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

CONTENTS

SECTION A. General description of project activity

A.1 Title of the project activity:

"El Chaparral Hydroelectric Project" (El Salvador)
Version 01 – 27/03/2008

A.2. Description of the project activity:

The "El Chaparral" Hydroelectric Project

"El Chaparral" Project consists of a 65.4 MW hydro power station over the Torola River in the department of San Miguel, El Salvador that will provide energy to the national grid. The project developer is Comisión Ejecutiva Hidroeléctrica del Río Lempa (CEL), autonomous state-owned electricity company. The Central American Bank for Economic Integration (CABEI) will provide partial financing for the project and constructions will be executed by a independent contractor that results elected after a competitive bid process specially designed for this purpose. El Chaparral will provide base load generation during the wet season[1] and peak-load during the dry season.

The main objectives of this project are:

- Satisfy the increase in demand for electricity by means of hydro resources in a competitive and sustainable manner.
- Reduce dependence on oil based fuels, replacing those for renewable resources.
- Make efficient use of the hydroelectric capacity of the Torola River.
- Promote the development of an alternative energy.

El Chaparral Power Plant's generation layout consists of an 87.5 m high concrete dam, two vertical-axis Francis turbines of 32 MW each, water intakes, penstocks, powerhouse, tailrace and a 115 kV substation. An auxiliary 1.42 MW unit will be installed in the powerhouse for an efficient use of the 2 m^3/s ecological flow of the river. The whole capacity of the plant will be 65.42 MW.

The Salvadorean electric sector consists of a Wholesale Market (SWM) and a Retail Market (SRM)[2]. The first of these markets is composed by all the generators, distributors, traders and major users that are directly connected to the 115kV transmission system. The Transactions Unit (UT – Unidad de Transacciones) coordinates and undertakes the programmed dispatch for each defined time unit according to the offered price of each unit for each energy transaction period. El Chaparral will deliver its electricity generation to this market.

Although electricity generation in El Salvador is a free (though regulated) market, there are no private hydro power stations. The last hydro power plant built by CEL (who owns and operates the four hydro

---

[1] The wet season goes from May to October; the rest of the year is considered "dry season".

[2] This market is made up of small hydro generation plants, sugar cane mills and self generators (diesel or fuel oil engines) which are connected to the distribution power lines and sell their surplus electricity directly either to distributors, traders, or final users.

plants available in El Salvador) was constructed almost 25 years ago[3], and although most of CEL's units have been upgraded and re-powered in order to increase their efficiency and generation, the steady increase in demand requires the periodical introduction of new energy sources. It is estimated that national energy demand rises 4.9% every year[4], and a similar rate applies for the rise in peak-hour demand. In this scenario, it is expected that the difference between maximum capacity and peak-hour demand will be less than 10% of the former in 2008[5], providing the need for new investments in the sector before 2009. El Chaparral project is one of the main efforts of the Salvadorean government in order to keep electrical supply and demand in balance.

Contribution to sustainable development

The project contribution to society can be divided into two groups:

a) **Socio-economic development:** Besides the numerous jobs that will be created by the construction and operation of El Chaparral project, the water reservoir will promote the diversification of productive activities in the area (fishing, tourism and others). This will improve the living conditions of the people in the area, one of the poorest in the country according to the latest poverty map by Fondo de Inversión Social y Desarrollo Local (FISDL)[6]. In addition, the project will improve access roads in the area; the roads affected by the mobilization of machinery will be repaired and replaced.

   In a broader sense, the project will provide the country a cheap energy source that will improve infrastructure conditions for families and industries as well. At the same time, the use of a renewable source will reduce the country's dependence on imported oil, therefore improving the Salvadorean current account and making it less vulnerable to oil price fluctuations.

b) **Sustainable development:** El Chaparral project will take care of the natural and sociological environment of the project's surroundings.

   A strict Environmental Management Plan (EMP) was determined in order to minimize the project impact on the local environment and enhance to the maximum extent possible the benefits of the project to the local community. This plan includes the construction of a housing complex, schools and bridges that will allow for a proper communication within the area, among others[7].

   El Chaparral Project will take place in a fossil-fuel intensive baseline scenario, with an estimated emission factor of 0.734, which implies that the project will displace a net amount of *150,181 tCO_2e per year* after accounting for the emissions from its own reservoir. In addition to this, CEL will undertake a reforestation process of part of the Torola River's basin that will contribute with the preservation of the basin. It is expected that this two actions will provide a positive example for future initiatives (especially those in the private sector, since the private sector owns the

---

[3] The last hydro plant built by CEL is the "15 de Septiembre" power station.

[4] Source: El Chaparral Feasibility Study (p. 2).

[5] Source: El Chaparral Feasibility Study (p. 2).

[6] Social Investment Fund for Local Development (www.fisdl.gob.sv) .

[7] Please refer to Section D for more on the project's EMP.

largest fraction of the electric generation mix), by showing the feasibility of undertaking a renewable energy project under the CDM regime.

A.3. Project participants:

Name of Party involved (*) ((host) indicates a host Party)	Private and/or public entity(ies) project participants (*) (as applicable)		Kindly indicate if the Party involved wishes to be considered as project participant (Yes/No)
El Salvador (Host Party)	Comisión Ejecutiva Hidroeléctrica del Río Lempa (CEL)	Public Entity	**Yes**
(*) In accordance with the CDM modalities and procedures, at the time of making the CDM-PDD public at the stage of validation, a Party involved may or may not have provided its approval. At the time of requesting registration, the approval by the Party(ies) involved is required.			

A.4. Technical description of the project activity:

A.4.1. Location of the project activity:

El Chaparral Hydro Power Plant will be located in the Department of San Miguel, approximately 136 km northeast from San Salvador, the capital city of El Salvador.

A.4.1.1. Host Party(ies):

El Salvador.

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

Department of San Miguel.

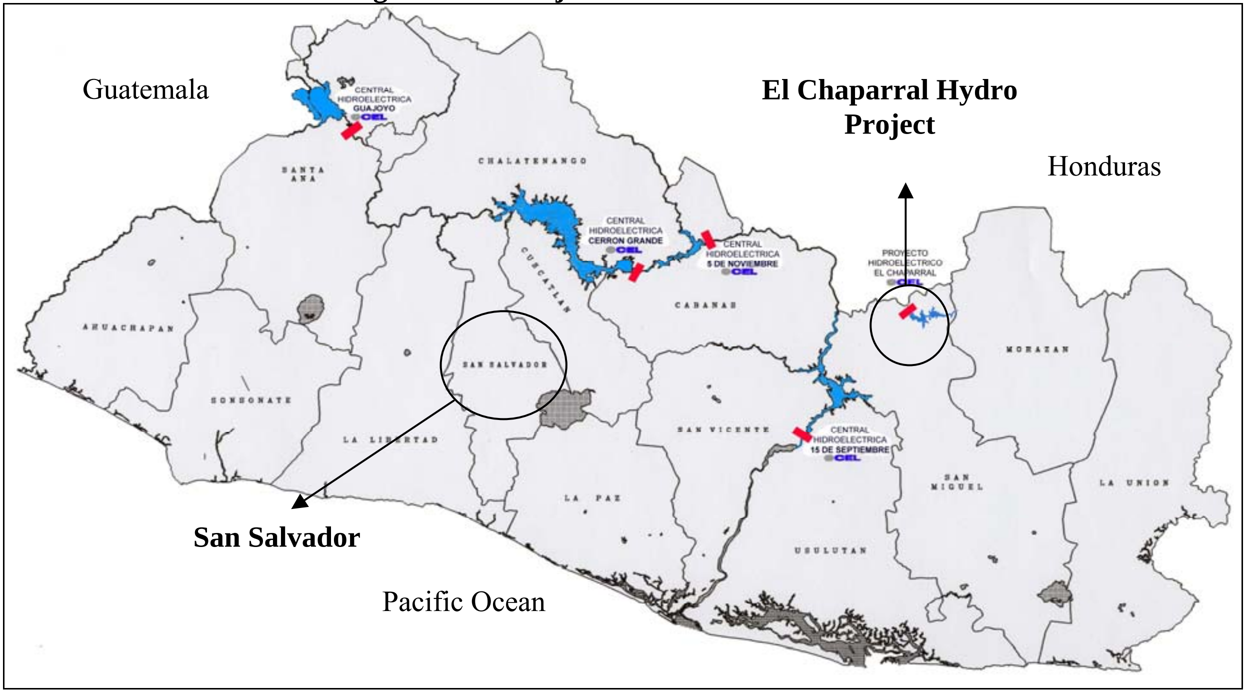
A.4.1.3. City/Town/Community etc:

San Luis de la Reina, Carolina and San Antonio del Mosco.

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

The project site will be located between 13˚50’ and 13˚53’ North, and 88˚22’ and 88˚16’ West.
Figure A.1 below presents a map with all of CEL’s hydro stations and the location of El Chaparral Hydro power plant.

Figure A.1 – Project Location in El Salvador



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

Scope number: 1
Sectoral Scope: Energy Industries - Renewable Sources (New hydro electric power project with reservoir having a power density greater than 4 W/m^2).

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

The following section presents a summary of the main technical aspects of the project layout. The project design[8] was performed by Intertechne Consultores Associados, from Brazil, based on the feasibility study previously performed by consultants from the firm J-Power, from Japan, under the sponsorship of the Japanese International Cooperation Agency (JICA).

The project consists of:
River diversion works: For the diversion of the Torola River, a rectangular section tunnel of 9 m wide (and height) and 350 m long will be constructed on the left margin of the river.

Dam: Roller compacted concrete (RCC), gravity dam, of 321 m long at its crest and 87.5 m of maximum height.

[8] This includes all the technical documentation for the competitive bid process that will be used in order to determine the project's constructor.

Spillway: Located on the structure of the RCC dam. Its flow will be controlled by four radial gates of 11.50 m wide and 15 m height each.

Intakes and penstocks: The hydraulic generation layout consists of two intakes and penstocks one for each generation unit and a single, 130 m long, outlet tunnel that will return the turbinated water to the Torola River.

Powerhouse: Located on the left margin of the Torola River, it will be equipped with two vertical axis, Francis turbines. These will be connected directly to the three-phase, synchronic generators and their auxiliary systems (speed regulators, excitement systems and other components). The nominal power of the plant will be of 65.42 MW, with each turbine able to provide up to 32 MW for a 72.50 m reference fall. An auxiliary 1.42 MW unit will be also installed in the powerhouse. The generators will have 36 MVA of nominal power with 13.8 kV of nominal tension.

In order to make efficient use of the river's ecological flow, a generating unit will be installed. This unit will be a horizontal axis, Francis unit rated at 1, 420 kW.

Substation: Also located on the left margin, will be designed for a nominal tension of 115 kV and will be based on a "breaker and a half" arrangement.

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

The project will displace electricity from a relatively carbon-intensive grid with a combined margin emission factor of 0.734 tCO_2/MWh. The project is expected to dispatch 233,200 MWh of electricity per year, thus reducing GHG emissions by 171,169 tCO_2 annually in the baseline scenario. However, the project must account for its own GHG emissions from its reservoir (20,988 tCO_2e per year). Therefore, the net reduction will be of 150,181 tCO_2e for each year in the renewable crediting period.

Table A.1 - Estimated amount of emission reductions during the First Crediting Period

Years	Annual estimation of emission reductions in tonnes of CO_2e
2011	150,181
2012	150,181
2013	150,181
2014	150,181
2015	150,181
2016	150,181
2017	150,181
Total estimated reductions (TCO_2 e)	**1,051,267**
Total number of crediting years	**7 x 3 = 21**
Annual average over the crediting period of estimated reductions (TCO_2 e)	**150,181**

A.4.5 Public funding of the project activity:

The project sources of funds will be as depicted in the table below. CABEI will provide funds for the Engineering, Procurement and Construction Contract (EPC), which accounts for almost 80% of the overall budget, while CEL will provide the remaining 20%. No annex I countries will provide funding for this project activity.

Global Investment Plan – El Chaparral Project

Detail	CEL	BCIE	Total
Project design	3,000.00	-	3,000.00
EPC Contract (maximum budget allowed)		163,300.00	163,300.00
Transmission lines	4,970.00	-	4,970.00
Environmental Management Program	10,710.06	-	10,710.06
Land acquisition	6,168.00	-	6,168.00
Management	7,000.00	-	7,000.00
Interests and commissions 1\	12,763.50	-	12,763.50
Total	**44,611.56**	**163,300.00**	**207,911.56**
Share (%)	**21.46%**	**78.54%**	**100%**

1\ To be recalculated by CABEI.

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:

Approved baseline and monitoring methodology applied:

- ACM0002: "Consolidated baseline methodology for grid-connected electricity generation from renewable sources" (Version 07 – December 2007)

The following tools were applied together with the methodology:

- "Tool to calculate the emission factor for an electricity system" (Version 01)
- "Tool for the demonstration and assessment of additionality" (Version 04)

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

The consolidated baseline methodology for grid-connected electricity generation from renewable sources is justified as the proposed project consists of the construction and addition of a hydroelectric power plant to the Salvadorean national grid.

ACM0002 is applicable to any new hydroelectric power project with reservoirs having power densities (installed power generation capacity divided by the surface area at full reservoir level) greater than 4

W/m^2. In the case of El Chaparral project, this value is[9] 7.60 W/m^2 and therefore the project complies with the power density requirement.

Likewise, a) the proposed project does not involve switching from fossil fuels to renewable energy; b) the geographic and system boundaries for the Salvadorean national grid can be clearly identified, and c) all relevant information on the main aspects of the grid is readily available. Therefore, all the methodology requirements are met.

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

According to the ACM0002, renewable energy projects shall only account CO_2 emissions from electricity generation in fossil fuelled power plants that are displaced due to the project activity. Therefore, the relevant sources of gases considered both for the baseline and the project activity are the following:

Table B.1. Emission Sources

	Source	Gas	Included?	Justification/Explanation
Baseline	Grid Electricity Generation	CO_2	Yes	Main emission source
		CH_4	No	Not considered (as stated by the ACM0002 methodology)
		N_2O	No	Not considered (as stated by the ACM0002 methodology)
Project Activity	Hydroelectric power plant and reservoir	CO_2	No	There are no CO_2 emissions generated from hydroelectric power projects
		CH_4	Yes	Emissions from the project's reservoir are taken into account since the latter's power density factor is below the 10W/m^2 threshold established in the methodology
		N_2O	No	There are no N_2O emissions generated from hydroelectric power projects

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

According to the ACM0002, for project activities that do not modify or retrofit an existing electricity generation facility (i.e. new plants), *the baseline scenario consists of the electricity that would have been delivered to the grid by the rest of the plants –or by new additions - in the absence of the proposed project activity.* In the context of El Chaparral project, such scenario is easy to identify.

The relevant electric power system for the project is the Salvadorean Wholesale Market (SWM). This market is composed of all the generators, distributors, traders and major users that are directly connected to the 115kV transmission system. The Transactions Unit (UT – Unidad de Transacciones) coordinates

[9] Calculated as the relation between 65.4 MW of installed power capacity and 8.6 km^2 of surface area at full reservoir level.

and undertakes the programmed dispatch for each hour according to the offered price of each unit for each energy transaction period.

In order to obtain an estimate of the electricity that –in absence of the proposed project- would be delivered to the grid by the rest of the plants, the current capacity mix is observed. In El Salvador, around 50% of the installed capacity is thermal, 35% hydro and 15% geothermal[10], which is the kind of thermal dominated mix that would prevail in the absence of El Chaparral project.

On the other hand, future additions to the grid are approximated by the most *recent* additions to the latter. Table B.2 presents a list of the six most recent power plants that entered the system, showing that around 84% of the capacity added by these has been based on thermal technologies and that renewable energy projects, on the other hand, have been scarce (only 16% of the capacity added is powered by this type of source). This trend is likely to continue: for example, the AES FONSECA coal power project is expected to start operations in 2011. With a power capacity of 250 MW, it will be able to deliver by itself around 75% of the amount delivered by these most recently built plants[11]. Other example includes the addition of 50 MW by the private firm INE, which will rely on thermal technology as well.

Table B.2 – Recently built plants by technology type (Excluding capacity additions at existing plants)

Plant name	Capacity		Technology	Starting Year
	MW	%		
Borealis	13.6	7%	Thermal	2007
GECSA	11.6	6%	Thermal	2007
Talnique	51.2	28%	Thermal	2006
CASSA	29	16%	Biomass	2003
CESSA	32.6	18%	Thermal	2001
Textufil	44.1	24%	Thermal	2000
Total	**182.10**	**100%**		

Source: SIGET – 2007

From the information presented above, it can be readily seen that thermal is both the prevalent technology in the country *and* the most common choice when it comes to new additions, and such is the baseline situation in which the project is expected to take place. Section B.6 of this PDD presents a quantitative estimation of the baseline scenario depicted above (i.e. the baseline *emission factor*).

[10] Source: UT (2007).

[11] For more on this project, see http://www.fonsecaenergia.com.

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):

The purpose of this section is to demonstrate that the proposed project would not take place in a hypothetical situation where no carbon credits existed to support clean projects. A project activity of such characteristics is said to be *additional* to the baseline scenario presented in the previous section.

The "Tool for the demonstration and assessment of additionality – version 04" (hereafter, the "additionality tool") was followed. This tool is divided in a series of steps that have to be fulfilled in order to complete the demonstration. The steps are:

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

In this step, credible alternatives to the project activity must be depicted. These alternatives can be part of the baseline scenario described in Section B.4.

Sub-step 1a. Define alternatives to the project activity:

A natural alternative to the proposed project activity would be a similar power plant that relies on a different kind of technology.

Thermal technologies are the most common in the country, as described on the previous section. Historically, residual fuel oil has been the first choice among the different kinds of fossil fuels for this type of plants. However, the steep rise in oil prices has displaced this formerly cheap fuel, and energy investors had to start seeking other alternatives.

As opposed to oil, coal prices have remained stable in the last 10 years. Figure B.1 below displays the behaviour of prices[12] for both residual fuel oil[13] and anthracite coal[14]. In the nineties, both prices moved along the same trend, keeping the relative price between the two approximately constant and without significant volatility. However, in 1999 the price of bunker oil started to climb sharply and by the end of the period under analysis the ratio of fuel oil to coal price had gone from 0.25 to 1.11. Since this upward trend is not likely to end in the short run, coal is increasingly thought as the first alternative to oil when it comes to energy generation. This is why a reasonable first alternative to El Chaparral Project would be a thermal power plant that burns coal in order to generate electricity.

Two more alternatives would be:

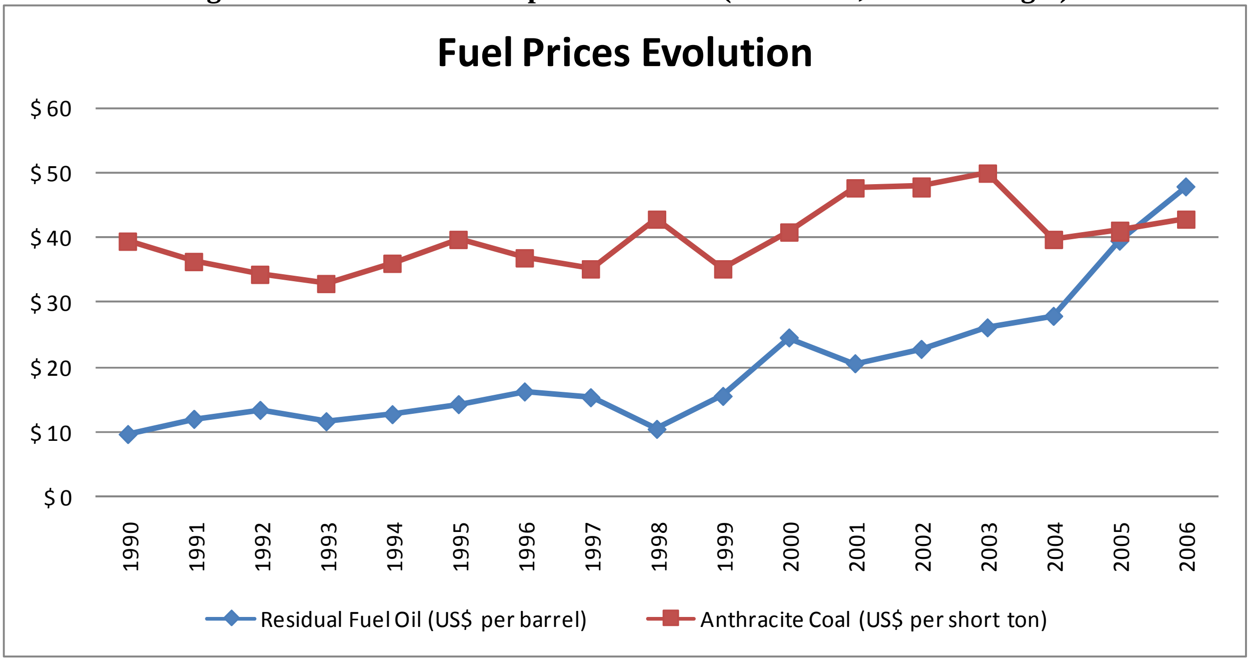
- The same project undertaken without being registered as a CDM project activity;
- Continuation of the current situation (no project activity or other alternatives undertaken).

[12] *Source:* Energy Information Administration (http://www.eia.doe.gov).

[13] Residual Fuel oil is also referred to as "bunker".

[14] Anthracite is the highest quality type of coal (i.e. it has the highest energetic value).

Figure B.1 – Selected fuel's price evolution (1990-2006, anual averages)



Source: Energy Information Administration (EIA)

Sub-step 1b. Consistency with mandatory laws and regulations:

The alternatives listed comply with all the mandatory laws and regulations in El Salvador[15].

Step 2. Investment analysis

This step will provide evidence to support the argument that - without the revenue from the sale of certified emission reductions - the proposed project activity is economically less attractive than at least one of the identified alternatives.

Sub-step 2a. Determine appropriate analysis method

Since El Chaparral Project will generate other revenues apart from the CDM related income, simple cost analysis (Option I) is not eligible. Option II – "Investment comparison analysis" appears to be the most appropriate method for this type of project activity, since it involves direct comparison between different choices among the alternatives listed in step 1.

[15] The main regulatory law in El Salvador is the "General Law of Electrical Power". An English version of the latter is available at: http://www.siget.gob.sv/documentos/electricidad/legislacion/general_law_of_electrical_power0.pdf

Sub-step 2b. – Option II. Apply investment comparison analysis

This section presents an evaluation of the Net Present Value (NPV) of two potential investments: the first is the proposed project activity, El Chaparral, and the second is the construction of an equivalent coal power plant (which was the first alternative listed in step 1).

Table B.3 – Assumptions for the coal powered plant

Parameter type	Assumption	Unit	Value
Investment and O&M* costs	Investment Cost	$/MW	1,300,000
	Project Lifetime	Years	20
	Fixed O&M Costs	$/MW year	25,000
	Variable O&M Costs	$/MWh	3.60
Capacity requirements	Net Annual Energy required	MWh	233,200
	Total Losses	%	5%
	Gross Annual Energy required	MWh	245,474
	Capacity Factor	%	80%
	Nominal capacity required	MW	35.03
Fuel Requirements and costs	Thermal efficiency	MMBtu/MWh	10.00
	Calorific Value	MMBtu/ton	28.7
	Fuel Price	$/ton	68.20
		$/MWh	23.80
	Fuel Required	tons/year	85,650.27
	Fuel costs	$/year	5,841,348.41

**Operation & Maintenance Costs*

Table B.3 presents the essential assumptions[16] used to build the coal power plant's investment and operating costs. Investment costs were taken from the "Regional Indicative Plan for the Expansion of Energetic Generation" (CEAC – 2002); the fixed part of the O&M cost is also taken from CEAC (2002); the variable part of the O&M is taken from the Monenco-Agra report (1995)[17]. Coal price was taken from the Coal & Energy Price Report (available upon request) (62US$/short ton is the base value[18] for anthracite, and this is incremented by a 10% to account for transport costs). The corresponding calorific value for this type of coal is 28.7 MMBtu/ton[19]. Similarly, coal heat rate was assumed to be of 10 MMBtu/MWh, a conservative value according to industry standards.

---

[16] In subsequent sections of this PDD we will refer to *metric tonnes* as "tonnes". On the other hand, "tons" refers to *short tons.*

[17] Section 6, Technic and Economic Information – Contract CEL-2330 Final Report "Actualización del Plan de Expansión del Sistema de Generación y Análisis Beneficio – Costo" elaborated by Monenco Agra Inc. (Canada). Document is available upon request by the DOE.

[18] This value corresponds to 28/12/2007.

[19] Coal & Energy Price Report, 28/12/2007. MMBtu = millions British Thermal Units.

The net annual generation is set at the same value of that of El Chaparral Project (233,200 MWh). With 5% energy loss, this implies that the gross annual generation needed is of 245,474 MWh, which in turn implies 35.03 MW of nominal capacity if an 80% plant factor is assumed[20].

From the table above and project information[21], the following tables with cost information are obtained.

Tables B.4 – Relevant costs for the proposed alternatives

1. Construction Costs – 35.03 MW Coal Power Plant (*)

Period	**%**	**Thousand $**
First Year	60%	27,323
Second Year	40%	18,216
Total	**100%**	**45,539**

(*) Expected lifetime: 20 years (straight line depreciation)

2. Construction Costs - El Chaparral Power Plant (thousand dollars)

Period	**Design and Engineering Consulting Fees**	**Civil Works**	**Hydro and electromechanical equipment (*)**	**Total**
First Year	4,637.48	16,294.54	6,574.85	**27,506.87**
Second Year	767.59	25,675.32	12,694.57	**39,137.48**
third year	767.59	46,365.83	22,658.29	**69,791.71**
fourth year	767.59	13,187.92	12,908.43	**26,863.94**
Total	**6,940.25**	**101,523.61**	**54,836.14**	**163,300.00**

(*) Expected lifetime: 35 years (straight line depreciation)

3. O&M Costs – 35.03 MW Coal Power Plant (thousand dollars)

Item	**Value over which applies**	**Unitary cost**	**O&M cost**
Fixed Costs	35.03 MW	25/MW	875.75
Variable Costs	245,474 MWh	0.0036/MWh	883.71
		Total/year	**1, 759.5**

[20] Coal power plants may take an extended period of time (ranging from hours to days) to achieve a steady state power output. On the other hand, they have low fuel costs. Since they require a long period of time to heat up to operating temperature, these plants typically handle large amounts of base load demand. Therefore, 80% is considered a reasonable value for a coal plant's capacity factor due to the technical nature of this type of plants.

[21] The information of El Chaparral used in these calculations is based on the correspondent project design study (page 5, volume 17) developed by Intertechne Consultores Associados S/C Ltda (Brasil). This document is available upon request by the DOE.

4. O&M Costs - El Chaparral Power Plant (thousand dollars)

O&M Costs	Construction Cost	O&M Rate[22]	O&M Value
Civil Works	101,523.61	0.5%	507.6
Equipment	54,836.14	1.5%	822.5
		Total/year	**1,330.10**

Due to the intrinsic technological nature of both alternatives, income may not be neglected from the analysis even though both projects would produce the exact same amount of electricity. This is because while a coal power plant would most likely handle base load demand, El Chaparral is expected to generate output for the peak hours in the dry season and all day during the wet season. Therefore, the price received by the hydro power plant is prone to be higher than the one received by a similar, coal based station. In El Salvador, power plants work within three time zones:

- Valley hours: go from 11 pm to 4:59 am
- Rest hours: from 5 am to 5:59 pm
- Peak hours: from 6 to 10:59 pm

A carbon plant that worked permanently (except for routine maintenance services) would receive the average price of the entire day. This average would include valley hours (the cheapest), rest hours and peak hours (the most expensive ones). A hydro power plant, on the other hand, would receive the same daily-average price in the wet season, but a higher price in the dry season, when it would only generate for the rest and peak hours. Therefore, the ratio of hydro to coal price has to be estimated in order to correctly account for the respective income in each case. This latter task was undertaken by means of an ordinary least squares (OLS) statistical analysis covering a sample of over 52 thousand hourly observations of the Salvadorean spot market for electricity[23].

The estimated model was as follows[24]:

$$\log(p_h) = \alpha + \beta_1 year_h + \beta_2 season_h + \beta_3 peak_h + \beta_4 rest_h + \beta_5 saturday_h + \beta_6 sunday_h + \beta_7 holiday_h + \varepsilon_h$$

where:

p_h: price of the spot market electricity for the h-th hour (source: UT)

$year_h$: is a standard deterministic trend

$season_h$, $peak_h$, $rest_h$, $saturday_h$, $sunday_h$ and $holiday_h$ are dummy variables taking the value 1 in the wet season, peak hours, rest hours, Saturdays, Sundays and national holidays respectively[25]. ε_h is the residual term

[22] These rates are taken from the feasibility study (page 14-3).

[23] Known as the "Mercado Regulador del Sistema" (MRS).

[24] For further guidance on OLS and dummy variables analysis see Woolridge, Jeffrey "*Introductory Econometrics: A modern approach*". South-Western College Publishing (2000).

The result of the estimation was the following:

Table B.5 – OLS analysis results

Dependent Variable: LOG(PRICE)
Method: Least Squares
Date: 03/04/08 Time: 16:56
Sample: 1 52387
Included observations: 52,387

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	3.838682	0.004181	918.1507	0.0000
YEAR	0.026568	0.000788	33.71691	0.0000
SEASON	0.011434	0.002693	4.245618	0.0000
PEAK	0.418825	0.003993	104.8907	0.0000
REST	0.277544	0.003256	85.23944	0.0000
SATURDAYS	-0.068870	0.003906	-17.63327	0.0000
SUNDAYS	-0.145853	0.003911	-37.28995	0.0000
HOLIDAYS	-0.064719	0.009851	-6.569839	0.0000

R-squared	0.219793	Mean dependent var.	4.143473
Adjusted R-squared	0.219689	S.D. dependent var.	0.348821
S.E. of regression	0.308132	Akaike info criterion	0.483577
Sum squared resid.	4973.146	Schwarz criterion	0.484931
Log likelihood	-12658.57	F-statistic	2107.965
Durbin-Watson stat	0.528835	Prob.(F-statistic)	0.000000

All the coefficients in the equation are statistically significant. Peak hours are in average 52% more expensive than valley hours, while rest hours prices are 32% higher than the latter[26].

[25] Although our interest is set in the peak and rest coefficients, the other variables are used as control variables in order to correctly estimate the coefficients of the former.

[26] This results from considering that

$$\log(p_h)_{|peak=1} - \log(p_h)_{|peak=0} = \log\left(\frac{p_{h|peak=1}}{p_{h|peak=0}}\right) = \beta_3;$$

therefore: $e^{\beta_3} - 1 = e^{0.418825} - 1 = 0.52 = \dfrac{p_{h,peak=1}}{p_{h,peak=0}} - 1$

Likewise, for the differential between rest and valley hours, we obtain
$e^{0.277544} - 1 = 0.32$.

The average price $\overline{p}_t$ for any year *t* is given by:

$$\overline{p}_t = \theta_v p_{v,t} + \theta_r p_{r,t} + \theta_k p_{k,t}$$

where,

p_j ($j=v,r,k$) are the valley, rest and peak prices;

θ_j are the corresponding weights (number of valley/rest/peak hours over total hours, each of them known constants).

Our previous analysis shows that $p_k=1.52p_v$ and $p_r=1.32\ p_v$. From the average price for 2007, $\overline{p}_t = 70$, the rest of the average prices may be calculated; which results in $p_v=54.68$; $p_r=72.17$ and $p_p=83.12$. Thus, if we make the conservative assumption that the hydro power plant will receive peak and rest prices *only,* 50% of the time each, the relevant prices for our analysis are *coal price =* $\overline{p}_t$ = 70 and *hydro price =* $0.5\ p_r + 0.5\ p_k = 77.65$.

These figures complete the set of assumptions and information needed to perform the economical evaluation of the two alternatives.

Sub-step 2c. Calculation and comparison of financial indicators

The results of the economic analysis[27] are summarised in table B.6 for 3 different discount rates. The reference rate in the Salvadorean energy market is 12%[28] and therefore this rate was considered. Even with a rate as low as 8%, El Chaparral's Net Present Value is 19 million dollars *below* that of an equivalent coal power plant. The results are even more conclusive when we consider a 12% discount rate; in this case, the hydro project has a negative NPV. This way, our analysis determines that a project like "El Chaparral" is by no means the most economically attractive alternative.

Table B.6 – Summary of the results from the economic analysis

Plant	Present Value of benefits (thousand US$)		
	8%	10%	12%
(1) El Chaparral	20,576	-12,294	-33,899
(2) Coal Power Plant	40,274	25,483	15,569
Difference (2) - (1)	**19,698**	**37,777**	**49,468**

[27] The cash flow for both alternatives is available on Annex 5.

[28] This is as stated by Decree number 146 (1994), available upon request.

Sub-step 2d. Sensitivity analysis

A sensitivity analysis is performed in order to test the robustness of the results from the previous sub-step. The following set of parameters has been identified as risky variables and was therefore included in the sensitivity analysis[29]:

- Coal price (±20%)
- Coal plant construction costs (±20%)
- El Chaparral construction costs (±10% - this is justified since the original values used for this parameter are much more certain than those used for the coal power plant)
- O&M expenses for the coal plant (±10%)
- O&M expenses for El Chaparral project. (±10%)

The results of this analysis are presented on table B.7. The largest variation was assumed for the coal price, even despite the fact that this is a very stable fuel. Even with a 20% raise on this parameter, a coal plant is still over 28 million dollars superior in terms of net present value. A similar result is obtained when considering a 20% raise on the coal plant's construction costs. Since El Chaparral's estimation of project investment costs are based on much certain grounds, a smaller variation is assumed for this variable. Likewise, 10% variations are considered for O&M costs in both plants. In all these cases, the results favour the coal alternative over El Chaparral project.

Table B.7 – Summary of the results from the sensitivity analysis

Risk Variable	%Variation	Difference between Chaparral cost and a coal equivalent plant cost
Coal Price	20%	28,716
	-20%	46,838
Investment Coal	+20%	29,317
	-20%	46,236
Investment Hydro	+10%	53,047
	-10%	22,508
O&M Coal	+10%	36,412
	-10%	39,141
O&M Hydro	+10%	38,808
	-10%	36,745

(*) In terms of present value. 10% discount rate used. Thousand US$

[29] Discount rate is set to 10% for the sensibility analysis.

Step 4. Common practice analysis

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

Below is a table with all the hydro power plants in El Salvador, all of which are public investments. As it can be observed, the last time a plant of this technology was built was almost 25 years ago, in 1983.

Table B.8 – Hydro power plants in El Salvador

Hydro Plant Name	Type	Nominal Capacity (MW)	Starting year
5 De Noviembre	Run of River	99.4	1954
Guajoyo	Reservoir	19.8	1963
Cerrón Grande	Reservoir	172.8	1976
15 De Septiembre	Run of River	180	1983

Source: SIGET

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

The hydro power plants that are currently providing energy to the grid were built under very different circumstances, 25 years ago or even earlier. As stated on the previous step, it is more profitable to build thermal plants, and a proof of this is the fact that none of the private projects that took place in the country have been hydro. This demonstrates that this kind of project is by no means a common practice in El Salvador.

This way, our demonstration of the proposed project's additionality successfully concludes after considering all the steps in the methodological tool.

B.6. Emission reductions:

B.6.1. Explanation of methodological choices:

As stated by the "Tool to calculate the emission factor for an electricity system", the baseline emission factor consists of a weighted average between an *operating margin emission rate* (EF_{OM}) and a *build margin emission rate* (EF_{BM}). The operating margin captures the project's effect on the operation of the power plants that are already part of the grid, while the build margin attempts to capture the project's effect on the construction of new power plants. The weighted average of these two effects is known as the *combined margin emission factor* (EF_{CM}).

For this project, the OM and the BM estimates were computed using the relevant time series from *SIGET*[30] (Superintendencia General de Electricidad y Telecomunicaciones – Electricity and Telecommunications Agency) for the 2005-2007 periods. *IPCC's Guidelines* (2006) and the "*Annual*

[30] Energy generation data is publicly available at www.siget.gob.sv.

Energy Outlook[31]" (2007) were used since national estimates for critical parameters are currently unavailable.

The OM emission factor is determined according to Step 2, option "b" (simple adjusted OM) from the "Tool to calculate the emission factor for an electricity system". This choice is justified since in El Salvador, low-cost/must run resources constitute more than 50% of the total grid generation. Likewise, there is not enough information about hourly fuel consumption by the power plants in the grid in order to perform the estimations according to option "d" (dispatch data analysis) in the methodology.

Information on the 3 most recent years for which data is available was collected to perform calculations (i.e. *ex-ante* vintage data is chosen). The OM emission factor for each year *y* (hereafter, $EF_{OM,y}$) is obtained as follows:

(1) $$EF_{OM,y} = (1-\lambda_y) \cdot \frac{\sum_{i,j} F_{i,j,y} \cdot NCV_i \cdot EF_i}{\sum_j GEN_{j,y}} + \lambda_y \cdot \frac{\sum_{i,k} F_{i,k,y} \cdot NCV_i \cdot EF_i}{\sum_k GEN_{k,y}}$$

$F_{i,j,y}$ is the amount of fuel *i* (in thousand gals) consumed by power source *j* in year *y*; *"j"* refers to the power sources delivering electricity to the grid (not including low-operating cost and must-run power plants); "*k"* is the set of low-operating cost and must-run power plants delivering electricity to the grid; *NCVi* is the net calorific value (energy content) per volume unit of fuel *i* (TJ/10^3 gals); EF_i is fuel *i*´s carbon dioxide content (tCO_2/TJ), and $GEN_{j,y}$ ($GEN_{k,y}$) is the electricity (in MWh) delivered to the grid by source *j (k)*.

The λ_y factor is calculated as follows[32]:

(2) $$\lambda_y = \frac{\text{number of hours per year for which low-cost/must-run sources are on margin}}{\text{8760 hours per year}}$$

Since the *k* group of plants includes hydro, biomass, and geothermal stations, its fuel consumption equals zero and therefore the entire second term in expression (1) one is null. Thus we may write:

(1) $$EF_{OM,y} = (1-\lambda_y) \cdot \frac{\sum_{i,j} F_{i,j,y} \cdot NCV_i \cdot EF_i}{\sum_j GEN_{j,y}}$$

As indicated on Step 4 of the "Tool to calculate the emission factor for an electricity system", the BM emission factor is estimated using the sample group of the "*m*" most recent additions to the grid. This

[31] Energy Information Administration (EIA) – Official Energy Statistics from the US government.

[32] Load duration curves needed to obtain the Lambda factor are presented on Annex 3.

group "m" is obtained from table B.9, which presents the latest power units added to the grid. As per the methodology, CDM projects that were built in the last ten years are excluded from the sample[33].

Table B.9 – Most recent units to enter the SWM (set "*m*" of power units)

	Units	Technology	Starting Year	Net Generation (MWh)	Accumulated Generation (MWh)	% accumulated over total generation
1	Borealis	Thermal	2007	73,523	73,523	1.5%
2	Gecsa	Thermal	2007	4,323	77,846	1.6%
3	Acajutla Unit 4	Thermal	2007	9,714	87,560	1.8%
4	Talnique	Thermal	2006	351,011	438,571	8.9%
5	Soyapango	Thermal	2003	49,167	487,738	9.9%
6	CESSA	Thermal	2001	153,433	641,171	13.0%
7	Acajutla Gas	Thermal	2001	44,866	686,037	13.9%
8	Acajutla Motors	Thermal	2001	724,585	1,410,622	28.6%
			Total	**1,410,622**		

Source: SIGET

The group "*m*" consists of either the five most recently built power units, or the capacity additions to the electricity system that comprises 20% of the system generation and that have been built most recently[34]. The alternative which comprises the larger annual generation[35] was chosen.

To calculate the BM using the set "m", the following formula is used:

(3) $$EF_{BM,y} = \frac{\sum_{i,m} F_{i,m,y} \cdot NCV_i \cdot EF_i}{\sum_{m} GEN_{m,y}}$$

$F_{i,m,y}$, NCV_i, EF_i and $GEN_{m,y}$ are analogous to the variables described for the simple OM method above.

Once the OM and BM emission rates are obtained, the *combined margin* (CM) is calculated according to the following expression:

(4) $$EF_{CM,y} = \omega_{OM} EF_{OM} + \omega_{BM} EF_{BM} \quad , \qquad \text{where } \omega_{OM} + \omega_{BM} = 1$$

The default $\omega_{OM} = \omega_{BM} = 0.5$ is assumed for the weights[36].

[33] Central Azucarera Salvadoreña S.A (CASSA) and the new units at the Berlin Geothermal Power plant are excluded from the sample since these are all registered CDM projects.

[34] Total net generation in 2007 was 5,577,426 MWh.

[35] As stated in the Methodological tool "Tool to calculate the emission factor for an electricity system" Version 01 (pag.13).

Next, the project's emission reductions (ER_y) are estimated according to the following equation:

(5) $$ER_y = BE_y - PE_y - L_y$$

The baseline emission reductions (BE_y) equals the $EF_{CM,y}$ times the electricity delivered by the project to the grid (EG_y). According to the methodology, leakage (L_y) for this type of projects is zero, and the (PE_y) project emissions (reservoir) are calculated as:

(6) $$PE_y = \frac{EF_{res} \cdot EG_y}{1000},$$

where $EF_{res}=90\ KgCO_2e/MWh$ is the default emission factor for emissions from reservoirs, as per the ACM0002 methodology (version 07)[37].

When substituting back in expression (5) we get:

(5) $$ER_y = EF_{CM,y} \cdot EG_y - 0.09 \cdot EG_y - 0$$
$$= (EF_{CM,y} - 0.09)\ EG_y$$

This is the expression that is ultimately used to obtain the amount of emissions displaced by El Chaparral project.

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

Data / Parameter:	**NCV_i**
Data unit:	MMBtu/10^3 gal (Million British thermal units / thousand gals)
Description:	Net calorific value (energy content) per volume unit of fuel i
Source of data used:	Energy Information Administration (EIA) – "Annual Energy Outlook 2007" (available at http://www.eia.doe.gov/oiaf/aeo/index.html)
Value applied:	Fuel Oil: 149,690 Diesel: 138,071
Justification of the choice of data or description of measurement methods and procedures actually applied:	No local or regional data is publicly available. EIA values have been used since they do not require previous conversion from volume to mass units.
Any comment:	

[36] As established by the methodological tool "Tool to calculate the emission factor for an electricity system". Version 01.

[37] This default value is presented in page 8 of the methodology.

Data / Parameter:	***EF_i***
Data unit:	tCO_2/MMBtu
Description:	CO_2 emission factor
Source of data used:	IPCC Guidelines for National Greenhouse Gas Inventories (2006)
Value applied:	Fuel Oil: 0.0815796 Original value: 77.4 tCO_2/TJ (TJ = 948.7666034 MMBtu) Diesel: 0.0781014 Original value: 74.1 tCO_2/TJ
Justification of the choice of data or description of measurement methods and procedures actually applied :	No other data is publicly available. IPCC guidelines have been used in a conservative manner.
Any comment:	Conversion from TJ to MMBtu was made with the most conservative value in the usually accepted range (943.40 to 948.77 MMBtu/TJ).

Data / Parameter:	***$F_{i,j,y}$ ($F_{i,m,y}$)***
Data unit:	Thousand gals
Description:	Amount of each fossil fuel consumed by each power plant/unit
Source of data used:	MARN (Ministerio del Medio Ambiente y Recursos Naturales, in English: “Ministry of Environment and Natural Resources”), El Salvador.
Value applied:	Data for the 2005-2007 period is available in Annex 3
Justification of the choice of data or description of measurement methods and procedures actually applied :	Data is obtained from official sources
Any comment:	

Data / Parameter:	***$GEN_{j,y}$ ($GEN_{m,y}$)***
Data unit:	MWh
Description:	Annual electricity generation of each power plant in the grid
Source of data used:	SIGET
Value applied:	Data for the 2005-2007 period is available in Annex 3
Justification of the choice of data or description of measurement methods and procedures actually applied :	Data is obtained from official sources
Any comment:	A summary of this data is publicly available at www.siget.gob.sv

Data / Parameter:	***Plant name***
Data unit:	Text
Description:	Identification of power sources for the OM (all the plants in the grid)
Source of data used:	SIGET
Value applied:	Data for the 2005-2007 period is available in Annex 3
Justification of the choice of data or description of measurement methods and procedures actually applied :	Data is obtained from official sources
Any comment:	This data is publicly available at www.siget.gob.sv

Data / Parameter:	***Plant name***
Data unit:	Text
Description:	Identification of power sources for the BM (recent additions to the grid)
Source of data used:	SIGET
Value applied:	Data for the 2005-2007 period is available in Annex 3
Justification of the choice of data or description of measurement methods and procedures actually applied :	Data is obtained from official sources
Any comment:	A summary of this data is publicly available at www.siget.gob.sv

B.6.3 Ex-ante calculation of emission reductions:

Expressions (1) to (6) are used to estimate the number of emissions displaced by the proposed project's activity. Tables B.10 and B.11 are based on data available in Annex 3; they present a summary of the OM calculations. The result for this rate is $EF_{OM} = 0.7355(1\text{-}\lambda) = 0.7329\ tCO_2/MWh$.

Table B.10 – Fuel consumption and CO_2 emissions by fuel type (plants in set "*j*")

Fuel Type	**Volume (000 gals)**			**COEF[38]**	**tCO_2**		
	2005	**2006**	**2007**	**(tCO_2/000 gal)**	**2005**	**2006**	**2007**
Fuel Oil No. 6	134,858	141,656	154,453	12.211689	1,646,844	1,729,859	1,886,132
Diesel	2,362	7,850	2,513	10.783572	25,471	84,651	27,099
				Total	**1,672,315**	**1,814,510**	**1,913,231**

Source: MARN

Table B.11 – Net Generation (plants in set "*j*", including imports)

Fuel Type	**Generation (MWh)**		
	2005	**2006**	**2007**
Domestic	2,137,030	2,266,398	2,457,796
Imports	322,100	11,100	147,600
Total	**2,459,130**	**2,277,498**	**2,605,396**

Source: SIGET

Similarly, the BM is obtained using formula (3) in the previous section. The following tables summarise the results and estimations (both are based on information available on Annex 3):

[38] COEF = NCV multiplied by EF.

Table B.12 – Fuel consumption and CO_2 emissions by fuel type (units in set *"m"*) – Year 2007

Fuel Type	Volume (000 gals)	COEF (tCO_2/000 gal)	tCO_2
Fuel Oil No. 6	82,696	12.211689	1,009,858
Diesel	2,467	10.783572	26,603
		Total	**1,036,461**

Source: MARN

Table B.13 – Net Generation by plant (units in set *"m"*) – Year 2007

Units	Technology	Starting Year	Net Generation (MWh)
Borealis	Thermal	2007	73,523
Gecsa	Thermal	2007	4,323
Acajutla Unit 4	Thermal	2007	9,714
Talnique	Thermal	2006	351,011
Soyapango Unit 1	Thermal	2003	49,167
CESSA ICE 1	Thermal	2001	153,433
Acajutla Gas	Thermal	2001	44,866
Acajutla Motors	Thermal	2001	724,585
		Total	**1,410,622**

Source: SIGET

The ratio between the total in tables B.12 and the generation provided to the grid by the set "*m"* results in $EF_{BM} = 0.7348\ tCO_2/MWh$. Thus, the combined margin is estimated as the average between the OM and the BM rate, resulting in $EF_{CM} = 0.734\ tCO_2/MWh$.

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

A summary of the results from previous section is presented below:

Table B.14.1 – Summary of the results

Parameter	Value	Unit
EF_{BM}	0.7348	tCO2/MWh
EF_{OM}	0.7329	tCO2/MWh
ω_{BM}	0.5	-
ω_{OM}	0.5	-
EF_{CM}	0.734	tCO2/MWh
EG_y	233,200	MWh
BE_y	171,169	tCO2
PE_y	20,988	tCO2
ER_y	150,181	tCO2

Table B.14.2 – Summary of the results

Year	Estimation of project activity emissions (tonnes of CO2e)	Estimation of baseline emissions (tonnes of CO2e)	Estimation of leakage (tonnes of CO2e)	Estimation of overall emission reductions (tonnes of CO2e)
2011	20,988	171,169	0	150,181
2012	20,988	171,169	0	150,181
2013	20,988	171,169	0	150,181
2014	20,988	171,169	0	150,181
2015	20,988	171,169	0	150,181
2016	20,988	171,169	0	150,181
2017	20,988	171,169	0	150,181

El Chaparral Project will take place in a baseline scenario with an estimated emission factor of 0.734, which implies that the project may potentially displace up to 171,169 tCO_2e for an annual generation of 233,200 MWh. However, since the project must account for its own emissions coming from its reservoir (20,988 tCO_2e), *the net reduction in emissions is 150,181 tCO_2e per year.*

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

B.7.1 Data and parameters monitored:

Data / Parameter:	***EG_y***
Data unit:	MWh
Description:	Electricity supplied to the grid by the project
Source of data to be used:	On-site metering system (same data submitted to SIGET / UT)
Value of data applied for the purpose of calculating expected emission reductions in section B.5	233,200 MWh
Description of measurement methods and procedures to be applied:	Data will be measured on site on a regular basis (minimum 1 minute, maximum 1 hr). Meters keep records for 60 days or more; additional records will be kept.
QA/QC procedures to be applied:	Meter should have a maximum error of 0.2% and be calibrated periodically according to the UT standards for electricity transactions in the SWM.
Any comment:	

B.7.2 Description of the monitoring plan:

Due to the project participant’s choice of an *ex-ante* emission factor, the most important variable to monitor is the project’s electricity generation. It will be measured according to the Transaction Unit’s (UT) standards and requisites for participating in the wholesale market. Each metering system will be provided with two three phase, read-only meters of equal characteristics (including non-volatile memory modules in compliance with ANSI C12.16 norms), one of them acting as a backup unit. Both units will be connected at the interconnection point where they inject energy to the transmission system.

All the meters will be provided with built-in registers, and generation data will be ready to download both remotely and/or locally by the UT and the project developer. The information will be acquired on programmable intervals ranging from a minimum of one minute to a maximum of an hour. The register will be provided with capacity for at least 60 days.

The firm that is assigned with the EPC contract after the public bid process will comply with all this specifications, providing and preparing the equipment accordingly.

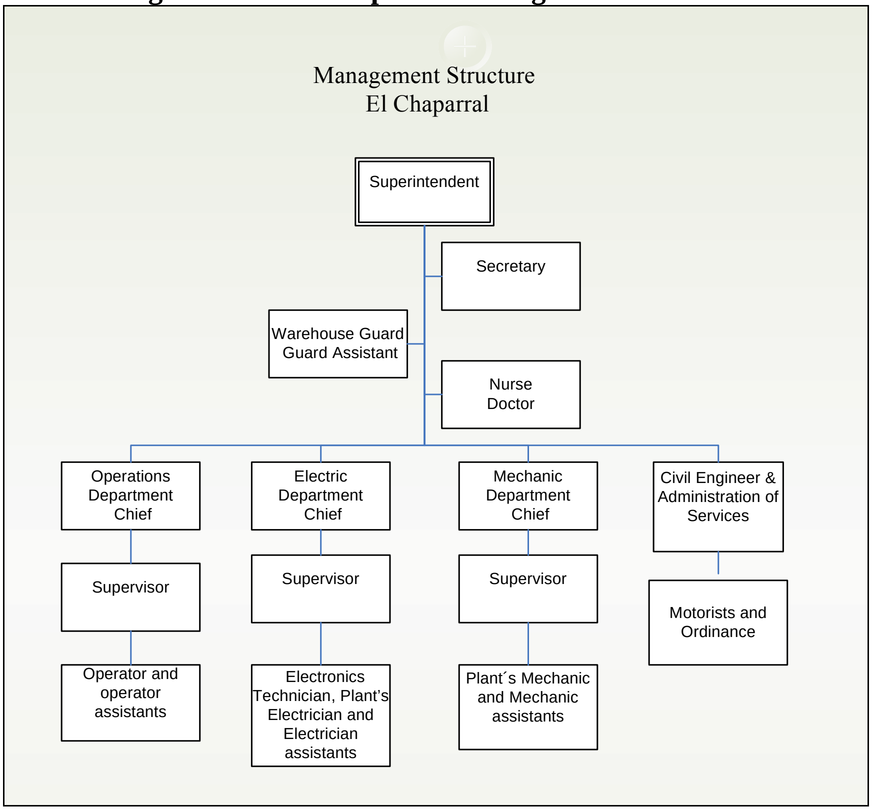
The project developer will implement a management structure where monitoring responsibilities shall be perfectly delimited. This structure will be as depicted on figure B.2. The Operation Department’s chief will be responsible for monitoring and keeping record of the project generation, as well as the implementation of proper QA procedures in all the relevant meters. All the information from this department will be consistent and easily verifiable with all the relevant data from other departments in case an external audit should require it. The information gathered by the Operations Department will be sent to CEL´s *Project Management and Control Unit*, specifically, to the *Project Financial Management Department* within the latter. This area will be in charge of the following activities:

- Calculation and record keeping of the emissions reduced by the project activity, according to the general guidelines described in the monitoring plan.

- Managing all the validation, registration and certification process of the project’s GHG emission reduction.

- Procuring financing resources by placing the CERs in the relevant carbon markets.

Figure B.2 – El Chaparral Management Structure



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)

This baseline and monitoring methodology application study was completed on 14/03/2008.

1. Geoingeniería Ingenieros Consultores S.A., San José - Costa Rica.
    - Phone: + (506) 2231 0167 / Fax: + (506) 2290 5297
    - E-mail: info@geoingenieria.co.cr

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:

Construction works at the project's site are expected to begin by August 2008; in which case the plant will be operational by December 2011.

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

The project has an expected lifetime of 50 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:

2011/12/01

C.2.1.2. Length of the first crediting period:

7 (seven) years.

C.2.2. Fixed crediting period:

C.2.2.1. Starting date:

Not applicable.

C.2.2.2. Length:

Not applicable.

SECTION D. Environmental impacts

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

As part of El Chaparral's feasibility study, and in line with the general guidelines proposed by the Salvadorean Designated National Authority (MARN – "Ministerio del Medio Ambiente y Recursos Naturales[39]"), an Environmental Impact Assessment (EIA) was undertaken.

The EIA –prepared by request of Electric Power Development Co. Ltd. (J-Power), the firm in charge of the feasibility study- was coordinated by the US based consultants from *Harza Engineering Company International L.P.* Field research in the areas of flora and fauna, water quality and aquatic life, socioeconomics, archeology, and historical and cultural legacy was undertaken by the Salvadorean firm *ECO Ingenieros S.A de C.V.*, specialists from Consejo Nacional para la Cultura y el Arte (*CONCULTURA)[40]* were in charge of the paleontology research. Geological, hydrological, seismic and

[39] Ministry of Environment and Natural Resources.

[40] National Council for Culture and Arts.

topographical research in the project area was undertaken by J-Power. The following is a detailed list of all the areas covered in the study:

a) Physical environment:
   - Soil
   - Water
   - Weather

b) Biological environment:
   - Vegetation
   - Fauna
   - Aquatic vegetation and fauna
   - Torola river's water quality

c) Socioeconomic environment:
   - Population
   - Health and education
   - Productive activities
   - Roads
   - Recreational areas
   - Services
   - Archeology
   - Paleontology

d) Landscape

Based on the above mentioned research and the different studies in all relevant areas, the team of professionals in charge of the EIA concluded that the project is environmentally and socially feasible, and that it will contribute to the sustainable development of the Republic of El Salvador, and particularly the communities of San Luis de la Reina, Carolina and San Antonio del Mosco.

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:

In order to mitigate and compensate for the potential negative impacts that may occur as a consequence of the project activity, an Environmental Management Plan (EMP) was established in the EIA. The EMP will allow to protect and improve the current conditions of the natural resources, as well as the quality of life of the local inhabitants in the project's area of direct influence. The project's financing entity (CABEI) will provide the guarantee to be presented by CEL to the MARN for accomplishment of the mitigation measures described in the EIA for as much as TEN MILLION SEVEN HUNDRED TEN THOUSAND AND SIXTY FOUR AMERICAN DOLLARS (US$ 10,710,064.00). CABEI's approval note for both this amount and the rest of the project financing are readily available upon request by the DOE.

A summary of the project activity's main environmental impacts in each area, as well as the corresponding mitigation measures, is presented below[41].

Soil: The flooding of the 8.6 km^2 reservoir area will constitute the major impact for the soil since it comprises a permanent change in its use. In addition, earth will have to be removed for the levelling and the construction of civil works (offices, camp site, dam, powerhouse, tunnel, substation and access roads). *Mitigation measures and positive impacts:* reforestation of the camp site as well as the reservoir's perimeter (119 ha.), and maintenance of drains, which will protect the surrounding soil from the effects of water erosion. For the opening and widening of streets, discharge heads will be constructed.

Air and climate: The construction of the civil works will temporarily generate dust and noise. The loss of the soil's vegetal cover will modify the environment and the microclimate. *Mitigation measures and positive impacts:* reforestation within the project site, as well as the plantation of 119 ha in the reservoir's surroundings will have a positive impact on the air's quality and the microclimate.

Population: The construction of the reservoir will require the relocation of 27 families, two praying houses and two schools. The thermal waters in the area will be affected by the construction of the reservoir as well. *Mitigation measures and positive impacts:* relocation and improvement of two displaced schools and two praying houses and design and execution of a relocation plan for 27 families that will be resettled, which comprises the construction of a housing complex with basic services, an additional school and social infrastructure. On the other hand, 54 families will receive financial compensation since they opted for their own relocation. The project also comprises the construction of 2 bridges that will enhance communications between the two margins of the river and public use of the street over the project's dam; improvements on 25 km of public roads and the creation of 15 km of new ones around the reservoir area.

Vegetation: The larger impact will come from the elimination of the vegetal cover located on the 8.6 km^2 area that will be flooded during the construction of the project. *Mitigation measures and positive impacts:* Reforestation in the plant's surroundings will have a positive impact by increasing the vegetal cover in an ordered manner. In the perimeter of the reservoir, 119 ha will be reforested and a plant nursery will be created as part of the project.

Superficial and underground waters: During the project execution there will be some risk of aquifers contamination due to oil spills. The removed earth as well as other materials from the project construction may also pollute superficial waters. *Mitigation measures and positive impacts:* Cesspools will be constructed together with a plant for sludge handling and treatment in order to avoid underground water pollution. On the other hand, the reservoir will allow the regulation of downstream river flows that may be potentially dangerous during the wet season. Likewise, the reservoir will regulate the river flow in the dry season, thus enhancing the environmental conditions for the aquatic life as well as allowing for other uses of the river.

The project will also implement a monitoring program as well as corrective actions in order to control sedimentation in the reservoir.

[41] The full version of the EIA (which includes a detailed version of the EMP) will be provided upon request (Spanish version only).

Terrestrial and aquatic fauna: Negative impacts in the area's fauna may arise from direct damage (during the construction works in the project's surroundings) as well as from hunting. The aquatic fauna may be damaged because of the transit interruption caused by the presence of the dam. *Mitigation measures and positive impacts:* The reservoir will allow the settlement and the development of wild fauna. In addition to this, a fish hatchery program will be undertaken in order to restore harmed species.

Regional and national economy: Extraordinary meteorological events may require discharges from the reservoir, that may put under risk the downstream human activity (crops, infrastructure, etc.). *Mitigation measures and positive impacts:* The overall effect on the economy will be notoriously beneficial. The project will demand 500 workers during the constructions phase and 40 during the operation phase. This in turn will raise the demand for goods and services, improving local and national economy. Equipment and other supplies will also be acquired during the construction phase, and the whole country will benefit from the raise in the energy supply.

Landscape: The infrastructure works will affect the natural landscape during the construction phase. *Mitigation measures and positive impacts:* The presence of a body of water in an arid environment will create pleasant scenic views. The planting of vegetal species in the project's surroundings will contribute to the integration of the infrastructure to the natural environment; therefore will mitigate the visual impact.

SECTION E. Stakeholders' comments

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

The stakeholder presentation took place on Friday February 22nd, 2008, at 2:00 p.m. in the Caribe Conference Room at the Radisson Hotel in San Salvador city, El Salvador.

The objectives of this presentation were: (a) to inform the local stakeholders of the project activity and its characteristics as a CDM project; (b) to gain insights on local concerns and opinions regarding the project activity; and (c) to identify the current social situation within the project activity's influence area.

Activities in preparation for the event are described below:
A preliminary research and selection for invitees was carried out by CEL. After the selection of the organizations and people, CEL delivered personalized invitation cards on site. The selected stakeholders were: the local government, universities, schools, and main representatives and residents from different cities and towns from the Project's surroundings.

Also, the stakeholder presentation was announced in the two most popular newspapers in El Salvador: "El Diario de Hoy" and "La Prensa Gráfica" on February 15th, 2008, one week before the event.[42]
A final invitation was made via email to all employees from CEL who were related with the project activity. The importance of an active participation in the event was highlighted.

More than 200 participants attended the stakeholder presentation representing a total of 40 organizations and institutions and 22 different communities, mostly located around the project site and some others

[42] Respective copies of the announcements can be presented upon request.

around the country. CEL hired a private bus that was offered to the people from the Project's site to transport them to where the stakeholder presentation was held.

Phases of the stakeholder presentation:
Registration process. At the entrance of the conference room the registration process was carried on and a brochure with specific information from El Chaparral Project was handed out as well as a paper form in which the assistants could write their questions and/or comments related to the project.

Video and presentation. At the beginning a video from El Chaparral project was played in order to introduce people to the project activity. The video was followed by Power Point presentation, explaining the project's features regarding its technology, construction, operation, mitigation measures and Clean Development Mechanism aspects.

Questions-and-answer panel. After the presentation, there was a multidisciplinary question-and-answer session panel with technical and consultant staff. The questions round was held using a mediator that read the questions to the panel members. A compilation of the questions and comments can be found in section E.2.

A video of the entire stakeholder presentation is available and can be submitted upon request.

E.2. Summary of the comments received:

The main topics exposed in the stakeholders' questions round are summarized below[43].

Most of the questions dealt with the topic of land acquisition for the construction of the project and consequently in some cases the resettling of some families from the area.

Joel Guevara Torres, from the surrounding community Santa Clara, in Carolina, asked if CEL was going to pay for the land acquisitions before starting the construction of the hydro plant. He also asked how much time before the reservoir is completed would the land be purchased.

On this same topic, Mauricio Sermeño from Unidad Ecológica Salvadoreña (UNES)[44] asked how CEL would restore the livelihoods of families to be resettled. Another concern from Mr. Sermeño was, if hydroelectric projects contributed to global warming.

Francisco Perdomo wanted to know the difference between the resettling process of El Cerrón Grande project[45] and El Chaparral project.
Continuing with this idea, Salvador Hernandez asked, what would happen if somebody doesn't want to sell his/her property and what would happen if this leads to a protest.

[43] Original comments can be watched directly from the video and it is available upon request.

[44] Salvadorean Ecological Unit.

[45] Cerrón Grande is a 172.8 MW Hydroelectric project developed by CEL in 1976.

Some comments were received by a priest from San Antonio del Mosco, who is against the construction of hydroelectric projects, stating that they contribute to global warming. He did not follow the procedure of the stakeholder presentation; neither wrote any comments in the paper form. He went away before the conclusion of the presentation, jointly with a group of people that came with him.

Regarding this situation, José Miguel Aguilar from Caserío Santa Rosa, in San Antonio del Mosco (the same community of the priest) said that he is aware that the people that came with the priest are not related to the project activity and hence are not direct influenced. He also stated that only a few people have lands around the project activity.

Fausto Martins from Plan de Nación wanted to know about the technology transfer of the project.

All comments and questions were heard and answered in a clear and complete way by panel members. This panel took into consideration every doubt and concern from the people interested and a summarized version of the answers given is presented in the following section.

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

As mentioned before, the main concerns relate to the resettling of some families from the project site.

Regarding the question about land acquisition mentioned in the previous section, CEL answered, that before any plant construction happens CEL will acquire all the lands needed, but they would never use a private land, only what is owned by CEL. Nowadays, 76% of the land has already been purchased by CEL, 10% of the lands are being negotiated. For the remaining portion CEL still has 4 years more to continue with the purchasing process.

As explained during the stakeholder presentation and according to the EIA of the proposed project activity, CEL has a relocation plan for the families that will be resettled. This plan includes not only a housing complex, but an entire adaptation plan for these families in this new environment. There will be a fund, which will be used to give each family for the first year of residence in the housing complex, a complete minimum salary for the first 6 months and a half minimum salary for the next 6 months. At the same time, training and development of projects will be performed in the community in order to develop new skills, such as fishing, agriculture and any other occupation. All these have the objective of increasing resettled families' productivity. CEL will give constant follow up to these activities as part of its Social Responsibility Program.

The resettling process from El Chaparral has been simple compared to the one carried out in Cerrón Grande, where 13,300 households had to be relocated. Because of this high number of families resettled, the process lacked from personalized negotiation and treatment and a standardized process was used. In contrast, El Chaparral will only have 27 resettled families, a very manageable number, which gives CEL the possibility to be flexible and adapt to almost every family's needs. CEL can offer each family different options and can negotiate different types of agreements depending on each family's situation.

On the comment regarding what would happen if somebody doesn't want to sell his/her property, from what has been monitored by CEL so far, most of the population is interested in selling their property. Even though the law empowers CEL to initiate an expropriation process, in case somebody doesn't want to sell his/her property, it is foreseen that this won't happen.

In accordance with the approved EIA of the project, CEL will implement all the mitigation and compensation measures in order to minimize the related social impacts. Finally, it's important to emphasize that the entire project complies with environmental laws and their respective requirements and most important that residents and the local government are all very supportive of the proposed project activity.

Annex 1

CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY

Organization:	COMISIÓN EJECUTIVA HIDROELÉCTRICA DEL RÍO LEMPA (CEL)
Street/P.O Box:	9a. Calle Pte. #950, Centro de Gobierno
Building:	N/A
City:	San Salvador
State/Region:	San Salvador
Postfix/ZIP:	N/A
Country:	El Salvador
Telephone:	503-22116000
FAX:	503-22116231
E-Mail:	N/A
URL:	www.cel.gob.sv
Represented by:	Irvin Pabel Tóchez Maravilla
Title:	Licenciado
Salutation:	Mister
Last Name:	Tóchez
Middle Name:	Pabel
First Name:	Irving
Department:	Executive Director
Mobile:	-
Direct FAX:	503-22116231
Direct telephone:	503-22116012
Personal E-Mail:	itochez@cel.gob.sv

Annex 2

INFORMATION REGARDING PUBLIC FUNDING

All the information on the project's funding is presented on section A.4.5.

Annex 3

BASELINE INFORMATION

El Salvador Energy statistics (units in set "m" in gray) – Thermal Power Plants - 2007

Owner	Unit	Technology	Starting Year	Capacity (MW)	Fuel Type	Fuel Consumption (000 gals)	Net Generation (MWh)
Duke Energy	Acajutla Unit 1	Steam Turbine	1967	30.0	FO	12,277	128,166
Duke Energy	Acajutla Unit 1	Steam Turbine			Dies.	46	
Duke Energy	Acajutla Unit 2	Steam Turbine	1970	33.0	FO		
Duke Energy	Acajutla Unit 2	Steam Turbine			Dies.		
Duke Energy	Acajutla Unit 3	Gas Turbine	1992	-	FO		
Duke Energy	Acajutla Unit 3	Gas Turbine			Dies.		
Duke Energy	Acajutla Unit 4	Gas Turbine	2007	27.0	FO	636	9,714
Duke Energy	Acajutla Unit 4	Gas Turbine			Dies.	718	
Duke Energy	Acajutla Unit 5	Gas Turbine	2001	82.1	FO	3,419	44,866
Duke Energy	Acajutla Unit 5	Gas Turbine			Dies.	1,671	
Duke Energy	Acajutla ICE 1	Internal Combustion	2001	99.0	FO	41,212	724,585
Duke Energy	Acajutla ICE 1	Internal Combustion			Dies.	75	
Duke Energy	Acajutla ICE 2	Internal Combustion	2001	51.0	FO		
Duke Energy	Acajutla ICE 2	Internal Combustion			Dies.		
Acajutla Power Plant					Fuel Oil No. 6	**57,544**	**907,331**
					Diesel	**2,511**	
Duke Energy	Soyapango Unit 1	Internal Combustion	2003	5.4	FO	3,739	49,167
Duke Energy	Soyapango Unit 1	Internal Combustion			Dies.	2	
Duke Energy	Soyapango Unit 2	Internal Combustion	2003	5.4	FO		
Duke Energy	Soyapango Unit 2	Internal Combustion			Dies.		
Duke Energy	Soyapango Unit 3	Internal Combustion	2003	5.4	FO		
Duke Energy	Soyapango Unit 3	Internal Combustion			Dies.		
Soyapango Power Plant					Fuel Oil No. 6	**3,739**	**49,167**
					Diesel	**2**	
Nejapa Power	Nejapa ICE 1	Internal Combustion	1995	91.0	Fuel Oil No. 6	45,288	696,800
Nejapa Power	Nejapa ICE 2	Internal Combustion	1998	53.5	Fuel Oil No. 6		
Nejapa Power Plant						**45,288**	**696,800**
CESSA	CESSA ICE 1	Internal Combustion	2001	19.2	Fuel Oil No. 6	9,608	153,433
CESSA	CESSA ICE 2	Internal Combustion	2001	13.4	Fuel Oil No. 6		
CESSA Power Plant						**9,608**	**153,433**
TEXTUFIL	TEXTUFIL ICE1	Internal Combustion	2000	44.1	Fuel Oil No. 6	14,192	222,209
Textufil Power plant						**14,192**	**222,209**
INE	Talnique	Internal Combustion	2006	51.2	Fuel Oil No. 6	19,363	351,011
INE Talnique						**19,363**	**351,011**
Borealis		Thermal	2007	13.6	Fuel Oil No. 6	4,420	73,523
Borealis						**4,420**	**73,523**
GECSA		Thermal	2007	11.6	Fuel Oil No. 6	299	4,323
GECSA						**299**	**4,323**
Total thermal fuel consumption / generation					**Fuel Oil No. 6**	**154,453**	**2,457,796**
					Diesel	**2,513**	

Source: **SIGET, MARN (detailed unit information provided by the respective plants)**

El Salvador Energy statistics – Low cost / must run plants - 2007

Owner	Unit	Technology	Starting Year	Capacity (MW)	Fuel Type	Fuel Consumption (000 gals)	Net Generation (MWh)
LaGeo	AHUACHAPAN	Geothermal water-dominated system	1975 - 1980	95.0	Geothermal		607,800
LaGeo	BERLIN	Geothermal water-dominated system	1992 - 1999	100.2	Geothermal		685,200
LaGeo Geothermal Power Plants (Total geothermal generation)							**1,293,000**
CEL	GUAJOYO	Storage	1963	19.8	Hydro		81,100
CEL	CERRON GRANDE	Storage	1976	172.8	Hydro		484,000
CEL	5 DE NOVIEMBRE	Run of River	1954	99.4	Hydro		527,400
CEL	15 DE SEPTIEMBRE	Run of River	1983	180.0	Hydro		642,530
CEL Hydroelectric Power Plants (Total hydro power generation)							**1,735,030**
CASSA	CASSA (CDM)	Cogenerator	2003	20.0	Bagasse		91,600
CASSA power plant							**91,600**
Total Biomass generation							**91,600**
Total Net Generation (Thermal + Geothermal + Hydro)					**TOTAL**	**MWh**	**5,577,426**
Imports							**147,600**

Source: **SIGET**

El Salvador Energy statistics (units in set “m” in gray) – Thermal Power Plants - 2006

Owner	Unit	Technology	Starting Year	Capacity (MW)	Fuel Type	Fuel Consumption (000 gals)	Net Generation (MWh)
Duke Energy	Acajutla Unit 1	Steam Turbine	1967	30.0	FO		
Duke Energy	Acajutla Unit 1	Steam Turbine			Dies.		
Duke Energy	Acajutla Unit 2	Steam Turbine	1970	33.0	FO		
Duke Energy	Acajutla Unit 2	Steam Turbine			Dies.		
Duke Energy	Acajutla Unit 3	Gas Turbine	1992	-	FO		
Duke Energy	Acajutla Unit 3	Gas Turbine			Dies.		
Duke Energy	Acajutla Unit 4	Gas Turbine	2007	27.0	FO		
Duke Energy	Acajutla Unit 4	Gas Turbine			Dies.		
Duke Energy	Acajutla Unit 5	Gas Turbine	2001	82.1	FO		
Duke Energy	Acajutla Unit 5	Gas Turbine			Dies.		
Duke Energy	Acajutla ICE 1	Internal Combustion	2001	99.0	FO		
Duke Energy	Acajutla ICE 1	Internal Combustion			Dies.		
Duke Energy	Acajutla ICE 2	Internal Combustion	2001	51.0	FO		
Duke Energy	Acajutla ICE 2	Internal Combustion			Dies.		
Acajutla Power Plant					Fuel Oil No. 6	**60,780**	**1,001,824**
					Diesel	**7,850**	
Duke Energy	Soyapango Unit 1	Internal Combustion	2003	5.4	FO		
Duke Energy	Soyapango Unit 1	Internal Combustion			Dies.		
Duke Energy	Soyapango Unit 2	Internal Combustion	2003	5.4	FO		
Duke Energy	Soyapango Unit 2	Internal Combustion			Dies.		
Duke Energy	Soyapango Unit 3	Internal Combustion	2003	5.4	FO		
Duke Energy	Soyapango Unit 3	Internal Combustion			Dies.		
Soyapango Power Plant					Fuel Oil No. 6	**3,572**	**48,890**
					Diesel		
Nejapa Power	Nejapa ICE 1	Internal Combustion	1995	91.0	Fuel Oil No. 6	52,161	807,805
Nejapa Power	Nejapa ICE 2	Internal Combustion	1998	53.5	Fuel Oil No. 6		
Nejapa Power Plant						**52,161**	**807,805**
CESSA	CESSA ICE 1	Internal Combustion	2001	19.2	Fuel Oil No. 6	10,791	177,430
CESSA	CESSA ICE 2	Internal Combustion	2001	13.4	Fuel Oil No. 6		
CESSA Power Plant						**10,791**	**177,430**
TEXTUFIL	TEXTUFIL ICE1	Internal Combustion	2000	44.1	Fuel Oil No. 6	13,495	216,173
Textufil Power plant						**13,495**	**216,173**
INE	Talnique	Internal Combustion	2006	51.2	Fuel Oil No. 6	857	14,277
INE Talnique						**857**	**14,277**
Borealis		Thermal	2007	13.6	Fuel Oil No. 6		
Borealis							
GECSA		Thermal	2007	11.6	Fuel Oil No. 6		
GECSA							
Total thermal fuel consumption / generation					**Fuel Oil No. 6**	**141,656**	**2,266,398**
					Diesel	**7,850**	

Source: **SIGET, MARN**

El Salvador Energy statistics – Low cost / must run plants - 2006

Owner	Unit	Technology	Starting Year	Capacity (MW)	Fuel Type	Fuel Consumption (000 gals)	Net Generation (MWh)
LaGeo	AHUACHAPAN	Geothermal water-dominated system	1975 - 1980	95.0	Geothermal		629,571
LaGeo	BERLIN	Geothermal water-dominated system	1992 - 1999	100.2	Geothermal		440,009
LaGeo Geothermal Power Plants (Total geothermal generation)							**1,069,580**
CEL	GUAJOYO	Storage	1963	19.8	Hydro		86,936
CEL	CERRON GRANDE	Storage	1976	172.8	Hydro		653,487
CEL	5 DE NOVIEMBRE	Run of River	1954	99.4	Hydro		547,857
CEL	15 DE SEPTIEMBRE	Run of River	1983	180.0	Hydro		668,331
CEL Hydroelectric Power Plants (Total hydro power generation)							**1,956,610**
CASSA	CASSA (CDM)	Cogenerator	2003	20.0	Baagasse		92,011
CASSA power plant							**92,011**
Total Biomass generation							**92,011**
Total Net Generation (Thermal + Geothermal + Hydro)					**TOTAL**	**MWh**	**5,384,599**
Imports							**11,100**

Source: **SIGET**

El Salvador Energy statistics (units in set "m" in gray) – Thermal Power Plants - 2005

Owner	Unit	Technology	Starting Year	Capacity (MW)	Fuel Type	Fuel Consumption (000 gals)	Net Generation (MWh)
Duke Energy	Acajutla Unit 1	Steam Turbine	1967	30.0	FO		
Duke Energy	Acajutla Unit 1	Steam Turbine			Dies.		
Duke Energy	Acajutla Unit 2	Steam Turbine	1970	33.0	FO		
Duke Energy	Acajutla Unit 2	Steam Turbine			Dies.		
Duke Energy	Acajutla Unit 3	Gas Turbine	1992	-	FO		
Duke Energy	Acajutla Unit 3	Gas Turbine			Dies.		
Duke Energy	Acajutla Unit 4	Gas Turbine	2007	27.0	FO		
Duke Energy	Acajutla Unit 4	Gas Turbine			Dies.		
Duke Energy	Acajutla Unit 5	Gas Turbine	2001	82.1	FO		
Duke Energy	Acajutla Unit 5	Gas Turbine			Dies.		
Duke Energy	Acajutla ICE 1	Internal Combustion	2001	99.0	FO		
Duke Energy	Acajutla ICE 1	Internal Combustion			Dies.		
Duke Energy	Acajutla ICE 2	Internal Combustion	2001	51.0	FO		
Duke Energy	Acajutla ICE 2	Internal Combustion			Dies.		
Acajutla Power Plant					Fuel Oil No. 6	**57,499**	**925,736**
					Diesel	**2,362**	
Duke Energy	Soyapango Unit 1	Internal Combustion	2003	5.4	FO		
Duke Energy	Soyapango Unit 1	Internal Combustion			Dies.		
Duke Energy	Soyapango Unit 2	Internal Combustion	2003	5.4	FO		
Duke Energy	Soyapango Unit 2	Internal Combustion			Dies.		
Duke Energy	Soyapango Unit 3	Internal Combustion	2003	5.4	FO		
Duke Energy	Soyapango Unit 3	Internal Combustion			Dies.		
Soyapango Power Plant					Fuel Oil No. 6	**1,878**	**25,408**
					Diesel		
Nejapa Power	Nejapa ICE 1	Internal Combustion	1995	91.0	Fuel Oil No. 6	49,696	763,136
Nejapa Power	Nejapa ICE 2	Internal Combustion	1998	53.5	Fuel Oil No. 6		
Nejapa Power Plant						**49,696**	**763,136**
CESSA	CESSA ICE 1	Internal Combustion	2001	19.2	Fuel Oil No. 6	11,133	179,292
CESSA	CESSA ICE 2	Internal Combustion	2001	13.4	Fuel Oil No. 6		
CESSA Power Plant						**11,133**	**179,292**
TEXTUFIL	TEXTUFIL ICE1	Internal Combustion	2000	44.1	Fuel Oil No. 6	14,653	243,458
Textufil Power plant						**14,653**	**243,458**
INE	Talnique	Internal Combustion	2006	51.2	Fuel Oil No. 6		
INE Talnique						**0**	**0**
Borealis		Thermal	2007	13.6	Fuel Oil No. 6		
Borealis							
GECSA		Thermal	2007	11.6	Fuel Oil No. 6		
GECSA							
Total thermal fuel consumption / generation					**Fuel Oil No. 6**	**134,858**	**2,137,030**
					Diesel	**2,362**	

Source: **SIGET, MARN**

El Salvador Energy statistics – Low cost / must run plants - 2005

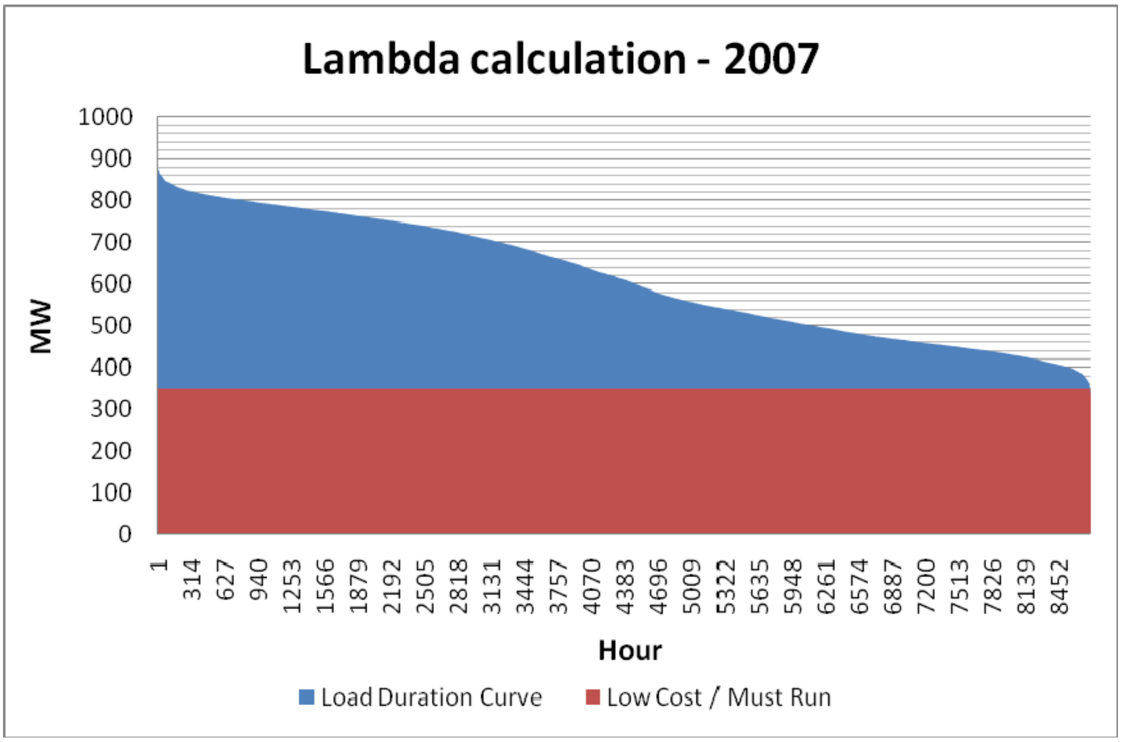
Owner	Unit	Technology	Starting Year	Capacity (MW)	Fuel Type	Fuel Consumption (000 gals)	Net Generation (MWh)
LaGeo	AHUACHAPAN	Geothermal water-dominated system	1975 - 1980	95.0	Geothermal		557,464
LaGeo	BERLIN	Geothermal water-dominated system	1992 - 1999	100.2	Geothermal		427,721
LaGeo Geothermal Power Plants (Total geothermal generation)							**985,184**
CEL	GUAJOYO	Storage	1963	19.8	Hydro		65,175
CEL	CERRON GRANDE	Storage	1976	172.8	Hydro		577,157
CEL	5 DE NOVIEMBRE	Run of River	1954	99.4	Hydro		540,921
CEL	15 DE SEPTIEMBRE	Run of River	1983	180.0	Hydro		481,173
CEL Hydroelectric Power Plants (Total hydro power generation)							**1,664,426**
CASSA	CASSA (CDM)	Cogenerator	2003	20.0	Baagasse		50,422
CASSA power plant							**50,422**
Total Biomass generation							**50,422**
Total Net Generation (Thermal + Geothermal + Hydro)					**TOTAL**	**MWh**	**4,837,062**
Imports							**322,100**

Source: **SIGET**

Lambda Calculations

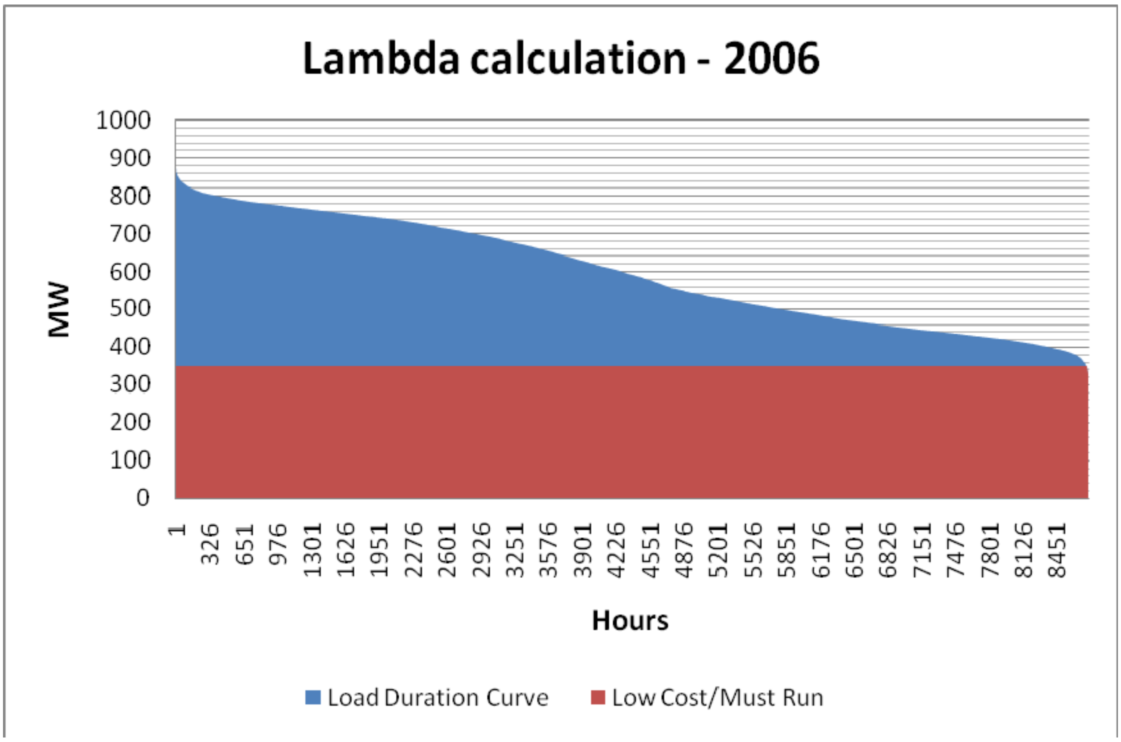
For more information about the estimation of the lambda coefficient, please refer to the latest version of the *"Tool to calculate the emission factor for an electricity system"*

Salvadorean Load Duration Curve – 2007



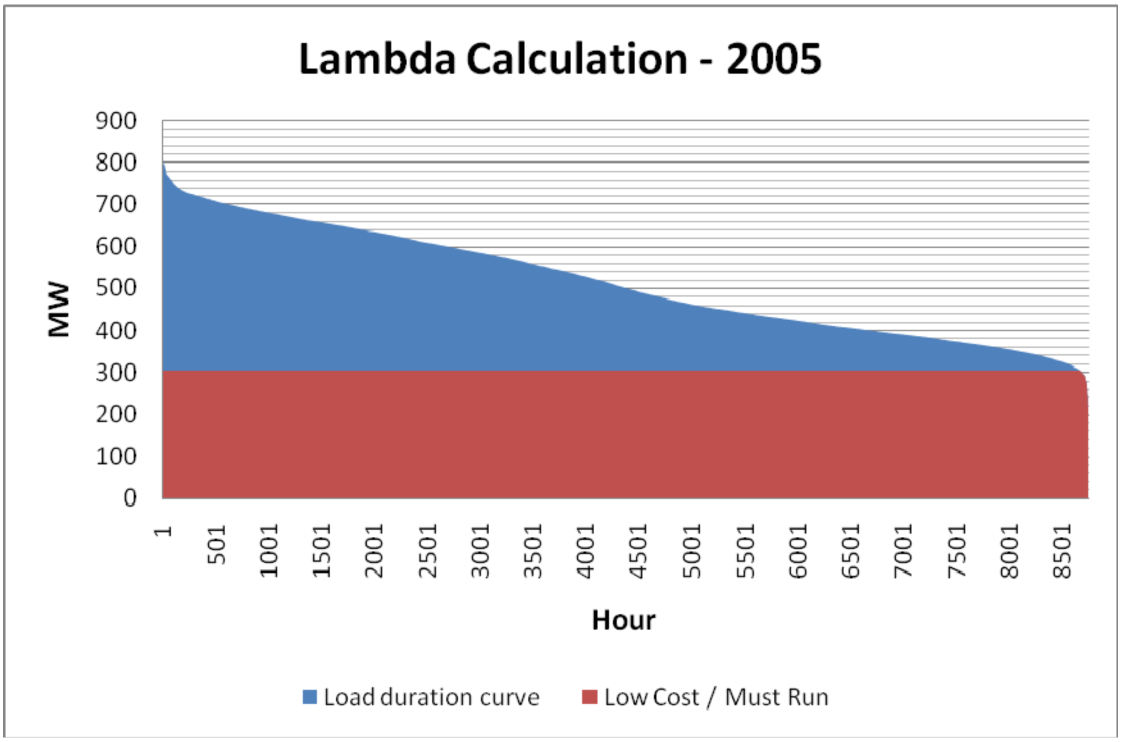
Source: Author's estimation based on information by the Transactions Unit (UT – available at www.ut.com.sv - Excel worksheet available to the DOE)

Salvadorean Load Duration Curve –2006



Source: Author's estimation based on information by the Transactions Unit (UT – available at www.ut.com.sv - Excel worksheet available to the DOE)

Salvadorean Load Duration Curve –2005



Source: Author's estimation based on information by the Transactions Unit (UT – available at www.ut.com.sv - Excel worksheet available to the DOE)

Summary of the lambda calculations

Variable	2005	2006	2007	Average
λ	0.008904	0.001712	0.000799	
1-λ	0.991096	0.998288	0.999201	
generation weight *(*)*	0.319108	0.355290	0.325602	
λ x weight	0.002841	0.000608	0.000260	0.003710
(1-λ) x weight	0.316267	0.354681	0.325342	**0.996290**

Source: Author's estimation based on information by the Transactions Unit (UT – available at www.ut.com.sv) and SIGET – *(*) Weights are defined, as per methodology, as the annual generation divided over the sum of the three year's generation.*

Annex 4

MONITORING PLAN

All the information on the project's monitoring programme is presented on section B.7.

Annex 5

ADDITIONALITY ANALYSIS CASH FLOWS

This Annex presents the cash flows used in order to perform the economic analysis presented on section B.5 of this PDD. The figures in the columns below correspond to the assumptions presented in tables B.3 and B.4 of the present document. The income is obtained as the net generation times the correspondent price (77.65US$/MWh for El Chaparral project and 70US$/MWh for the coal power plant - see page 16). The net cash flow for each period is then brought to present value using the relevant discount rate. In our analysis, three alternative rates were considered: 8%, 10% and 12% (the latter being the reference rate for CEL). Depreciation is estimated using the straight line method and taking into account the relevant assets lifetime; the first year of depreciation is the last year of investments. The results of these calculations may be readily seen on page 17 (table B.6) of the present document as well.

El Chaparral hydro project cash flow – Years 2008 to 2032 (thousand dollars)

Year	El Chaparral				
	Investment (I)	O&M (II)	Total costs (III = I + II)	Income (IV)	Cash Flow (III + IV)
2008	27,507		27,507		-27,507
2009	39,137		39,137		-39,137
2010	69,792		69,792		-69,792
2011	26,864	554	27,418	7,543	-19,875
2012		1,330	1,330	18,103	16,773
2013		1,330	1,330	18,103	16,773
2014		1,330	1,330	18,103	16,773
2015		1,330	1,330	18,103	16,773
2016		1,330	1,330	18,103	16,773
2017		1,330	1,330	18,103	16,773
2018		1,330	1,330	18,103	16,773
2019		1,330	1,330	18,103	16,773
2020		1,330	1,330	18,103	16,773
2021		1,330	1,330	18,103	16,773
2022		1,330	1,330	18,103	16,773
2023		1,330	1,330	18,103	16,773
2024		1,330	1,330	18,103	16,773
2025		1,330	1,330	18,103	16,773
2026		1,330	1,330	18,103	16,773
2027		1,330	1,330	18,103	16,773
2028		1,330	1,330	18,103	16,773
2029		1,330	1,330	18,103	16,773
2030		1,330	1,330	18,103	16,773
2031		1,330	1,330	18,103	16,773
2032		1,330	1,330	18,103	16,773

Source: Tables B.3 and B.4

El Chaparral hydro project cash flow – Years 2033 to 2060 (thousand dollars)

Year	El Chaparral				
	Investment (I)	O&M (II)	Total costs (III = I + II)	Income (IV)	Cash Flow (III + IV)
2033		1,330	1,330	18,103	16,773
2034		1,330	1,330	18,103	16,773
2035		1,330	1,330	18,103	16,773
2036		1,330	1,330	18,103	16,773
2037		1,330	1,330	18,103	16,773
2038		1,330	1,330	18,103	16,773
2039		1,330	1,330	18,103	16,773
2040		1,330	1,330	18,103	16,773
2041		1,330	1,330	18,103	16,773
2042		1,330	1,330	18,103	16,773
2043	6,575	1,330	7,905	18,103	10,198
2044	12,695	1,330	14,025	18,103	4,079
2045	22,658	1,330	23,988	18,103	-5,885
2046	12,908	1,330	14,239	18,103	3,865
2047		1,330	1,330	18,103	16,773
2048		1,330	1,330	18,103	16,773
2049		1,330	1,330	18,103	16,773
2050		1,330	1,330	18,103	16,773
2051		1,330	1,330	18,103	16,773
2052		1,330	1,330	18,103	16,773
2053		1,330	1,330	18,103	16,773
2054		1,330	1,330	18,103	16,773
2055		1,330	1,330	18,103	16,773
2056		1,330	1,330	18,103	16,773
2057		1,330	1,330	18,103	16,773
2058		1,330	1,330	18,103	16,773
2059		1,330	1,330	18,103	16,773
2060	-31,335	1,330	-30,005	18,103	48,108

Source: Tables B.3 and B.4

Coal power plant cash flow – Years 2008 to 2032 (thousand dollars)

Year	Coal Power Plant					
	Investment (I)	O&M (II)	Fuel Cost (III)	Total costs (IV = I+II+III)	Income (V)	Cash Flow (IV + V)
2008	0			0		0
2009	0			0		0
2010	27,323			27,323		-27,323
2011	18,216	733	2,434	21,383	6,808	-14,574
2012		1,759	5,841	7,601	16,340	8,740
2013		1,759	5,841	7,601	16,340	8,740
2014		1,759	5,841	7,601	16,340	8,740
2015		1,759	5,841	7,601	16,340	8,740
2016		1,759	5,841	7,601	16,340	8,740
2017		1,759	5,841	7,601	16,340	8,740
2018		1,759	5,841	7,601	16,340	8,740
2019		1,759	5,841	7,601	16,340	8,740
2020		1,759	5,841	7,601	16,340	8,740
2021		1,759	5,841	7,601	16,340	8,740
2022		1,759	5,841	7,601	16,340	8,740
2023		1,759	5,841	7,601	16,340	8,740
2024		1,759	5,841	7,601	16,340	8,740
2025		1,759	5,841	7,601	16,340	8,740
2026		1,759	5,841	7,601	16,340	8,740
2027		1,759	5,841	7,601	16,340	8,740
2028		1,759	5,841	7,601	16,340	8,740
2029		1,759	5,841	7,601	16,340	8,740
2030	27,323	1,759	5,841	34,924	16,340	-18,584
2031	18,216	1,759	5,841	25,816	16,340	-9,476
2032		1,759	5,841	7,601	16,340	8,740

Source: Tables B.3 and B.4

Coal power plant cash flow – Years 2033 to 2060 (thousand dollars)

Year	Coal Power Plant					
	Investment (I)	O&M (II)	Fuel Cost (III)	Total costs (IV = I+II+III)	Income (V)	Cash Flow (IV + V)
2033		1,759	5,841	7,601	16,340	8,740
2034		1,759	5,841	7,601	16,340	8,740
2035		1,759	5,841	7,601	16,340	8,740
2036		1,759	5,841	7,601	16,340	8,740
2037		1,759	5,841	7,601	16,340	8,740
2038		1,759	5,841	7,601	16,340	8,740
2039		1,759	5,841	7,601	16,340	8,740
2040		1,759	5,841	7,601	16,340	8,740
2041		1,759	5,841	7,601	16,340	8,740
2042		1,759	5,841	7,601	16,340	8,740
2043		1,759	5,841	7,601	16,340	8,740
2044		1,759	5,841	7,601	16,340	8,740
2045		1,759	5,841	7,601	16,340	8,740
2046		1,759	5,841	7,601	16,340	8,740
2047		1,759	5,841	7,601	16,340	8,740
2048		1,759	5,841	7,601	16,340	8,740
2049		1,759	5,841	7,601	16,340	8,740
2050	27,323	1,759	5,841	34,924	16,340	-18,584
2051	18,216	1,759	5,841	25,816	16,340	-9,476
2052		1,759	5,841	7,601	16,340	8,740
2053		1,759	5,841	7,601	16,340	8,740
2054		1,759	5,841	7,601	16,340	8,740
2055		1,759	5,841	7,601	16,340	8,740
2056		1,759	5,841	7,601	16,340	8,740
2057		1,759	5,841	7,601	16,340	8,740
2058		1,759	5,841	7,601	16,340	8,740
2059		1,759	5,841	7,601	16,340	8,740
2060	-22,770	1,759	5,841	-15,169	16,340	31,509

Source: Tables B.3 and B.4

- - - - -