC-SIC databases and AM0026 procedures
Monitoring frequency	Annually
QA/QC procedures to be applied:	Automatic calculation procedure through a revised worksheet. Calculation should be done after CDEC-SIC energy balance to ensure data validity
Any comment:	

Data / Parameter:	$EF_{j,h}$
Data unit:	tCO_2e/MWh
Description:	Operating Margin Emission Factor of hour ***h***
Source of data to be used:	Calculated based on formula **f2** using CDEC-SIC data
Value of data applied for the purpose of calculating expected emission reductions in section B.5	Average estimation is 0,517 tCO_2e/MWh (EF_{OM})
Description of measurement methods and procedures to be applied:	Calculated from CDEC-SIC databases and AM0026 procedures.
Monitoring frequency	Hourly
QA/QC procedures to be applied:	Automatic calculation procedure through a revised worksheet. Calculation should be done after CDEC-SIC energy balance to ensure data validity

Any comment:	

Data / Parameter:	***D(j,i)***
Data unit:	Energy in MWh
Description:	Energy displacement of the marginal plant '***i***' due to the proposed CDM project '***j***'
Source of data to be used:	Calculated based on formula **f3** using CDEC-SIC data
Value of data applied for the purpose of calculating expected emission reductions in section B.5	Displaced energy is calculated hourly for each system unit. Total energy displacement is equivalent to project generation (422 GWh per year)
Description of measurement methods and procedures to be applied:	Calculated from CDEC-SIC databases and AM0026 procedures.
Monitoring frequency	Hourly
QA/QC procedures to be applied:	Automatic calculation procedure through a revised worksheet. Calculation should be done after CDEC-SIC energy balance to ensure data validity
Any comment:	

Data / Parameter:	d_i
Data unit:	tCO_2e/MWh
Description:	Emission factor of the marginal plant '***i***'
Source of data to be used:	IPCC manual and CNE node price report
Value of data applied for the purpose of calculating expected emission reductions in section B.5	Average for Coal powered units = 1.29 tCO_2e per MWh Average for diesel powered units = 0.81 tCO_2 per MWh Average for natural gas powered units = 0.55 tCO_2 per MWh
Description of measurement methods and procedures to be applied:	Calculation based on official data from CNE's Node Price Report. Verification procedure shall be applied based on hystorical data per fuel type.
Monitoring frequency	Hourly
QA/QC procedures to be applied:	Calculation based on official data.
Any comment:	

Data / Parameter:	SFC_i
Data unit:	Fuel intensity in Ton/MWh or TJ/MWh
Description:	Specific fuel consumption per unit of electric energy produced in the 'i^{th}' marginal plant
Source of data to be used:	CNE node price report
Value of data applied for the purpose of calculating expected emission reductions in section B.5	Average for Coal powered units = 0,56 tons per MWh Average for diesel powered units = 216 m^3 per MWh Average for natural gas powered units = 0.25 m^3 per MWh
Description of measurement methods and	Calculation based on official data from CNE's Node Price Report. Verification procedure shall be applied based on hystorical data per fuel

procedures to be applied:	type.
Monitoring frequency	Twice a year
QA/QC procedures to be applied:	Data is obtained from official reports. Historic comparison of each unit can provide data validation for existing and new units in the system.
Any comment:	

Data / Parameter:	***M***
Data unit:	Number
Description:	Number of electricity generation plants on the margin, that would supply to the system in the absence of the CDM projects in the system
Source of data to be used:	Calculation based on formula 2 and CDEC-SIC data
Value of data applied for the purpose of calculating expected emission reductions in section B.5	Not available
Description of measurement methods and procedures to be applied:	Calculated from CDEC-SIC databases and AM0026 procedures.
Monitoring frequency	Hourly
QA/QC procedures to be applied:	Electronic worksheet shall be implemented to deliver automatic calculations through revised worksheet
Any comment:	

Data / Parameter:	***N***
Data unit:	Number
Description:	List of CDM plants in the system
Source of data to be used:	CDEC-SIC and UNFCCC registered projects for the country
Value of data applied for the purpose of calculating expected emission reductions in section B.5	1
Description of measurement methods and procedures to be applied:	Determined from CDEC-SIC databases
Monitoring frequency	As required
QA/QC procedures to be applied:	Data is obtained from official reports.
Any comment:	

Data / Parameter:	C_j
Data unit:	MWh
Description:	Electric energy of the j^{th} CDM project of the system (j = 1 .. N) in the hour h
Source of data to be used:	CDEC-SIC
Value of data applied for the purpose of calculating expected emission	Since N=1, all CDM energy is equivalent to 422 GWh per year

reductions in section B.5	
Description of measurement methods and procedures to be applied:	Calculated from CDEC-SIC databases and AM0026 procedures.
Monitoring frequency	Hourly
QA/QC procedures to be applied:	Automatic calculation procedure through a revised worksheet. Calculation should be done after CDEC-SIC energy balance to ensure data validity
Any comment:	

Data / Parameter:	A_i
Data unit:	MW
Description:	Generation capacity of the ***ith*** plant on the margin during hour ***h***
Source of data to be used:	CDEC-SIC
Value of data applied for the purpose of calculating expected emission reductions in section B.5	Several system units are considered in the estimation. Official CDEC-SIC data was used
Description of measurement methods and procedures to be applied:	Determined from CDEC-SIC databases
Monitoring frequency	As required
QA/QC procedures to be applied:	Data is obtained from official CDEC-SIC databases.
Any comment:	

Data / Parameter:	B_i
Data unit:	MWh
Description:	Electric energy of the i^{th} plant on the margin during hour ***h***
Source of data to be used:	CDEC-SIC
Value of data applied for the purpose of calculating expected emission reductions in section B.5	Several system units are considered in the estimation.
Description of measurement methods and procedures to be applied:	Determined from CDEC-SIC databases
Monitoring frequency	Hourly
QA/QC procedures to be applied:	Data is obtained from official CDEC-SIC databases.
Any comment:	

Data / Parameter:	$EF_{BM,y}$
Data unit:	tCO_2e/MWh
Description:	Build Margin Emission Factor of the grid for the year ***y***
Source of data to be used:	Calculated based on formula **f5**. based on CNE Node Price Report and IPCC manual

Value of data applied for the purpose of calculating expected emission reductions in section B.5	0,298 tCO_2e/MWh
Description of measurement methods and procedures to be applied:	Calculated using CDEC-SIC databases and AM0026 procedures
Monitoring frequency	Annually
QA/QC procedures to be applied:	Automatic calculation through a revised worksheet using CDEC-SIC and official databases and CNE Node Price report values.
Any comment:	

Data / Parameter:	$EF_{BM,,i}$
Data unit:	tCO_2e/MWh
Description:	Emission Factor for the ***ith*** plant in the Build Margin Cohort for the year ***y***
Source of data to be used:	Calculated based on formula **f6**. CNE Node Price Report, IPCC manual, CDEC-SIC
Value of data applied for the purpose of calculating expected emission reductions in section B.5	Average estimation is 0,298 tCO_2e/MWh (EFOM)
Description of measurement methods and procedures to be applied:	Calculated from CDEC-SIC databases and AM0026 procedures.
Monitoring frequency	Annually
QA/QC procedures to be applied:	Official data is used
Any comment:	

Data / Parameter:	$Gen_{BM,,i}$
Data unit:	MWh
Description:	Energy generation of the ***ith*** plan on the Build Margin cohort
Source of data to be used:	CDEC-SIC (for ex-post calculation)
Value of data applied for the purpose of calculating expected emission reductions in section B.5	Several system units are considered in the estimation.
Description of measurement methods and procedures to be applied:	Determined from CDEC-SIC databases
Monitoring frequency	Annually
QA/QC procedures to be applied:	Automatic calculation through a revised worksheet using CDEC-SIC data
Any comment:	

Data / Parameter:	***Plant name***
Data unit:	text
Description:	Plant name. Identification of power sources
Source of data to be used:	CDEC-SIC
Value of data applied for the purpose of calculating expected emission reductions in section B.5	Several system units are considered in the estimation.
Description of measurement methods and procedures to be applied:	Determined from CDEC-SIC databases
Monitoring frequency	As new power plants are available in the system
QA/QC procedures to be applied:	
Any comment:	

Data / Parameter:	CEF_i
Data unit:	TC per ton of fuel or TJ
Description:	Carbon emission factor of fuel used in the i^{th} plant of the Build Margin cohort
Source of data to be used:	Estimated based on official data form CNE node price reports and IPCC default values
Value of data applied for the purpose of calculating expected emission reductions in section B.5	Average for Coal powered units = 25.8 tons per TJ Average for diesel powered units = 20.2 tons per TJ Average for natural gas powered units = 15.3 tons per TJ
Description of measurement methods and procedures to be applied:	Determined from IPCCC guidelines
Monitoring frequency	Annually
QA/QC procedures to be applied:	
Any comment:	

Data / Parameter:	$Oxid_i$
Data unit:	%
Description:	Fraction of fuel oxidized on combustion
Source of data to be used:	IPCC Guidelines
Value of data applied for the purpose of calculating expected emission reductions in section B.5	Average for Coal powered units = 98.0% Average for diesel powered units = 99.0% Average for natural gas powered units = 99.5%
Description of measurement methods and procedures to be applied:	Determined from IPCCC guidelines
Monitoring frequency	As required

QA/QC procedures to be applied:	
Any comment:	

Data / Parameter:	$SFC_{BM,i}$
Data unit:	ton of fuel /MWh or TJ of fuel /MWh
Description:	Specific fuel consumption of the ***ith*** electricity generation plant
Source of data to be used:	CNE node price report and CDEC-SIC
Value of data applied for the purpose of calculating expected emission reductions in section B.5	Average for Coal powered units = 0.014 TJ/MWh Average for diesel powered units = 0.011 TJ/MWh Average for natural gas powered units = 0.010 TJ/MWh
Description of measurement methods and procedures to be applied:	Determined from IPCCC guidelines and official data form CNE node price reports
Monitoring frequency	Yearly or twice a year
QA/QC procedures to be applied:	Internal validation check should be performed contrasting historical data for existing plants. For new plants, validation should be accomplished through fuel type normal emission factors for similar plants.
Any comment:	

Data / Parameter:	w_{BM}
Data unit:	%
Description:	Weight for Build Margin emission factor
Source of data to be used:	AM0026 default value = 50%
Value of data applied for the purpose of calculating expected emission reductions in section B.5	50%
Description of measurement methods and procedures to be applied:	AM0026 procedures
Monitoring frequency	Annually
QA/QC procedures to be applied:	
Any comment:	

Data / Parameter:	w_{OM}
Data unit:	%
Description:	Weight for Operating Margin emission factor
Source of data to be used:	AM0026 default value = 50%
Value of data applied for the purpose of calculating expected emission reductions in section B.5	50%
Description of	AM0026 procedures

measurement methods and procedures to be applied:	
Monitoring frequency	Annually
QA/QC procedures to be applied:	
Any comment:	

Data / Parameter:	***Changes in the regulatory framework that could affect the methodology***
Data unit:	Text
Description:	Changes in the regulatory framework that could affect the methodology
Source of data to be used:	Official Gazette
Value of data applied for the purpose of calculating expected emission reductions in section B.5	-
Description of measurement methods and procedures to be applied:	-
Monitoring frequency	As required
QA/QC procedures to be applied:	-
Any comment:	

B.7.2. Description of the monitoring plan:

>>

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

Please refer to section **B.6.3** for formulae reference

The monitoring methodology involves the monitoring of the following:

- Electricity generated and fed into the grid by the proposed CDM project, and other CDM registered projects (data available at CDEC-SIC).
- Public data on dispatch of electricity and other relevant information from the CDEC-SIC. This data is used to calculate the emission factor for the operating margin based on a dispatch increment analysis.
- Public data on official expansion planning for the system. This data will be used to calculate the emission factor for the build margin.
- Emission Factors for every thermal power plant that operates or is included in the expansion plan.
- Data needed to calculate the build margin emission factor consistent with the Consolidated Baseline methodology for grid-connected electricity generation from renewable sources. (AM0026 - ACM002).

All data monitored and required for verification and issuance are to be kept for two years after the end of the crediting period or the last issuance of CERs for this project activity, whichever occurs later.

The marginal plant(s) are identified using the merit order and the official marginal price for that hour.

1-. Data Processing for ER calculation

- **Step 1. Calculation of Operating Margin Emission Factors**

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

Net Hourly Generation output from the Quilleco Hydroelectric Project and all other generators in the system
(MWh)

↓

Analysis of hourly dispatch from all units of the SIC to determine
Marginal Plant(s) not dispatched (or displaced) due to dispatch of all existing CDM projects
(CDEC-SIC hourly data)

↓

Calculation of emission factors of all operational thermal units of the system
(CNE report and IPCC manual)
(tonnes CO_2e/MWh)

↓

Determination of the marginal plants and energy being displaced due to the operation of each CDM project, Chacabuquito (1^{st} CDM project) and Quilleco (2^{nd} CDM project) and other CDM project
(MWh and tonnes CO_2e/MWh)

- **Step 2. Calculation of the Build Margin**

Following AM0026, the Build Margin is calculated using option 2 of ACM002 for the first crediting period. For subsequent crediting periods, Build Margin EF shall be calculated ex-ante, as described in Option 1 of ACM002

Please refer to formulae stated in section B.6 (**f5** and **f6**)

The next diagram shows the complete process for calculating and assigning the Build Margin emission factor:

SIC Dispatch of all power units of the system
(MWh)
⇩
Determination of 20% of energy generated from most recent power units
(set of m plants following ACM0002 option2)
(MWh)
⇩
Calculation of emission factor of thermal units in the plan
(CNE reports and IPCC manual)
(tonnes CO_2e/MWh)
⇩
Determination of EF_{BM} (ACM0002) as the weighted average emission factor of the dispatched plants and their individual emission factor
(tonnes CO_2e/MWh)

- **Step 3. Calculation of the Project Emissions Reductions**

The combined emission factor for the proposed Quilleco Hydroelectric Project, according to AM0026 (v.2) is calculated with weighted average for both the Operating Margin (OM) and the Build Margin (BM).

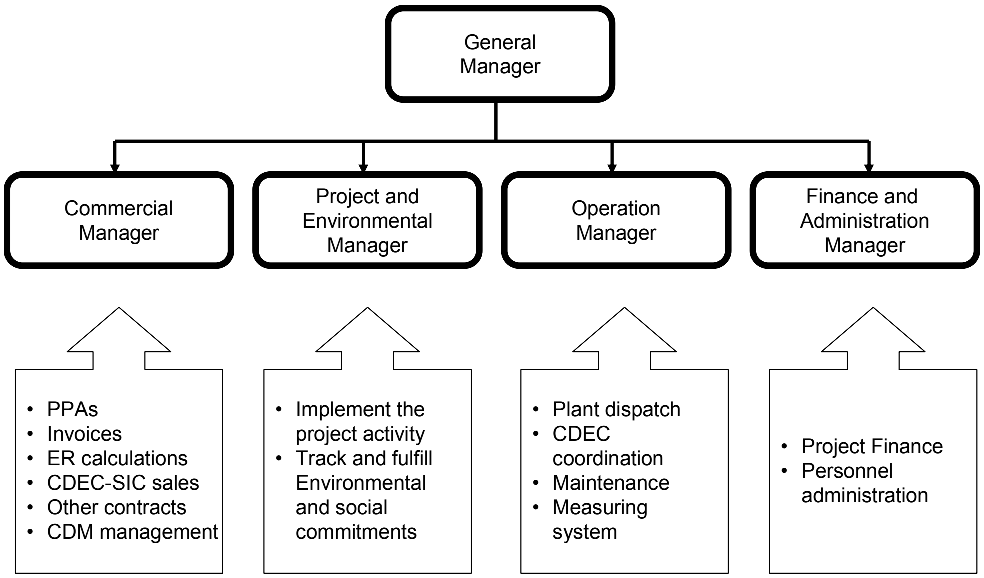
Please refer to formulae stated in section B.6.3 (**f7**, **f8** and **f9**)

Calculation of Combined Margin Emission factor of EF_{BM} and EF_{OM}
(tonnes CO_2e/MWh)
⇩
Energy generation of the Project Activity
(from CDEC-SIC or metering data)
(MWh)
⇩
Calculation of Baseline Emissions of the Project
(tonnes CO_2e)
⇩
Discount any leakage or project activity emissions, if any (No leakage emission was identified for Quilleco, and project emissions are null)
(tonnes CO_2e)

2-. Operational and Management structure

In order to secure a correct emission reduction issuance, the project developer will implement and maintain a proper management structure as follows:

Figura B.3: General Management Structure for Colbun S.A.



Colbún S.A. will designate a competent manager who will be in charge of and accountable for the generation of ERs including monitoring, record keeping, computation of ERs, audits and verification. An operational manager will be in charge of all plant production and maintenance activities. A commercial manager will be in charge of Power Procurement Agreements (PPA), Emission Reduction Purchase Agreements (ERPA) and other related commercial activities for this kind of project. An environmental/project manager will be in charge of developing the project and fulfil all social and environmental obligations relative to the project activities.

Colbún S.A. will ensure that the required capacity and internal training is made available to its operational staff to enable them to undertake all the required tasks in transparent manner with.

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

>>

The baseline and monitoring methodology application study was completed on:
31/08/2006

- Carl Weber, Hidroeléctrica Guardia Vieja S.A., Apoquindo 4775, piso 13, Santiago, Chile, tel +56-2-460-4000; **cweber@colbun.cl**
- José Manuel Contardo, Consultant, Carbon Finance Unit, The World Bank, **jmcontardo@gmail.com**.

Both, the World Bank and Hidroeléctrica Guardia Vieja S.A. are project participants listed on Annex 1.

The Deal Manager of the Project at the World Bank is:

- Pedro Huarte-Mendicoa, Deal Manager, Carbon Finance Unit, The World Bank, **phuartemendicoa@worldbank.org**

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 project start date is 26/10/2004.

Quilleco hydroelectric project was implemented based on the Board of Directors decision on 26/10/2004 to invest in the Project. The decision to invest was a irrevocable decision, which took into consideration the expectation of carbon finance revenue from the project

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

>>
The operational lifetime of run-of-river hydropower plants is estimated over 30 years. Therefore the project seeks a 7 year, twice renewable crediting period (total 21 years)

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:

>>
01/07/2008

C.2.1.2. Length of the first crediting period:

>>
Seven (7) years

C.2.2. Fixed crediting period:

C.2.2.1. Starting date:

>>

C.2.2.2. Length:

>>

SECTION D. Environmental impacts

>>

D.1. Documentation on the analysis of the environmental impacts, including transboundary impacts:

>>

The project complies with the specific applicable regulations of the host country in regard to Environment Impact Assessment (EIA). The EIA follows the regulations for EIA System set in Chile by the Supreme Decree N 30/97 of the Ministry General Secretariat of the Presidency, Regulation for the Environmental Impact Assessment System and its modifications set in Supreme Decree N 95/2001, and the Act N 19300 on the Environmental Framework. Review and clearance of EIA is a perquisite for an environmental license issued by the National Commission for the Environment (CONAMA). The EIA has also passed the World Bank's Safeguard Policies, included in the Project Appraisal Document (PAD) completed by the Bank on April 2006. PAD included an analysis of ten World Bank safeguard policies that the Project could be triggered by the Project. Safeguards like Environmental Assessment, Safety on Dams or Cultural Property were identified to have a Low Risk to be triggered and if so specific measures to be taken were included within PAD.

The EIA discusses a wide range of environmental impacts related to physical, biotic, human, cultural, patrimonial and landscapes impacts during the plant's construction and operation stages. It identifies the risk or contingency zones and the type of risk associated to them. It also discusses a number of corrective measures and establishes an environmental management plan to deal with the impacts identifie. This plan addresses the significant and medium impacts providing measures for their mitigation, restoration or compensation.

In regard of environmental impacts of the project, the approval report recommends a number of measures to mitigate environmental impacts during the construction and implementation phases, which are the following:

- Minimum Ecological Flow: The Minimal Ecological Flow (MEF) is the most important environmental aspect for project operation phase. The MEF was defined by EULA in October 2002, approved by COREMA and added as part of the Environmental Qualification Resolution (26/12/2000). The conservative In-stream Flow Increase Methodology (IFIM) was used by EULA for the first time in Chile for MEF determination. Criteria of this methodology include landscape, habitat and biodiversity conservation. Special emphasis was given in this case to avoid the extinction of endangered and vulnerable fish species. Some of the detected species are manintroduced fish species, but they have economic value associated to fishing activities.

  The MEF will be monitored at three points within the area if influence of the project, as recommended by EULA: (i) the South arm of the Laja River on a critical stretch of 2km will be monitored via remote signal in order to generate hourly data; (ii) the Laja River before Rucúe confluence will be monitored twice a year for 5 years; (iii) the Laja River after the Rucúe confluence in front of Quilleco aqueduct channel will be monitored twice a year for 5 years. Even though these monitoring measures are only recommendations from EULA, Colbún S.A. has ensured that they will be fully implemented as monitoring procedures for Quilleco's operation.

Table D.1 indicates MEF values established by EULA and accepted by COREMA. These values were included in the EIA Resolution.

Table D.1. Minimum Ecological Flow for the Quilleco Hydroelectric Project

River Section or Branch	MEF
Laja river before confluence of Laja river	>17 m^3/s
Laja river after Rucue confluence (south branch included) until Quilleco release	>17 m^3/s
South branch of Laja River, between Rucue confluence and 2 Km downstream	>6 m^3/s
South branch of Laja River, downstream of previous section	>13 m^3/s

Source: www.eula.cl

- Fauna: To mitigate impacts on aquatic fauna, water and terrestrial fauna, Colbún S.A. must maintain a Minimal Ecological Flow (MEF) of 6m3/s in the south arm of Laja river along 2km starting from Laja-Rucúe river union. The project area of influence involves 8 km of river system.

- Flora: For tree covered areas to be affected by works, project operator has to plant native trees (a minimum density of one tree per each 10 m2). Colbún S.A will set out a 0.15 m layer of vegetal soil in every tree to be planted, a minimum of 0,5 m2 of vegetal soil has to be put around the roots in order to facilitate root fixation. Species to be used are specified in the EIA resolution. – For pastures and bush areas to be affected by the project, Colbún S.A. will set out a 0.15m layer of vegetal soil and plant with native species. - Local trees and bush species will be planted on slopes, embankments and working areas associated to the project according to an established plan.

- Water Quality: Run-of-river projects are considered benign to water quality. No major changes in water quality are expected from Quilleco plant operation. For the construction phase, every single potential water pollutant was identified during EIA and specific and suitable control measures to avoid underground and river water pollution were assessed and approved by the local environmental authority. The EIA established that water from the area of influence has in general a good quality considering requirements for irrigation, recreation, aquatic life and drinking purposes. No sewage emissions were observed. Variations in water parameters such as conductivity, dissolved solids and chlorine are caused by seasonal fluctuations of river flow only. Several river arms, mainly near the north shore, present low water level particularly in March due to low natural flow. Although water quality could be affected only during the construction phase of Quilleco, systematic monitoring of chemical and physical parameters of river water is contemplated for both the Rucúe and Quilleco projects.

- Waste and garbage management: - Arid deposits must be covered with 0.15 m of vegetal soil. – Project operator will maximize use of existing ways and routes and minimize construction of new ones – Project operator must fit out decantation pools for liquid waste from arid plants during construction phase - Garbage storage, transport and disposal are well defined in EIA.

Supervision corresponds to Health Services. - Health Services will supervise treatment and disposal of sewage. Three treatment plants are considered for the construction phase. During operation, impacts will be significantly less than during construction. Sewage will be treated in a suitable treatment plant. Garbage will be stored adequately and disposed of systematically according to law.

- Land Value: In order to mitigate landscape impacts, the sponsor must implement re-vegetation and reforestation on exposed soils (soil cuts and embankments) - The EIA resolution specifies surface treatment (topography, upper layer) and tree species to be used for vegetation of arid deposits. - Colbún S.A. has to consider the following criteria for modeling arid deposits: a) Avoid topographic elements that denote artificiality, b) Respect natural topographic scales, c) Occult unavoidable visual impacts and d) Use vegetation in order to harmonize landscape.

- Natural Habitats: Through the MEF, Colbún S.A. ensures: a) Conservation of landscape structure of river system in the critical zone, b) Habitat conservation for all existing species, c) Conservation of Biodiversity of all species (micro algae, primary consumers and superior consumers), d) Increase of habitat usable surface for permanent and temporary species, e) Permanence of species under extinction risk as well as of vulnerable species e) Permanence of economically most important species (Onchorhynchus mykiss).

- Reforestation Plan: A reforestation plan was approved by CONAF. The plan includes recovery of land and planting of trees to compensate for trees cut during construction phase. Reforestation follow-up measures are considered as well. Plantation and transplantation measures are considered for some species. Rescue, relocation and habitat protection measures for flora and fauna are defined in the EIA for construction and for operating phase, with emphasis on species under protection.

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:

>>

Quilleco's EIA was approved in 26/12/2000 as COREMA was technically convinced that the established minimum ecological flow would not impact the ecosystem or the distribution of river branches. Irrigation channels are not affected by the project, since they operate downstream of the area of influence. The project will not produce large impacts on landscape value.

All objections were assessed and officially cleared up by COREMA in a meticulous way including those generated by lack of public information. Suitable mitigation, reparation and compensation measures are considered for minor impacts on life quality during construction and operation phases, particularly related to farming activities. Protection of livestock from stress generated by use of explosives during tunnel construction was not considered relevant, since operation will be executed away from permanent grazing zones. Furthermore, specific measures are considered for soil, natural water courses, transport, risk and emergency control, specially fire and spills.
Quilleco Hydroelectric Project does not entail any physical construction such as dams and dikes, or cause reservoir-like impoundments on the Laja River or any of its branches. Low height diversion weirs are placed on the river bed to ensure adequate diversion of water and hydraulic heads during the low-flow winter months.

SECTION E. Stakeholders' comments

>>

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

>>

Local Authorities:

In compliance with the Chilean environmental law, the EIA was distributed to 11 local authorities selected by COREMA in consideration to their legal relation to identified impacts of the project. These are:

- National Fishing Service (Servicio Nacional de Pesca)
- Municipality of Tucapel
- Municipality of Quilleco
- National Agriculture Service (Servicio Agrícola y Ganadero, SAG)
- Local Health Service (Servicio de Salud Bío Bío)
- National Energy Commission (Comisión Nacional de Energía, CNE)
- Fishing Undersecretary (Subsecretaría de Pesca)
- National Monument Council (Consejo de Monumentos Nacionales)
- General Water Directorate (Dirección General de Aguas, DGA)
- National Forestry Corporation (Corporación Nacional Forestal, CONAF)
- National Tourism Service (Servicio Nacional de Turismo, SERNATUR)

Local Community:

As established by the Chilean law, the EIA included a public consultation period of 60 days, which was conducted through announcements in local newspapers and workshops attended by representatives of the local community of Quilleco. All objections and questions posed by the Quilleco community were assessed and officially cleared up by the local environmental authority (COREMA) in a meticulous way.

Even though the EIA was approved about 5 years ago (26/12/2000), COREMA will not make further requirements to Colbún S.A. or changes to the EIA resolution. Nevertheless, COREMA has monitored the environmental commitments since project construction begun.

E.2. Summary of the comments received:

>>

Comments received by local authorities and the community relate to the following aspects: Increased erosion deterioration of the landscape, air emissions, noise generation during construction, loss of vegetation and biodiversity due to project operation, loss of agricultural area, lack of water for biological functions in the river, extinction of fish species in Laja river, employment generation and archaeological site founding. Details of each of the comments received can be obtained from the EIA process at CONAMA's web site **www.seia.cl**

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

>>

Comments, observations and questions received from above mentioned authorities and local communities were answered by Colbún S.A during the EIA process. The answers were compiled in four documents added to the EIA before the final approval by COREMA. Most legal permissions and authorizations required to carry out the project were obtained in 1998 and 1999.

Apart from the above comments, no major issues were raised that could be related to the environmental or CDM aspect of the project. All comments and questions were duly taken into account by the project developer for the construction and operation of the project.

Every single impact and risk was assessed by the local environmental and social authorities and discussed in detail with the project operator and third parties involved.

With respect to environmental monitoring, most sensitive aspects correspond to the conservation of two endangered fish species existing within the area of influence, and monitoring of Minimal Ecological Flow (MEF) within the area of influence.

Appropriate measures were met to ensure conservation of endangered species, which are included in the Environmental Monitoring Plan. On the other hand, even though MEF measurement frequency was not defined within EIA resolution, Colbún S.A. committed itself to implement MEF monitoring measures, including techniques and frequency according to recommendations made by EULA from the University of Concepción (see 7.5.2.c).

Colbún S.A. will implement a follow up plan in order to know and assess projects effects on water quality for aquatic species, biodiversity and hydro-biological resources under following considerations, conditions and requirements, and will complement this monitoring with independent environmental audits (with previous agreement of COREMA). Results of the follow up plan will be submitted to COREMA and relevant authorities in the form of reports of all activities committed. All data and resolving actions of a problem will be informed to COREMA within 24 hours after detection. Changes in the follow up plan will be informed to relevant authorities and no change will be implemented before approval by COREMA. Colbún S.A. will construct a monitoring station downstream of Rucúe discharge channel.

Annex 1

CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY

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Annex 2

INFORMATION REGARDING PUBLIC FUNDING

There is no public funding in the projects. The fund used to financing is not diversion of ODA

Annex 3

BASELINE INFORMATION

AN 3.1. SYSTEM EMISSION FACTORS

For calculating the emission factor of thermal power plants in the Central Grid of Chile the methodology uses the following sources:

- Fuel Specific Consumption for every power plant: Semi-annual CNE Node Price Report
- Calorific Content of every Fuel: Semi-annual CNE Node Price Report
- Fuel Carbon Content: Greenhouse Assesment Handbook, Worldbank, September 1998, based on UNEP/OECD/IEA/IPCC/ 1995
- Combustion Efficiency: Greenhouse Assesment Handbook, Worldbank, September 1998, based on UNEP/OECD/IEA/IPCC/ 1995

The following table shows the emissions factors for the power units available at 01/07/2002. The following data will be periodically updated for each CNE node price report. The values in the table however do not have significant changes. The only changing parameters are related to the imported fuels calorific content.

1 Unit =	Kcal	Joule	BTU	KWh
Kcal	1	4.187E+03	3.968E+00	1.163E-03
Joule	2.388E-04	1	9.478E-04	2.778E-07
BTU	2.520E-01	1.055E+03	1	2.931E-04
KWh	8.598E+02	3.600E+06	3.412E+03	1

1. Coal, Petcoke and Petroleum

	Units	[illegible]	[illegible]	[illegible]	GUACOLDA 1	GUACOLDA 2	[illegible]	[illegible]	PETROPOWER
Especific consumption (2)	kg/KWh	0.368	0.415	0.397	0.336	0.336	0.740	0.850	0.313
Calorific Content (2)	kcal/kg	6,468	6,650	6,650	6,544	6,544	6,333	6,650	6,790
Factor Conversion (3)	kcal/KWh	2,377	2,760	2,640	2,199	2,199	4,686	5,653	2,125
	TJ/GWh	9.95	11.56	11.05	9.21	9.21	19.62	23.67	8.90
Fuel Carbon Emision Factor (1)	tC/TJ	25.80	25.80	25.80	26.09	26.09	25.80	25.80	27.50
Carbon Emissions	tC/GWh	256.71	298.11	285.18	240.15	240.15	506.22	610.58	244.71
Combustion Efficiency (4)	%	98.0%	98.0%	98.0%	98.0%	98.0%	98.0%	98.0%	98.0%
CO2 conversion	tCO2/tC	3.67	3.67	3.67	3.67	3.67	3.67	3.67	3.67
Emisiones de Dioxido de Carb	tCO2/GWh	922.46	1,071.20	1,024.74	862.83	862.83	1,818.03	2,194.62	879.33

(1) Exhibit 3-6, page. 28 GHG Assesment Handbook
(2) From CNE semestral report
(1,3) Guacolda uses a mixture of petcoke (16,88%) and coal (83,12%)
(4) Exhibit 3-7, page. 29 GHG Assesment Handbook

2. Natural Gas

	Units	NUEVA RENCA	CENTRAL SAN ISIDRO	NEHUENCO	[illegible]	TALTAL 1	TALTAL 2	[illegible]	[illegible]
Conversion Factor (2)	KJ/KWh	6,982	6,656	6,513	14,037	10,705	10,705	6,520	0
	TJ/GWh	6.98	6.66	6.51	14.04	10.71	10.71	6.52	0.00
Fuel Carbon Emision Factor (1)	tC/TJ	15.30	15.30	15.30	15.30	15.30	15.30	15.30	15.30
Carbon Emissions	tC/GWh	106.82	101.82	99.65	214.77	163.79	163.79	99.76	0.00
Combustion Efficiency (3)	%	99.5%	99.5%	99.5%	99.5%	99.5%	99.5%	99.5%	99.5%
CO2 conversion	tCO2/tC	3.67	3.67	3.67	3.67	3.67	3.67	3.67	3.67
Emisiones de Dioxido de Carb	tCO2/GWh	388.73	371.48	363.65	783.54	597.55	597.56	363.94	0.00

(1) Exhibit 3-6, page. 28 GHG Assesment Handbook
(2) From CNE semestral report
(3) Exhibit 3-7, page. 29 GHG Assesment Handbook

3. Diesel and Oil

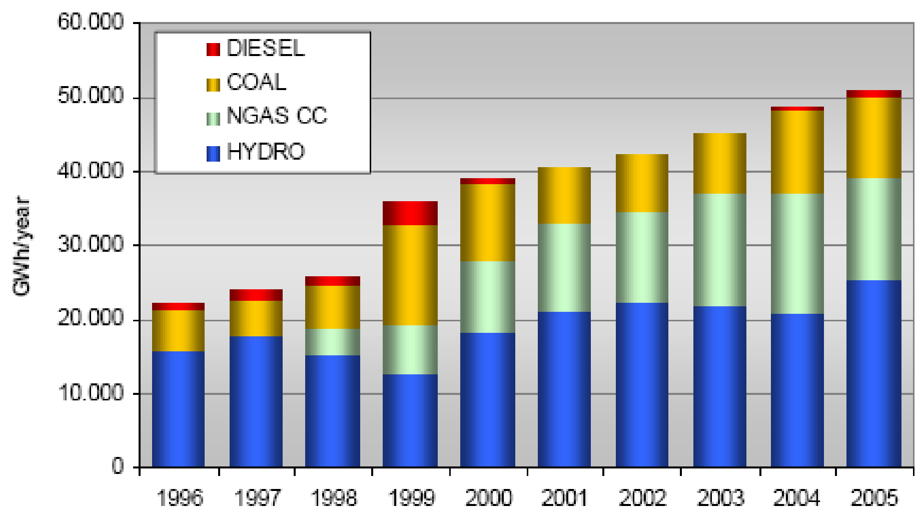
	Units	Turbina Gas 1	Turbina Gas 2	[illegible]	RENCA	[illegible]	DIEGO DE ALMAGRO	[illegible]	CONSTITUCION [illegible]	SAN FRANCISCO [illegible]
Fule Type		Fuel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel
Calorific Content (3)	TJ/ton	43.33	43.33	43.33	43.33	43.33	43.33	43.33	43.33	43.33
Especific Consumption (2)	kg/KWh	0.362	0.337	0.264	0.362	0.229	0.337	0.362	0.309	0.309
	TJ/GWh	15.69	14.60	11.44	15.69	9.92	14.60	15.69	13.39	13.39
Fuel Carbon Emision Factor (1)	tC/TJ	20.20	20.20	20.20	20.20	20.20	20.20	20.20	20.20	20.20
Carbon Emissions	tC/GWh	316.85	294.96	231.07	316.85	200.44	294.96	316.85	270.46	270.46
Combustion Efficiency (4)	%	99.0%	99.0%	99.0%	99.0%	99.0%	99.0%	99.0%	99.0%	99.0%
CO2 conversion	tCO2/tC	3.67	3.67	3.67	3.67	3.67	3.67	3.67	3.67	3.67
Emisiones de Dioxido de Carb	tCO2/GWh	1,150.15	1,070.72	838.78	1,150.15	727.59	1,070.72	1,150.15	981.78	981.78

(1) Exhibit 3-6, page. 28 GHG Assesment Handbook
(2) From CNE semestral report
(3) Exhibit 3-3 page 26 From GHG Assesment Handbook.
(4) Exhibit 3-7, page. 29 GHG Assesment Handbook

AN 3.2. NATIONAL AND SECTOR BACKGROUND

To meet its growing energy demand (approximately 7 percent annually since 1986), in the 1980s Chile began to separate its government-owned power generation, transmission and distribution assets. Over the past decade, Chile completely privatized its electricity industry and unbundled the national generation, transmission, and distribution systems. Private companies now provide 100 percent of Chile's electricity. Chile's electricity sector has served as a model for subsequent privatizations throughout the world, and despite recent shortages due to drought, is improving its efficiency and reliability. The opening of Chile's gas sector in 1996 has increased choices among energy sources, lowered the energy prices, and helped to satisfy growing demand in the industrial and power-generating sectors. Over the long term, Chile hopes to benefit from opening its energy markets to the private sector by receiving steady and reliable supplies of energy at competitive prices to meet growing demand from all economic sectors. A significant portion of this growth has come from increased power demand by the copper mining sector, the country's single biggest industry, and by growing populations in large urban areas, such as Santiago. Energy policy decisions in Chile are the shared responsibility of the Ministry of the Economy and the specialized agencies the National Energy Commission, the Superintendence of Electricity and Fuels, and the Chilean Commission of Nuclear Energy.

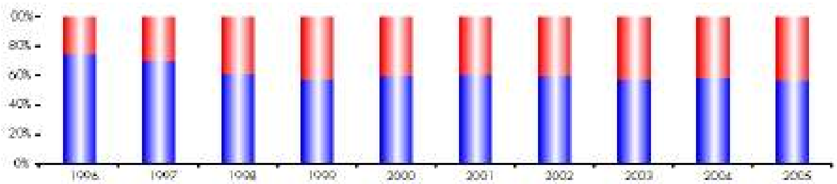
Chile Annual Energy Demand Through 1996 to 2005



Source: CNE

Chile consumed near 50,000 GWh of electricity in 2004, from this figure, almost 21,000 GWh was hydropower energy. About 38 percent of Chile's installed power generation capacity is hydroelectric, which is mainly concentrated in the central grid (SIC) representing near 60% of SIC’s capacity. Hydropower from westward flowing rivers from the Andes Mountains is Chile's single largest electricity source. The severe drought that gripped Chile from late 1997 until well into 1999 hobbled the country's electricity sector. Chile's capital city, Santiago, experienced rolling blackouts from November 1998 until May 1999. As a result, Chile now is working to become less reliant on hydropower. In 1996 Chile and Argentina signed an Agreement to allow the export of natural gas from Argentinean fields to Chile. Since then, 1.000 MW in Combined Cycle Power Plants have been added to the Chilean grid decreasing the energy prices dramatically (by about 45 percent to 21 US$/MWh in 1997).

Chile SIC Power Capacity Evolution Through 1996 to 2005



	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
TOTAL[MW]	**4.858,5**	**5.266,8**	**6.242,4**	**6.695,1**	**6.652,8**	**6.579,2**	**6.737,2**	**6.996,2**	**7.867,4**	**8.259,8**
TÉRMICO	1.191,9	1.562,2	2.350,8	2.788,8	2.622,5	2.548,9	2.681,9	2.940,9	3.172,1	3.565,0
	24,5%	29,7%	37,7%	41,7%	39,4%	38,7%	39,8%	42,0%	40,3%	43,2%
HIDRÁULICO	3.666,6	3.704,6	3.891,6	3.906,3	4.030,3	4.030,3	4.055,3	4.055,3	4.695,3	4.694,8
	75,5%	70,3%	62,3%	58,3%	60,6%	61,3%	60,2%	58,0%	59,7%	56,8%

While only an estimated 13 percent of hydroelectric potential is now utilized, large viable sites are far from Santiago (which represents 40 percent of demand), requiring large transmission line investments. Together with other fossil fuels, natural gas has become an increasingly important electricity source in the coming years.

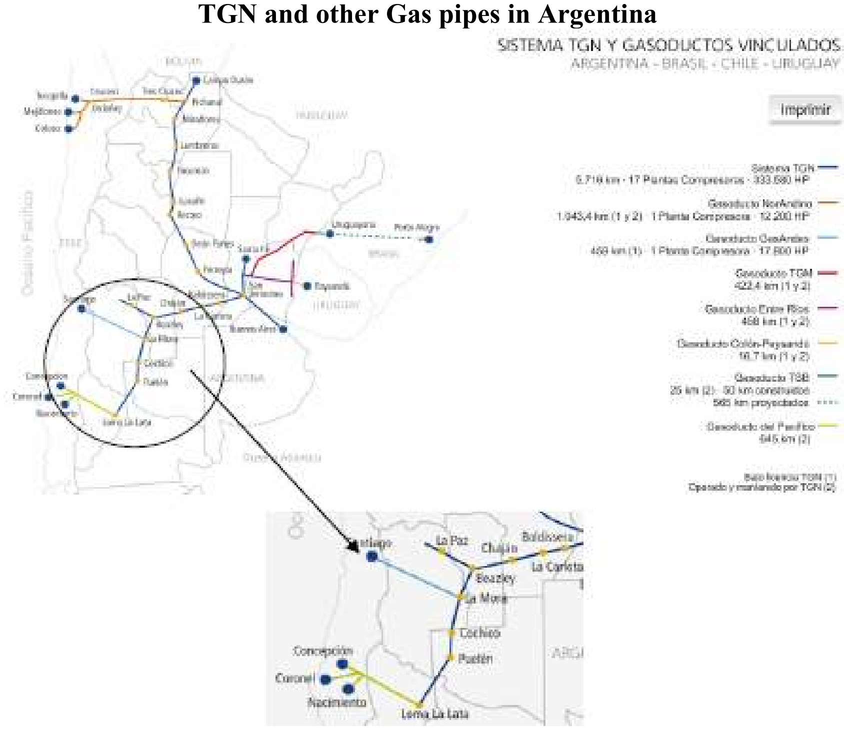
An 3.2.1. The Natural Gas Restriction Efects in the Chilean grid:

The Chilean Central Interconnected System (SIC), natural gas requirements are based on the installed capacity of combined cycle (CC) natural gas power plants, conformed by Electrica Santiago S.A. (Nueva Renca CC. power plant), Colbun S.A. (Nehuenco I and Nehuenco II CC power plants and Nehuenco III open cycle power plant) and San Isidro S.A. (San Isidro CC power plant).

In mid 2004 Chile was affected by a natural gas shortage due to Argentina unilateral restrictions on gas supply. The restriction commenced with slight restrictions, however this became more critical on late 2005 once it was evident that the shortage had no easy solution in the short and mid term. Since most of the expansion of the system was based on NG after 1996, the Chilean grids had to react increasing the energy prices in order to avoid mid term energy shortages.

Chilean natural gas import from Argentina reaches 7.83 MMm3/day in 2004 (this included firm gas contracts plus spot gas supply). This total volume was 15.4% higher than the natural gas imports in 2003 and exceeded firm contract volumes. Total natural gas firm volumes for the SIC represents 6.50 MMm3/day (millions of m3 per day) of the gas supply coming from TGN Centro Oeste and GasAndes gas Pipes, as shown in the the table below. From this 6.50 MMm3/day, only 5.27 MMm3/day have firm transport capacity through TGN and GasAndes pipes. This situation was valid from 2003 to 2005.

TGN and other Gas pipes in Argentina



Source: **www.tgn.com.ar** Transportadora del Gas del Norte S.A.

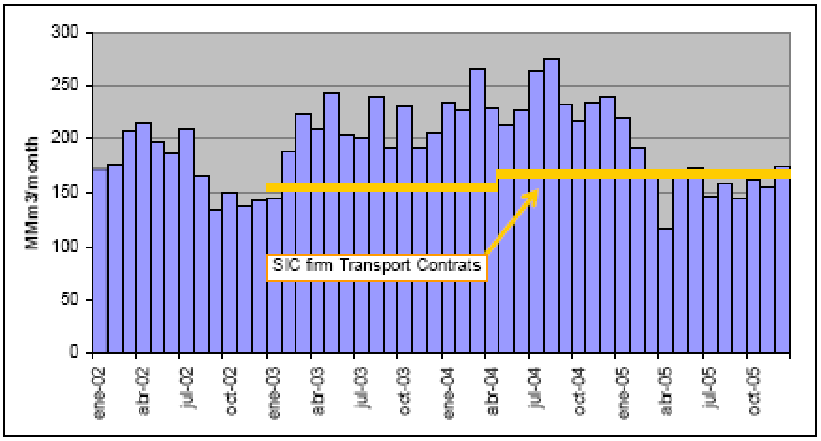
2003 – 2005 TGN Centro Oeste Gas Pipe
Transport Contract Volumes and Gas Contracts

Country	Through Gas Pipe	Contract	Destination	Transport Capacity Firm MMm3/ day	Transport Capacity Interruptible MMm3 /day	Transport Capacity Total MMm3 /day	Firm Gas Contracts Total MMm3 /day
Chile	Gasandes	Elecrica de Santiago S.A.	Generator SIC	1,78		1,78	1,78
Chile	Gasandes	Colbún S.A. (*)	Generator SIC	1,76	1,23	2,99	2,99
Chile	Gasandes	San Isidro	Generator SIC	1,73		1,73	1,73
	GasAndes Generators Subtotal			5,27	1,23	6,50	6,50
Chile	Gasandes	Metrogas (*)	Distribution	3,79		3,79	3,79
	Total GasAndes Subtotal			9,06	1,23	10,29	10,29
Chile	Gasod. del Pacifico	Innergy	Distribution	1,20		1,20	1,20
Brasil	TGN-TGM	YPF uruguayana	Generator	2,92		2,92	2,92
Uruguay	TGN-TGM	PetroUruguay (ANCAP)	Industrial	0,37		0,37	0,37
TOTAL				13,55	1,23	14,78	14,78

(*) in May 2004, Colbún firm transport contract increased from 1.52 MMm3/day to 1.76 MMm3/day and Metrogras increased from 3.4 MMm3/day to 3.79 MMm3/day

From the total TGN pipe capacity of 14.78 MMm3/day, only 6.50 MMm3/day are related to the SIC energy dispatch, from which only 5.27 MMm3/day have firm transport contracts on the TGN and GasAndes pipes.(5.27 MMm3/day is equivalent to near 158 MMm3/month)

Total TGN-GasAndes Gas Supply from Argentina



Source: **www.enargas.gov.ar**

In year 2004 effective restrictions to Chile, relevant to the SIC supply (through TGN-GasAndes pipes) where in total 110 MMm3/year over an exportable maximum of 4,500 MMm3/year (gas pipe capacity), which is only 2% of the total gas supply.

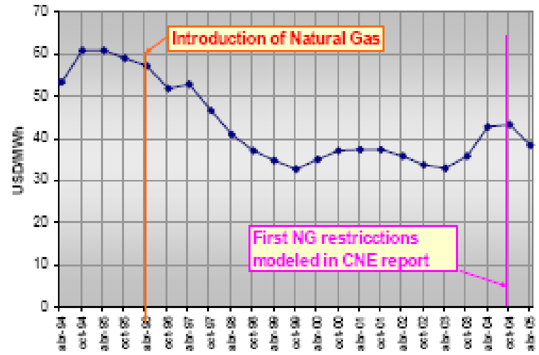
At the end of 2004, previous historical restriction information from Argentina gas imports was not significant enough to foresee a deeper restriction scenario in the future that could affect the electric system. In CNE Node Price Report October 2004, modeled natural gas restrictions only for Taltal 2 unit without gas and Nueva Renca for one week per month during April to August of each year. Both considered to operate with replacement fuel during those restrictions (diesel). See pages 9, 10 and 11 of the attached Node Price Report October 2004.

In March 2005, the reduction in the SIC gas supply explained by Colbun's interruptible transport contract of 1.23 MMm3/day. This required Nehuenco II power plant to use diesel fuel for its operations. However, this reduction did not generate a significant effect on the system, and was not considered a permanent effect.

At April 2005, CNE node price report accounted some natural gas restrictions in its long term model (see pages 5 and 6 of the attached report). However, the restrictions did not represent any significant impact on the system price (see page 29 of the report of node prices table).

As it is shown in the Figure 3 below, Node Price report of October 2004 showed a price on near 43.29 USD/MWh and April 2005 report the price showed a slight decrease 38.23 USD/MWh explained mainly by the dollar devaluation between both reports.

SIC Monomic Node Price Variation
(in real USD of Oct-06)



Source: CNE and Bls.gov for CPI indexation
Evidence of this table is provided in separate worksheet

In May 2005 potential natural gas restrictions due to the Argentinean winter scenario, mainly concentrated in June and July 2005 were considered insignificant considering the USD denominated gas imports of Chile from Argentina.

It is important to note that the node price in the Chilean electric grid represents the average system prices for the next 10 years of operation, representing an official estimate and the most plausible scenario of capacity additions, fuel prices and other relevant operating data such as the natural gas restrictions.

An 3.2.2. Sector barriers:

No concession is required to become a generator and there is no entry restriction to the market for generators, who freely and competitively can sell firm capacity and energy via negotiated power contract sales and/or make power available to the system’s spot market. Generators have no obligation to supply beyond the terms of their contracts. All generation is undertaken by the private sector, under the concept of merchant plants. In each interconnected system, a load dispatch center (CDEC) is responsible for coordinating and dispatching load from generating units utilizing the system. The Law establishes the obligation to optimize generation and thus, dispatch is based on a pre-programmed economic merit order based on least marginal cost of generation for the corresponding system.

Most Chilean power generation companies are organized around four grid systems, the *Sistema Interconectado Norte Grande (SING)*, the *Sistema Interconectado Centra*l (**SIC**), the Aysen Grid and the Magallanes Grid. These four grids are not interconnected to each other. Private sector power transmission companies transmit electricity sold by the generation companies to power distribution companies, regulated and unregulated customers and other power generation company. The central grid (SIC) serves over 90 percent of Chile's population and more than 40 percent of the land area. The northern grid (SING) is mainly thermal and serves mostly mineral-processing centers in the region and the Aysen and the Magallanes systems in the south of the country serve remote areas with a combined capacity of about 1 percent of the total. Coordination within each system is carried out by the Economic Dispatching Center (CDEC), an autonomous entity composed of members from all utilities within each system to ensure efficiency and security of the electric system. Aside from these four grids, "self producers" account for about 12 percent of national generation.

An 3.2.3. Sector Institutions:

- **CDEC**: The economic load dispatch center in each system is controlled by a private, independent entity CDEC (*Centro de Despacho Económico de Carga*), composed of representatives of generation and transmission companies, but its operation is fully regulated by law and supervised by the *Comisión Nacional de Energía* (CNE) and the *Superintendencia de Electricidad y Combustibles* (SEC), both described below. CDEC is in charge of planning the optimum operation of the system, based on lowest marginal costs, and of determining values of economic transactions that were carried out among the generators. The SING (Northern Grid) and the SIC (Central Grid) have each their own independent dispatch centers.

  CDEC–SIC (Economic Dispatch Center in the Central Interconnected System) will play an important role in the quantification of the actual emission reductions achieved each year. CDEC's operation and information system enables a relatively easy quantification of the actual emission reductions achieved on an hourly basis.

  CDEC-SIC is a private entity composed of representatives of generation and transmission companies, independent from the Government. Although HGV is not a CDEC member (as membership is obligatory only for generators of capacity above 2 percent of the total installed capacity in the whole SIC), all generating plants supplying electricity to the system, including Chacabuquito, are under CDEC-SIC operating supervision.

- **CNE:** *Comisión Nacional de Energía.* The sector is regulated by an autonomous agency, CNE. Its main responsibilities for the power sector include (i) proposing sector norms and regulations; (ii) coordinating planning, policies and norms for efficient functioning of the market; and (iii) calculating and enforcing regulated prices.

- **Ministry of Economy**: In the area of the power sector, the Ministry of Economy is responsible for (i) setting distribution tariffs and node prices (based on CNE's calculations), (ii) resolving possible conflicts among the members of CDEC, and (iii) awarding concessions.

- **SEC:** *Superintendencia de Electricidad y Combustibles* is responsible for supervising compliance with existing laws, regulations and technical norms related to the generation, production, storage, transport and distribution of liquid fuels, gas and electricity.

Annex 4

MONITORING INFORMATION

THE MONITORING AND VERIFICATION PROTOCOL

>>

AN 4.1. PURPOSE OF THE MVP

In the context of the Clean Development Mechanism (CDM) of the Kyoto Protocol, monitoring describes the systematic surveillance of a project's performance by measuring and recording performance-related indicators relevant to the project or activity. Verification is the periodic auditing of monitoring results, the assessment of achieved emission reductions (ER) and of the project's continued conformance with all relevant project criteria.

This Monitoring and Verification Protocol (MVP) defines a standard against which the project performance in terms of its greenhouse gas (GHG) reductions and conformance with all relevant Clean Development Mechanism (sustainable development) criteria will be monitored and verified. As such the MVP, after its validation, will be an integral part of the contractual agreement between the Project Sponsor, the Project Operator and the ERs Buyer(s). The MVP builds on the baseline scenario identified in the Baseline Study and is fully consistent with the Baseline Study.

The MVP is a working document that identifies the key project performance indicators and sets out the procedures for tracking, monitoring, calculating and verifying the impacts of the project, in particular with respect to the project’s ERs. The MVP must therefore be used throughout the life of the project. Specifically, the MVP provides the requirements and instructions for:

- Establishing and maintaining the appropriate monitoring system including spreadsheets for the calculation of ERs.
- Checking whether the project meets key sustainable development indicators;
- Implementing the necessary measurement and management operations;
- Preparing for the requirements of independent, third party verification and audits.

The MVP can be updated and adjusted to meet operational requirements, provided such modifications are approved by the Verifier during the process of initial or periodic verification. In particular, any shifts

in the applicable baseline that are identified by following this MVP may lead to such amendments, which may be mandated by the Verifier.

AN 4.2. CONCEPTS AND PRINCIPLE ASSUMPTIONS

An 4.2.1. The Project Activity

The Quilleco Hydroelectric Project (the Project Activity), consists of a run-of-river power plant of 70 MW capacity that utilizes the waters of the Laja river. The project developer and operator (the Project Operator) is Colbún S.A. Hidroeléctrica Guardia Vieja S.A. (HGV) is one of it subsidiaries and it will be acting as the project sponsor.

Being a CDM Project Activity, Quilleco Hydroelectric Project must meet the requirements of the Kyoto Protocol Art. 12 for CDM projects. The methodology for carrying this out and the monitoring and verification protocol for establishing the emission reduction are provided in this document.

An 4.2.2. Emission reductions from the Project Activity

As indicated in the Baseline Study, the actual emission reduction to be credited from the project will depend on the CNE expansion plan and the actual dispatch data for the SIC provided by the Economic Dispatch Center (CDEC)[2]. Emission Reductions of CDM projects shall be accounted as stated in the AM0026.

An 4.2.3. Geographic and System Boundaries for the MVP

The Baseline Study defines the project boundary to correspond to the Central Interconnected System (SIC) for the purpose of identifying potential emissions and leakage during the projects lifetime.

The Baseline Study has not found leakage to be a problem for the project as the project is a closed system. Therefore the MVP does not correct the calculated ERs to account for leakage.

An 4.2.4. Time Boundary and Baseline Review Protocol

The Baseline Study has opted for a 7-year renewable baseline (for a total crediting period of 21 years) for which the project is likely to generate ERs in compliance with the CDM.

An 4.2.5. Calculating Emission Reductions

The emission reduction calculation results from the electricity from the Project Activity displacing power generated mainly by coal and combined cycle gas or other thermal units on the margin in the Central Interconnected System.

The outline of the method to calculate the emission reduction is as follows:

[2] The institutional set-up in the power sector is discussed in detail in subsequent section of this study.

- **Key Steps for Estimating Operating Margin Emission Factor**

Net Hourly Generation output from the Project Activity and all other generators in the system (MWh)
⇩
Analysis of hourly dispatch from all units of the SIC to determine Marginal Plant(s) not dispatched (or displaced) due to dispatch of all CDM projects (CDEC-SIC hourly data)
⇩
Calculation of emission factors of all operational thermal units of the system (CNE semestral report and IPCC manual) (tonnes CO_2e/MWh)
⇩
Determination of the marginal plants and energy being displaced due to the operation of each CDM project following the "first-built first-served"[3] principle stated on AM0026 (v.2) (MWh and tonnes CO_2e/MWh)
⇩
Determination of EF_{OM} of each CDM project as the weighted average emission factor of the Marginal Plant(s) not dispatched (or displaced) by each CDM project activity (tonnes CO_2e/MWh)

[3] The "first-built first-served" principle implies that the "last" plant, existing in the grid, that would have been dispatched to meet the electricity requirement fulfilled by all the CDM projects in the grid is considered to be displaced due to introduction of the First CDM project built in the system. Similarly the first marginal plant is considered to be displaced by the CDM plant built last. Note that all CDM projects (even projects adopting other methodologies) must be considered

- **Key Steps for Estimating Build Margin Emission Factor**

SIC Dispatch of all power units of the system
(MWh)
⇩
Determination of 20% of energy generated from most recent power units
(set of m plants following ACM0002 option2)
(MWh)
⇩
Calculation of emission factor of thermal units in the plan
(CNE semestral report and IPCC manual)
(tonnes CO_2e/MWh)
⇩
Determination of EF_{BM} as the weighted average emission factor of the dispatched plants and their individual emission factor
(tonnes CO_2e/MWh)

- **Key Steps for Estimating Project Emissions**

Calculation of Combined Margin Emission factor of EF_{BM} and EF_{OM}
(tonnes CO_2e/MWh)
⇩
Energy generation of the CDM Project Activity
(from CDEC-SIC or metering data)
(MWh)
⇩
Calculation of Baseline Emissions of the Project Activity
(tonnes CO_2e)
⇩
Discount any leakage or project activity emissions, if any
(tonnes CO_2e)

AN 4.3. OPERATIONAL AND MONITORING OBLICAGATIONS

An 4.3.1. Operational Obligations

The operational obligations of the Project Activity operator are to ensure that all reasonable steps are taken to maximize the generation from the project facility and, thereby, maximize the GHG emissions reduction. This is in the interest of the operator anyway.

An 4.3.2. Data Requirements and Project Database

The data required for the MVP is in line with the kind of information collected by an electricity utility.
The data used in this MVP will be collected by the project operator and comes from the following sources:

- The hourly generation of the project is obtained from the metering system of the plant, which is submitted every 2 hours to CDEC-SIC.
- The actual dispatch of all units in the system and dispatch priority list of the power units is collected from the CDEC-SIC website (**www.cdec-sic.cl**)
- The expansion plan and the CO2e Conversion Factor for thermal plants is obtained from the Node Price Fixation Report issued by the CNE (Comisión Nacional de Energía, the government agency for the energy) complemented with the IPCC manual.

AN 4.4. PROJECT WORKBOOK

An 4.4.1. Main Data

The project MVP consists of one workbook made up of the following four separate worksheets:

- **Generation and other data collected from CDEC-SIC:** Data from electricity generation of all units of the system from Load Economic Dispatch Center (CDEC-SIC).
- **Tonnes of CO2e (tCO2) Emission Factors:** Emission Factor of thermal units of the system, calculated every six months form the CNE official node price reports.
- **Emission Displacement:** Calculation of the Operating Margin and the Build Margin. Determination of emission displacement due to the operation of the project.

The following sections describe how the first three worksheets calculate ERs.

An 4.4.2. Energy Generation of The CDM Project

The hourly net generation of the Project Activity is obtained from the metering system of the power plant.
This information is submitted to CDEC-SIC every two hours, as all other plants of the SIC. With this data, CDEC-SIC provides an hourly report of the system dispatch.

		Hour				
Day		1	2	3	..	24
1	Energy Generation (MWh)					
2	Energy Generation (MWh)					
3	Energy Generation (MWh)					
	Energy Generation (MWh)					
31	Energy Generation (MWh)					

The electronic metering system of the Project Activity must have precision class of 0.2%, which is the minimum standard for the electric system in Chile. This meter will be placed at the generation bus. The metering register the instantaneous sum of the power of the four generators, which is integrated in 15 minutes intervals. The data from the meter will be collected by the Project Operator, and is then transmitted every two hours to the CDEC-SIC electronically.

Every meter in the system, including the Project Activity meters, are calibrated every year or every two years by independent and accredited third parties. The calibration procedure consists in comparing the

measuring system with a higher precision reference meter. A calibration report is then issued for each meter.

An 4.4.3. Energy Generation Data of All Generating Units of the System

- **Actual Dispatch in the CDEC-SIC**

For every hour of the monitoring period, the actual dispatch of the SIC is obtained from the CDEC-SIC. This information can be retrieved through a web access or a dedicated connection that works as a file server. A sample data is reproduced below.

Operación Real del Sistema Interconectado Central (MWh)

FECHA

Centrales	1	2	3	23	24	Total
Embalse	1.120	1.150	...	2.100	1.020	30.506
El Toro	0	2	...	0	0	26
Antuco	171	235	...	181	171	5.113
Machicura	19	19	...	60	60	881
Pangue	463	483	...	461	461	11.117
San Ignacio	0	0	...	20	20	168
Ralco	570	570	...	570	570	13.680
...	...	...	...	...	...	...
Pasada	1.107	1.171	...	1.236	1.210	28.355
Abanico	45	45	...	44	43	1.060
Aconcagua	26	25	...	28	26	602
Alfalfal	56	53	...	57	57	1.309
Capullo	12	12	...	11	12	280
Chacabuquito	19	18	...	17	17	421
Quilleco	70	70	...	70	70	980
...	...	...	...	...	...	...
Térmicas	1.626	1.336	...	1.511	1.465	36.432
Constitución A.	16	15	...	15	15	354
Constitución	7	7	...	7	6	146
Horcones TG	18	17	...	16	16	405
Laja	3	4	...	5	6	124
Licantén	2	2	...	0	0	17
Valdivia	0	0	...	0	0	0
Petropower	68	68	...	68	68	1.634
Arauco	31	32	...	31	31	701
Cholguán	12	12	...	10	11	276
Nueva Renca	186	67	...	367	332	6.463
Nehuenco II	379	379	...	0	0	4.603
Nehuenco	351	336	...	354	356	8.262
San Isidro	305	187	...	352	353	7.289
Guacolda 1	0	0	...	0	0	0
Guacolda 2	150	150	...	151	152	3.618
Taltal 2	0	0	...	0	0	0
Taltal 1	97	80	...	116	117	2.435
Ventanas 2	0	0	...	0	0	0
Bocamina	0	0	...	0	0	0
...	...	...	...	...	...	...
Total Generación	3.940	3.657	...	4.346	4.496	103.303

- **Dispatch Priority List**

For every week the CDEC-SIC state the dispatch priority list of the power units in the SIC according to their marginal operation cost. That information is also available from CDEC-SIC and a sample is reproduced below.

Priority	Variable Cost USD/MWh	Unit
1	0	ACONSTITUCION Arauco
2	0	CONSTITUCION Gener
3	0	HORCONES TG
4	0	LAJA
5	0	LICANTEN
6	0	P.VALDIVIA
7	0	PETROPOWER
8	2,4	ARAUCO
9	9,9	CHOLGUAN
10	12,5	NUEVA RENCA
11	16,6	NEHUENCO 2
12	16,7	NEHUENCO
13	17,3	CENTRAL SAN ISIDRO
14	20,4	GUACOLDA 1
15	20,4	GUACOLDA 2
16	21,3	TALTAL 1
17	21,3	TALTAL 2
18	27,4	VENTANAS2
19	29,4	BOCAMINATV
...	...	...

- **The "Marginal Power Unit in the SIC"**

From the data issued by the CDEC-SIC on the hourly marginal power unit, it is possible to determine the marginal power plant and the next marginal plants in the priority dispatch order list that would be dispatch in the system if no CDM project activities were present in the system.

Every Thermal Plant has its own tCO2/GWh conversion factor according to its specific consumption and type of fuel. The emission factors can be calculated using CNE node price report and IPCC manual.

PLANT NAME	CAPACITY In MW	TCO2/GWh
ACONSTITUCION Arauco	20	0
CONSTITUCION Gener	9	962
LAJA	9	0
PETROPOWER	49	879
ARAUCO	101	0
NUEVA RENCA	379	396
NEHUENCO 2	360	353
NEHUENCO	352	396
CENTRAL SAN ISIDRO	370	422
GUACOLDA 1	152	886
GUACOLDA 2	152	886
TALTAL 1	120	641
TALTAL 2	120	641
VENTANAS2	212	1025
BOCAMINATV	125	925
VENTANAS1	120	1071
NEHUE.9B	100	604
HUASCOTV	16	1829
LAGVERDE	55	2194
SAN FRANCISCO M.	24	962
DIEGO DE ALMAGRO	24	1071
RENCA	100	1150
HUASCOTG	64	1150

- **The "Theoretical Dispatch without CDM Projects" and Emission Displacement**

Without the Project Activity and other CDM projects, the marginal dispatched plant should increment its generation to supply the system demand in each hour. Since the generation from the marginal plant has a capacity limit, and if it is insufficient to meet the demand, a next power unit must be dispatched in the economic merit order priority to supply the required energy to meet the system demand. And if still there is not sufficient energy with the next marginal plant, then other unit(s) must be dispatched following the same order. In order to determine the Project Activty's energy and emission displacement, it must be taken into account all other CDM units of the system. The following table presents an example how the dispatch should change and the energy displacement that CDM projects will produce in the system.

				H1	H2	...	H23	H24
CDM N°1 (CHACABUQUITO)		Energy in MWh	C1	19,0	18,0	...	17,0	17,0
		Capacity in MW		26,0	26,0	...	26,0	26,0
CDM N°2 (QUILLECO)		Energy in MWh	C2	40,0	40,0	...	40,0	40,0
		Capacity in MW		70,0	70,0	...	70,0	70,0
Marginal Plant 1	Energy	MWh	B1	97,0	80,0	...	116,0	117,0
	Plan Name			TALTAL1	TALTAL1	...	TALTAL1	TALTAL1
	Capacity	MW	A1	120,0	120,0	...	120,0	120,0
	E. Factor	TCO2/GWh	d1	641,0	641,0	...	641,0	641,0
Marginal Plant 2	Energy	MWh	B2	-	-	...	-	-
	Plan Name			TALTAL2	TALTAL2	...	TALTAL2	TALTAL2
	Capacity	MW	A2	120,0	120,0	...	120,0	120,0
	E. Factor	TCO2/GWh	d2	641,0	641,0	...	641,0	641,0
Marginal Plant 3	Energy	MWh	B3	-	-	...	-	-
	Plan Name			VENT2	VENT2	...	VENT2	VENT2
	Capacity	MW	A3	212,0	212,0	...	120,0	120,0
	E. Factor	TCO2/GWh	d3	1.025,0	1.025,0	...	1.025,0	1.025,0

If other CDM projects are implemented in the system then, for each hour, the emission displacement should meet the formulae stated on AM0026 (v.2).

- **Emission Displacement for Operating Margin**

The emission factor form the Operating Margin can be estimated following formaulas indicated en AM0026. The following prsentes an illustrated example to calculate the emission displacemet of the Operating Margin.

			H1	H2	...	H23	H24
MDL N°1 (CHACABUQUITO)							
MWh Displacement							
Marginal Plant 1	min(C1, (A1-B1) - D21) =	D11	-	-	...	-	-
Marginal Plant 2	min(C1-D11; (A2-B2) - D22) =	D12	19,0	18,0	...	17,0	17,0
Marginal Plant 3	min(C1-D11-D12; (A3-B3) - D23) =	D13	-	-	...	-	-
TCO2 Displacement							
	d1*D11+d2*D12+d3*D13 =	ER1	12,2	11,5	...	10,9	10,9
MDL N°2 (QUILLECO)							
MWh Displacement							
Marginal Plant 1	min(C2;(A1-B1) - 0) =	D21	23,0	40,0	...	4,0	3,0
Marginal Plant 2	min(C2-D21; (A2-B2) - 0) =	D22	17,0	-		36,0	37,0
Marginal Plant 3	min(C2-D21-E22; (A3-B3) - 0) =	D23	-	-	...	-	-
TCO2 Displacement							
	d1*D21+d2*D22+d3*D23 =	ER2	25,6	25,6	...	25,6	25,6

- **The Build Margin Calculation Worksheet**

For the first crediting period, the Build Margin emission factor EFBM, must be updated annually *ex post* for the year in which actual project generation and associated emissions reductions occur, accounting energy and emission form the power plants capacity additions in the electricity system that comprise 20% of the system generation (in MWh) and that have been built most recently. The following table presents an illustrated example how to calculate the Build Margin Emission Factor for the Project project for a given year.

COMM DATE	Plant Name	Type	EF	Energy
	OTHERS			3.853.386
1970	BOCAMINATV	Thermal	925	300.051
1973	EL TORO	Reservoir	0	1.693.974
1977	HUASCOTG	Thermal	1002,9	29.064
1977	VENTANAS1	Thermal	1071	413.467
1977	VENTANAS2	Thermal	1024,96	1.050.510
1981	ANTUCO	RoR	0	1.662.081
1981	ARAUCO	Thermal	0	156.044
1985	COLBUN	Reservoir	0	2.021.022
1985	CONSTITUCION Gener	Thermal	982	50.265
1985	CURILLINQUE	RoR	0	627.902
1985	DIEGO DE ALMAGRO	Thermal	1071	6.236
1985	MACHICURA	RoR	0	453.530
1990	CANUTILLAR	Reservoir	0	1.094.674
1991	PEHUENCHE	Reservoir	0	2.567.234
1993	ACONCAGUA	RoR	0	371.391
1993	CONSTITUCION Arauco	Thermal	0	132.388
1993	ALFALFAL	RoR	0	840.860
1995	CAPULLO	RoR	0	74.237
1995	GUACOLDA 2	Thermal	893,697	2.468.970
1995	LAJA	Thermal	0	39.483
1996	PANGUE	Reservoir	0	1.675.343
1996	SAN IGNACIO	RoR	0	182.344
1997	LOMA ALTA	RoR	0	276.888
1997	NUEVA RENCA	Thermal	396	2.275.586
1997	PUNTILLA	RoR	0	118.339
1998	QUELTEHUES	RoR	0	357.697
1998	RUCUE	RoR	0	1.091.127
1998	CENTRAL SAN ISIDRO	Thermal	424,012	2.705.618
1998	NEHUENCO	Thermal	396,115	1.847.504
1998	PETROPOWER	Thermal	879	526.035
2000	MAMPIL	RoR	0	173.898
2000	PEUCHEN	RoR	0	261.831
2000	TALTAL 1	Thermal	641	624.403
2000	TALTAL 2	Thermal	641	364.208
2002	NEHUE.9B	Thermal	604	106.395
2003	CHOLGUAN	Thermal	0	93.347
2003	NEHUENCO 2	Thermal	411,691	1.996.332
2003	SAN FRANCISCO M.	Thermal	982	9.380
2004	ANTILHUE TG (*)	Thermal	0	160
2004	ANTILHUE TG	Thermal	820	710
2004	HORCONES TG (*)	Thermal	0	12.023
2004	HORCONES TG	Thermal	944	56
2004	ITATA	Thermal	0	319
2004	LICANTEN	Thermal	0	21.412
2004	P.VALDIVIA	Thermal	0	153.204
2004	RALCO	Reservoir	0	1.332.259
Total SIC Energy Generation of 2004			MWh	36.113.187
Latest 20% of Capacity additions Generation			MWh	7.523.475
Total Emiission of latest 20%			TCO2e	2.723.889
EF_BM			**TCO2/GWI**	**362**

AN 4.5. QUILLECO SUSTAINABLE DEVELOPMENT MVP

An 4.5.1. Monitoring Sustainable Development

The MVP compares the project's actual environmental and development performance as measured by the indicators below with the set target values and determine whether the targets have been reached. The following local environmental benefits have been identified from the Quilleco Hydroelectric Project (see Quilleco's EIA from CONAMA official website **www.seia.cl** for more details).

- The project will contribute with clean renewable energy for the Central Interconnected System of Chile, displacing thermal generation

The direct social and development impact of the project are as follows (see Quilleco's EIA from CONAMA official website **www.seia.cl** for more details).

- Job creation during the construction period and also during the operation
- Economic activity during the construction period and also during all of its lifetime.

An 4.5.2. Monitoring, Recording and Reporting

For the monitoring, recording and reporting of the environmental, social and developmental impacts identified for the project, the following two points sustain beyond the construction phase of the project:

- Job creation during the operation of the power plant, particularly for the local community
- Increase in economic activity due to the Project Activity.

AN 4.6. MANAGEMENT AND OPERATIONAL SYSTEMS MVP

An 4.6.1. Allocation of Project Management Responsibilities

The management and operation of the project, related to CDM activities, is part of the Project Operator's responsibilities. Ensuring the environmental credibility of the project through accurate and systematic monitoring of the project's implementation and operation for the purpose of achieving trustworthy ERs is the key responsibility and accountability of the sponsor as far as this MVP is concerned.

An 4.6.2. Management and Operational Systems

- **Data handling**

The establishment of a transparent system for the collection, computation and storage of data, including adequate record keeping and data monitoring systems. The Project Operator must develop and implement a protocol that provides for these critical functions and processes, which must be fit for independent auditing.

- **Quality assurance**

The Project Operator must designate a competent manager who will be in charge of and accountable for the generation of ERs including monitoring, record keeping, computation of ERs, audits and verification. He or she will officially sign-off on all GHG Emission worksheets. Proper management processes and systems records must be kept by the Project Operator, as the auditors will request copies of such records to judge compliance with the required management systems.

- **Reporting**

The Project Operator will report regularly to the ERs Buyer(s) as well as to Chilean authorities as required by them.

- **Training**

It is the responsibility of the Project Operator to ensure that the required capacity and internal training is made available to its operational staff to enable them to undertake the tasks required by this MVP. Initial staff training must be provided before the project starts operating and generating ERs.

AN 4.7. AUDITING AND VERIFICATION PROCEDURES

An 4.7.1. Audit and Verification Regime

The Project Activity must be submitted to third party validation and verification, which is conducted by independent firms specializing in environmental auditing services (auditors, validators, verifiers, certifiers). The verification system for the Project Activity consists of these four activities:

- **Validation of project design**

The Project Activity must undergo a CDM validation of the project's design, baseline and MVP against CDM requirements and modalities. Validated MVP for a project must be followed by the Project Operator.

- **Initial audit and verification of project readiness**

The Project Activty is required to successfully complete an initial audit and verification process before the the commissioning the project and acceptance of emission reductions delivered by it. To prevent conflicts of interest, verification must not be conducted by the same firm and individuals that have provided validation services for the project.

The purpose of the initial audit and verification process is threefold:

- Ensure that the project has been implemented as planned, that the monitoring system is in place and that the project is ready to generate and record GHG emission reductions.

- Approve adjustments and amendments to the MVP that may have become necessary during the detailed design and construction of the project.
- Assist meeting any buyer supervision obligations and clear the way for project commissioning and generation of high quality ERs.

- **Periodic verification of emission reductions**

The Project Activity must undergo periodic audits and verification of emission reductions. This is a CDM requirement and the basis for issuance of Certified Emission Reductions (CERs) and for their value in the market place. Verification must be arranged and conducted at annual or longer intervals as appropriate for the Project Sponsor or ERs Buyers. Verification concludes with a formal verification report. The report may include a statement that may permit the renewal of the project's crediting period in line with applicable CDM rules and modalities.

The purpose of periodic audits and verification is to confirm that:

- The project has achieved the ERs for the verification period in compliance with the methodology laid down in this PDD.
- The claimed ERs are real and additional to any that would have occurred in the baseline scenario as interpreted and developed in the Baseline Study and this MVP.
- The operation of the project continues to be in compliance with all Kyoto Protocol, host country requirements and modalities for CDM projects, and the ERs buyer(s).
- The project maintains a high quality monitoring systems consistent with the MVP.

- **Certification of emission reductions**

A successfully completed verification process and the related verification report provide the basis for the issuance by the verifier of an emission reduction certificate. The certificate is a legally binding statement which confirms the (successful) verification report's conclusion that project has achieved the stated quantity of ERs in compliance with all relevant criteria and requirements.

- **Auditing Criteria and Needs**

Verification includes an audit of the project's output information and data and management systems on the basis of the following established criteria: Completeness; accuracy; coverage and risk management controls.

The auditor will produce an audit report and verification report, which summarizes the audit findings.
The draft verification report will state the number of ERs achieved by the project and will point to areas of possible non-compliance if warranted. The report will also include conclusions on data quality, the projects monitoring and management and operational system, and other areas where corrective action may be required to come into compliance, improve performance or mitigate risks.