Cover Page for CTF Project/Program Approval Request

1. **Country/Region**	Nicaragua		2. **CIF Project ID#**	PCTFNI618A	
3. **Investment Plan (IP) or Dedicated Private Sector Program (DPSP)**	IP		4. **Public or Private**	Public	✓
	DPSP	✓		Private	
5. **Project/Program Title**	Nicaragua Geothermal Exploration and Transmission Improvement Program under the PINIC				
6. **Is this a private sector program composed of sub-projects?**	Yes				
	No	✓			

7. **Financial Products, Terms and Amounts**

Financial Product		**USD** (million)	**EUR** (million)
Grant			
Fee on grant		0.476	
MPIS (for private sector only)			
Public sector loan	Harder terms		
	Softer terms		
Senior loan			
Senior loans in local currency hedged			
Subordinated debt / mezzanine instruments with income participation			
Second loss guarantees			
Equity			
Subordinated debt/mezzanine instruments with convertible features			
Convertible grants and contingent recovery grants		9.524	
Contingent recovery loans			
First loss guarantees			
Other (please specify)			
Total		10.000	

8. **Implementing MDB(s)**	Inter-American Development Bank (IDB)
9. **National Implementing Agency**	Ministry of Energy and Mining (MEM), with the support from the Nicaraguan Electricity Company (Empresa Nicaragüense de Electricidad, ENEL), and the National Electricity Transmission Company (Empresa Nacional de Transmisión Eléctrica, ENATREL)
10. **MDB Focal Point**	Claudio Alatorre (calatorre@iadb.org)

11. **Brief Description of Project/Program (including objectives and expected outcomes)**

In 2015 electricity demand reached 665.4 MW, and it is projected to reach 896 to 1,038 MW by 2026. Around 80% of all electricity is produced by the private sector in Nicaragua and geothermal power for electricity production is solely developed by the private sector through exploration and exploitation concessions granted by the government. Despite having a good legal framework for geothermal energy, there is uncertainty regarding the availability, long-term durability, and cost of extracting it for power generation, that limit private investment, especially in the initial stage of exploration. Financing mechanisms need be developed to mitigate this risk and to stimulate competition in the development of the resource, in order to bring in private investors.

The IDB has developed this Program with two components. The first one seeks to diversify Nicaragua's energy matrix by developing additional geothermal capacity through supporting early exploration activities; and the second component seeks to increase access to electricity and improve service reliability by increasing the national and regional transmission capacity through network reinforcements.

CTF and SREP resources are being requested in parallel to support the first Component (a separate submission is being sent to the SREP Trust-Fund Subcommittee).

The Geothermal Development component consists of feasibility exploration activities at the Cosigüina geothermal field, including drilling of 5 commercial diameter explorations wells, road infrastructure and a feasibility evaluation report, all to be carried out by the Ministry of Energy and Mining (MEM). In case the field, with an expected capacity of 40MW, is considered feasible for further development, this component will also support the MEM in designing and implementing an international bidding process to award an exploitation concession to a private investor for the commercial development at the Cosigüina geothermal field. In addition, the design of an early exploration risk mitigation mechanism will be financed to attract private investment for the implementation of future geothermal projects. The revenues from the bidding process will provide the funding for this mitigation mechanism.

The Nicaraguan Government will repeatedly reinvest the resources from the mitigation mechanism in subsequent projects during a period of 30 years.

For procedural reasons, the IDB is requesting a "fee" of USD 476,000. This amount will be used mainly to support the implementation of the Program through specialized consultants and other technical assistance activities.

12. **Consistency with CTF investment criteria**

(1) Potential GHG emissions savings	For CTF the potential GHG emissions savings are as follows: 110,655 tons CO_2e/year and 3,319,650 tons CO_2e during the lifetime of the Project (30 years).[a]
(2) Cost-effectiveness	The cost effectiveness of the project is: a) Considering only CTF resources and emission savings[a]: 0.33 tons CO_2e/USD, or 3.01 USD/ton CO_2e b) Considering all resources (CIF, IDB and Government resources) and all emission savings[a]: 0.13 tons CO_2e/USD, or 7.8 USD/ton CO_2e

(3) Demonstration potential at scale	In Nicaragua there are 12 geothermal fields with an estimated potential of 1,500MW, but only two, San Jacinto-Tizate and Momotombo with a total capacity of 154.5 MW, have been developed so far by the private sector. Development of additional fields is mainly hindered by uncertainty related to the availability, long-term durability and cost of geothermal resource exploration for power generation. The proposed bidding process to award a concession for the Cosigüina field will attract international developers to Nicaragua. The design and implementation of a risk mitigation mechanism will support future project development activities and therefore support scaling up geothermal power in Nicaragua.
(4) Development impact	Apart from Geothermal power being a low carbon renewable energy source with positive impacts on the electricity grid, it also offers positive development impacts such as high quality labor during exploration, construction and operation of the plant (estimated at 45 during exploration, 160 during construction and 68 during operation)[a]. In addition, fossil fuel imports and related spending can be reduced. Finally, the fact that the early exploration activities, as well as the design and implementation of the bidding process and the risk mitigation instrument, will be developed by the public sector creates important capacities in the relevant public sector institutions, which can be applied with other infrastructure projects. It also creates important links of collaboration between the public and private stakeholders which can be beneficial for the sector as a whole.
(5) Implementation potential	The implementation potential for the project is good due to several reasons: (i) Geothermal energy has a long operating history in Nicaragua, with the first plant—Momotombo—starting operation in 1983 and the second one—San Jacinto—in 2005; (ii) a solid legal framework for geothermal energy has been in place since 2002 and has already been updated twice; and (iii) the IDB has a track record with Nicaragua's energy sector that dates back to 1973. The IDB has supported a number of investments in electricity infrastructure, as well as reform processes that have promoted the institutional strengthening of the country's energy sector.

(6) Additional costs and risk premium	Geothermal resource risks are perceived as significant by lenders during the exploratory drilling stage, significantly limiting debt financing to private sector to corporate lending backed by a strong balance sheet, or concessional financing by public sector institutions. When project debt financing is not available, and private sponsors need to finance this stage with equity, the cost of capital is often times prohibitive. In the face of these constraints for the access to finance for private developers, the Nicaraguan government has opted for a model where it carries out the exploration activities and then offers a concession to a private developer. Limited public resources are however needed for other competing uses. Contingent recovery CTF and SREP resources will therefore provide the missing financing.
Additional CTF investment criteria for private sector projects/ programs (The following items are filled out for this public sector operation because it is using DPSP resources)	
(7) Financial sustainability	The project seeks to recover CTF and SREP resources through revenues from the award of the exploitation concession for the Cosigüina field, and to make these resources available for a new risk mitigation scheme supporting additional projects.
(8) Effective utilization of concessional finance	Consistent with its principles and objectives, CTF funding will take risks that commercial lenders or investors are not able to bear, crowding in the private sector by catalyzing investment that would not happen otherwise.
(9) Mitigation of market distortions	The IDB will target a segment and certain types of financing modalities that currently are not being served by the private sector.
(10) Risks	See Section II of the main document (pages 13 to 18).
13. **For DPSP projects/programs in non-CTF countries, explain consistency with FIP, PPCR, or SREP Investment Criteria and/or national energy policy and strategy**	
This Project is seeking resources from both SREP and CTF (DPSP). It is part of the Nicaragua SREP Investment Plan (PINIC) and is fully consistent with SREP investment criteria.	

14. **Stakeholder Engagement**

1. On March 17, 2016, the workshop "Development of Geothermal Energy in Nicaragua" was organized by MEM and IDB, with the participation of public and private sector organizations active in Nicaragua's geothermal sector, as well as international organizations. The objective of the workshop was to receive feedback on the proposed SREP/CTF program regarding funding amounts, timing, management and sustainability models, mitigation of impacts and the possibility of scale up.
2. On April 27 and 28, 2016, information about the scope of the Project was provided to cooperatives, representatives of the municipality in the area of influence of the project, and to the Ministry of Environment and Natural Resources (MARENA).
3. On June 2, 2016, a public consultation about the Project was carried out with the participation of residents of the municipality in the area of influence of the project, representatives of the municipalities' environmental management unit, the Cosigüina natural reserve management committee and MARENA.

15. **Gender Considerations**

The project will include a gender perspective by integrating activities that promote job creation and training among women. Also, incentives for access of women to technical careers or technical studies with career opportunities in the field of geothermal energy and / or creation of partnerships with technical schools and universities to promote internship programs for female students will be created. The institutions responsible for coordinating the geothermal project will be strengthened in order to include a gender perspective in the project.

16. **Indicators and Targets**

Project/Program Timeline		
Expected start date of implementation		October 2016
Expected end date of implementation		October 2021
Expected investment lifetime in years (for estimating lifetime targets)		30
Core Indicators		**Targets**
GHG emissions reduced or avoided over lifetime (tons of CO_2-eq)		3,319,650 [a]
Potential annual GHG emissions reduced or avoided (tons of CO_2-eq/year) (specify: upon completion of the project/program / on the maximum year / on a representative year)	Once project is in operation	110,655[a]
Feasible capacity of renewable energy (MW)		22[a]
Number of additional passengers using low-carbon transport per day		N/A
Energy savings cumulative over lifetime of investment (MWh)		N/A
Annual energy savings (MWh/year) (specify: upon completion of the project/program / on the maximum year / on a representative year)		N/A
Identify relevant development impact indicator(s)		**Targets**
Jobs created		153[a]
Reduction in oil imports (USD million per year)		13.2[a]

17. **Co-financing**		
	Please specify as appropriate	Amount (in million USD)
MDB 1	IDB	12.68[a]
MDB 2 (if any)		
Government		3.573[a]
Private Sector		
Bilateral		
Others (please specify)		(SREP co-financing excluded to avoid double-counting)
Total		16.253
18. **Expected Date of MDB Approval**		
September 2016		

NOTES:

[a] Note on the attribution of results between CTF and SREP:

Since the Program is requesting both CTF and SREP resources, in order to avoid double-counting in CIF-level reporting, the expected and actual results of the program will be divided between both funds commensurately to the amount of funding (USD 9.524 million from CTF excluding MDB fees, and USD 7.5 million from SREP). The expected results are therefore as follows:

Indicator	Total	Attributable to CTF	Attributable to SREP
Capacity (MW)	40	22	18
Emission reductions over lifetime of 30 years (tons CO_2e)	5,933,820	3,319,650	2,614,170
Annual emission reductions (tons CO_2e / year)	197,794	110,655	87,139
Jobs created	273	153	120
Reduction in oil imports	23.6	13.2	10.4
IDB co-financing (USD million)	22.67	12.68	9.99
Government co-financing (USD million)	6.387	3.573	2.814

DOCUMENT OF THE INTER-AMERICAN DEVELOPMENT BANK

NICARAGUA

NICARAGUA GEOTHERMAL EXPLORATION AND TRANSMISSION IMPROVEMENT PROGRAM UNDER THE PINIC

(NI-L1094)

PROPOSAL FOR OPERATION DEVELOPMENT

This document was prepared by the project team consisting of: Hector Baldivieso (ENE/CNI) Project Team Leader; Alberto Levy-Ferre, Deputy Chief; Christiaan Gischler; Carlos Trujillo; Shohei Tada; Rodrigo Aragon; Wilkferg Vanegas; Stephanie Suber (INE / ENE); Claudio Alatorre (CSD / CCS); Paloma Marcos (SCL / GDI); Maria Cristina Landázuri (LEG / SGO); Zachary Hurwitz and Rachel Atkinson (VPS / ESG); Juan Carlos Lazo; Santiago Castillo (FMP / CNI); Alma Reyna Selva (CID / CNI); Samar Rimawi (ENE/CNI).

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ABBREVIATIONS	
CBA	Cost Benefit Analysis
CIF	Climate Investment Funds
CTF	Clean Technology Fund
EA	Executing Agency
EE	Energy Efficiency
EIA	Environmental Impact Assessment
EIRR	Economic Internal Rate of Return
ENATREL	Electricity Transmission National Company
ENEL	Nicaraguan Electricity Company
ENPV	Economic Net Present Value
ESAP	Environmental and Social Action Plan
ESMR	Environmental and Social Management Report
FIRR	Financial Internal Rate of Return
FNPV	Financial Net Present Value
FSO	Fund for Special Operations
GWh	Gigawatt-hour
IDB	Inter-American Development Bank
INE	Nicaraguan Energy Institute
km	Kilometers
kWh	Kilowatt-hour
MEM	Ministry of Energy and Mines
MHCP	Ministry of Finance and Public Credit
MW	Megawatt
MWh	Megawatt-hour
OC	Ordinary Capital
PEU	Program Execution Unit
PINIC	Nicaragua SREP Investment Plan
PNESER	National Sustainable Electrification and Renewable Energy
POM	Program Operating Manual
RE	Renewable Energy
REM	Regional Electricity Market
SIEPAC	Electric Interconnection System for Central American Countries
SIN	National Interconnected System
SREP	Scaling up Renewable Energy Program
SS	Substation
T/L	Transmission line

PROJECT SUMMARY
NICARAGUA
NICARAGUA GEOTHERMAL EXPLORATION AND TRANSMISSION IMPROVEMENT PROGRAM UNDER THE PINIC (c)
(NI-L1094)

Financial Terms and Conditions

Borrower / Recipient: Republic of Nicaragua

Executing Agency: Ministry of Energy and Mines (MEM), with support from the Nicaraguan Electricity Company (ENEL); and National Electricity Transmission Company (ENATREL)

Source	Amount (US$)	Loan %	Grant %
IDB (BL OC):	17,220,000	60.0	16.7
IDB (BL FSO):	11,480,000	40.0	11.1
IDB (Grant Leverage Mechanism OC) (d) -	22,670,000	51.0	21.9
KFI – (Korean Facility for Infrastructure) (f)	25,000,000		24.2
SREP (Contingent recovery grant):	6,750,000		6.5
SREP (non-reimbursable grant):	750,000	49.0	0.7
CTF (Contingent recovery grant):	9,524,000		9.2
Local contribution	10,009,000		9.7
TOTAL	103,403,000		100.0

	IDB (BL OC) and (IDB-GLM)	FSO	KIF
Amortization period:	30 years	40 years	30 years
Disbursement period:	5 years	5 years	5 years
Grace period:	6 years	40 years	10 years
Inspection and supervision Committee:	(a)	N/A	N/A
Charges on loan facility	N/A	N/A	0.1%
Interest rate:	Fixed Single Currency Facility (b)	0.25%	1.0%
Credit fee:	(a)	N/A	N/A
Currency approved:	US Dollar	US Dollar	US Dollar

Project Outline

Project objective / description: The overall objective of the project is to contribute to the sustainability of the electricity sector in Nicaragua through: (i) develop geothermal exploration potential to diversify the energy matrix; and (ii) increase the capacity of national and regional transmission through the network reinforcements. The specific objectives of the program include: (i) develop a geothermal field explored on a feasibility level mitigating risk and enhancing strong investment opportunities for its implementation; (Ii) design and implement a risk mitigation mechanism for geothermal projects; (Iii) ensure the continuous supply of electricity in the target areas for the expansion of electricity infrastructure under the program; (Iv) increase the transmission capacity to meet the load demand for electricity generation and supply of energy in the area of influence of the program; and (v) optimize the capacity of regional Transmission Line (T / L) in the sections located in Nicaragua (paragraph 1.17)

Special Contractual Conditions (a) precedent to the first disbursement: (i) that has been approved and is in effect (e) the Program Operating Manual in the terms previously agreed with the Bank (paragraph 3.3); (ii) it has been signed an implementation agreement between the Ministry of Finance and Public Credit (MHCP) and the MEM, and an agreement for transfer of resources between MHCP and ENATREL in the terms of paragraph; (Paragraph 3.1); and (iii) have been recruited to the program its coordinator and staff PEU identified in paragraph (paragraph 3.2); (iv) an Environmental and Social Action Plan is presented and all management plans identified in the ESMR.

(b) execution: (i) the MEM and ENATREL shall comply with environmental and social obligations as detailed in the Environmental and Social Management Report (ESMR) ii) MEM shall keep the financial indicators specified in the Financial Assessment of ENATREL: State and Projected Financial Indicators; and (iii) that prior to the awarding of each construction contract, the EA show that it has legal possession, easements or other rights necessary to start the work (paragraph 2.11).

Exceptions to Bank policies: None

Strategic Planning

Challenges [(g)]:	**SI**	☐	**PI**	☑	**EI**	☑
Cross-cutting issues [(h)]:	**GD**	☐	**CC**	☑	**IC**	☐

(a) The credit committee and the inspection and supervision committee will be established periodically by the Board as part of its review of the Bank's financial positions, in accordance with relevant policies.

(b) The Borrower shall pay interest on the outstanding portion of the loan under the OC at a rate based on LIBOR balance. When the outstanding balance reaches 25% of the approved amount or US $ 3 million, whichever is greater, the base rate will be set based on that balance. In any case the portion of the OC will have more than four base interest rates.

(c) Investment Plan for Nicaragua (PINIC) under the Program for the Promotion of Renewable Energy in Low Income Countries (Scaling up Renewable Energy Program - SPREP) from the Strategic Climate Fund (Climate Investment Fund - CIF). Nicaragua, April 15, 2015.

(d) Nicaragua has requested the use for PINIC of the IDB's Grant Leverage Mechanism (GLM) (AB-2946). The SREP resources and the Clean Technology Fund (CTF) are administered by the Bank in accordance with the financial procedures agreements signed between the Bank and the World Bank as manager of both funds. These resources correspond to the counterpart of the resources from the Ordinary Capital of the Bank within its regular program funding, representing 49% of this combination and will be disbursed simultaneously (pari passu) in accordance with the provisions of the AB -2946.
(e) Funds managed by the Bank under the Korean Infrastructure Facility. The charge of 0.1% of KIF is an initial fee on the approved loan amount payable only once.
(f) SI (Social Inclusion and Equality); PI (Productivity and Innovation); and EI (Economic Integration).
(g) GD (Gender Equality and Diversity); CC (Climate Change and Environmental Sustainability); and IC (Institutional Capacity and Rule of Law).

I. PROJECT DESCRIPTION AND RESULTS MONITORING

A. Background, Problem Addressed, and Justification

1.1 **Energy sector.** Nicaragua consumes daily 56,000 barrels of oil equivalent of primary energy. A high percentage comes from renewable energy (RE): geothermal (22%), hydro and solar (3%), biofuels (52%); and 23% oil. In power generation, in 2015 the RE in the National Interconnected System (SIN) came to 50.6%; while 49.4% was thermal. Electricity coverage increased from 73.7% in 2012 to 80.4% in 2014 and it is expected to reach 90% by 2020**.**

1.2 The transmission system in 2015 consisted of 2,287 km of national lines and 305.6 km of Electric Interconnection System for Central American Countries (SIEPAC). The last section of the SIEPAC of 1,790 km began operations in October 2014, designed to make up to 300MW exchanges between countries and increase the efficiency and reliability of the electrical system.

1.3 In 2015, electricity demand reached 665.4 MW, representing a growth of 4.6%; in 2014 the growth was 2.6% and 1.7% in 2013. Demand is projected to reach between 896 MW and 1,038 MW by 2026.[1]

1.4 The electricity sector has institutions and companies with fully identified functions: Ministry of Energy and Mines (MEM) designs policies, the Nicaraguan Energy Institute (INE) has the regulatory responsibility; the Nicaraguan Electricity Company (ENEL) the generation subsector and the National Electricity Transmission Company (ENATREL) the transmission subsector. The subsectors for generation and distribution have significant participation of private companies.

1.5 **Energy Sustainability**[2]. According to the World Energy Council, sustainable energy seeks balance within three dimensions: energy security, social equity and environmental impact mitigation. In other words, the development of stable, affordable and environmentally friendly energy. In that sense, Nicaragua faces a major challenge, mainly due to the steady increase in energy demand in the country - resulting from economic growth[3] and expansion of electricity coverage (paragraph 1.1) - which causes severe pressure on the generation as a source of supply and energy security, and on the transmission as the central axe of the electric system that guarantees its universal access.

1.6 According to the above, the country is still highly dependent on firewood and fossil fuels. The import of petroleum and petroleum products rose to US $ 1,186 MM in 2013 and represented more than 10% of GDP. The growth rate of final energy consumption was about 3.5% and the primary energy supply rose to

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1 NPUD – IDB. *Sustainable Energy for All. Rapid Assessment Gap Analysis Nicaragua*. 2013.

2 The information contained in items paragraph 1.5, paragraph 1.6 and paragraph 1.7 of the report was extracted from SREP (Scaling-Up Renewable Energy Program) Investment Plan for Nicaragua. Investment developed by the Climate Fund, 2015.

3 Economic activity grew 4.9% in 2015. The largest contribution to growth came from services and trade with 2.7%, followed by construction activity with 1.3%, and agriculture, livestock and forestry activities with 0.6%. Source: Central Bank of Nicaragua. "Annual Report", 2015.

2,028 ktep in 2012. Oil imports accounted for an estimated 25.9% of total primary energy supply, while still almost half (49.5%) is covered by wood and other biomass. The residential sector is the largest energy consumer in the country, accounting for 46.3% of total energy consumption in 2012. Within this sector, fuelwood accounts for 87.1% of energy consumption, followed by electricity 8.5%, liquefied petroleum gas with 3.8% and 0.4% charcoal. The industrial sector, with 12.8%, most use fossil fuels (46%) and wood (19%).

1.7 Despite being a country with a low rate of per capita emissions of greenhouse gases (GHGs) in the world (0.8 tons of CO_2 per year), the Global Climate Risk Index ranked Nicaragua in fourth place among the countries most at risk to adverse extreme weather events and it is estimated that electricity generation and heat production contributes about 35% of emissions CO_{2EQ}[4]. Also, one in five people in Nicaragua have no power to light their homes or to provide energy at work and almost 60% of the rural population and 20% of the urban population still use firewood, charcoal or animal origin to cook. Also insufficient electricity coverage in the country, technical and non-technical losses and dependence on fossil fuels, which have been the primary means to meet the demand for energy stability and energy generation base over the past decade - have kept consumer prices among the highest in the region[5].

1.8 **Causal factors or main determinants of the problem**. There has been identified as determinants factors which cause the general problem of energy sustainability in Nicaragua have: i) constraints to meet the requirement of generating electricity using geothermal resource, identified as having the highest potential in the country; and ii) physical limitations in the transmission system.

1.9 **Constraints for geothermal development.** In Nicaragua there are 12 geothermal fields with an estimated potential of 1,500 MW. Despite having a legal framework for geothermal[6], and the benefits of geothermal energy in terms of reducing power generation costs, energy unserved and reduction of emissions (EEO # 1), this potential has been underdeveloped given the uncertainty related to the availability of the geothermal resource, durability in the long run, and the cost of removing it for power generation, thereby limiting private investment, especially in the initial stage of exploration. This uncertainty is reflected in the fact that only 10% has been developed (San Jacinto-Tizate and Momotombo with a capacity of 154.5 MW) out of the estimated potential.

1.10 **Constraints of the transmission system**. Efforts to increase electricity service coverage, the increased demand, diversification of the energy matrix and the need to continue to deepen the country's commitment to regional integration have resulted in pressure on sections of the transmission system and substations that have affected its reliability[7], limited its capacity and has prevented the connection of new users to the network. Among the determinants of the specific problems highlight the existence of points in the network where transformers are

[4] http://data.worldbank.org/country/nicaragua.
[5] For example, residential end users who consume more than 300kWh in Nicaragua pay 154% more than their neighbors in Costa Rica and 310% more than in Honduras.
[6] "Law on Exploration and Exploitation of Geothermal Resources", Act 443 of 2011.
[7] In 2014 the energy not served in Nicaragua reached 8,000 MWh representing 67% of the entire Central American region.

overloaded and in some cases to levels where the degradation of their physical parameters is accelerated, and of transmission lines operating outside the standards, producing high interruptions, both in quantity and magnitude.

1.11 **Transmission Line El Sauce - Villanueva.** Is a transmission line of 69 kV in the National Transmission System, built in wooden structures that already reached their time of service and drivers who exceeded their useful life. Both factors, the materials and the ancient towers, cause odd line outputs, with consequent disruption of service to users. Also the capacity of the line (69kV) is insufficient for current and future demand.

1.12 **Lack of support for transmission circuits.** The SS Sébaco has great importance since it is the point of convergence of a total of six 138 kV lines: Line Sébaco - Carlos Fonseca, line Sébaco - Tipitapa, line Sébaco - Esteli, line Sébaco-San Ramon and two lines to the Centralamerica plant. This substation, which came into operation more than 50 years ago and feeds the municipalities of Ciudad Dario, San Isidro, La Trinidad, Sébaco, Santa Rosa del Peñón and surrounding areas, has a simple bar scheme. This feature, the dependence of a bar makes more likely the occurrence of episodes of discontinuity of service, for example because of a failure or a breaker bar. These episodes leave unpowered 10 SSs connected to this node, with a load of approximately 45 MW. Another consequence of the output of this SS is the impossibility of hydroelectric plants Centroamérica, Larreynaga y Pantasma to inject 80MW of capacity to the system.

1.13 **Expanding capacity of 6 substations**. According to the analysis performed by ENATREL regarding transformer substations SIN, with measurements in the active part of the team, thermographic, of the insulation resistance in the dielectric oil, concentration of dissolved gases, among others, it was concluded that there are 23 transformers in hazardous operating condition, one of the key factors is the amount of time operating this equipment. The age of these teams hampers the availability and purchase of spare parts for repair, since in many cases models have been discontinued by the manufacturer. Given this situation, the project has identified equipment in substations: Acahualinca, Diriamba, San Benito, Catarina, Ticuantepe I and II, which have transformers at risk of overload and instability due to its obsolescence[8].

1.14 **Restrictions on the SIEPAC transmission capacity**. In October 2014 the SIEPAC line, designed under the compromise between countries to transport 300MW came into full operation. However, the line has not yet reached operating conditions for maximum capacity due to deficiencies in national networks - 403km in the case of Nicaragua - occupy part of the transfer capacity of the regional line. This requires the construction of additional infrastructure in certain sections of national lines of Nicaragua. According to the Regional Operator Unit, during the second half of 2014, the transport capacity of the SIEPAC between Honduras and Nicaragua to import or export energy was 200 MW and 210 MW, respectively, while the capacity of transactions between Nicaragua and Costa

[8] Some transformers (such as Catarina and Diriamba) also have overload (are loaded more than 90% of its nominal capacity), causing considerable losses in transformation and decreasing the efficiency of these teams.

Rica was reduced to 210 MW to export and 150 MW to import. This limitation has considerable economic consequences because it reduces the amount of energy in the Regional Electricity Market (REM). Specifically, the existing conductor between the points of interconnection Leon-Border Honduras and Amayo-Liberia does not meet the required transmission capacity.

1.15 **Proposed solutions.** To address the constraints that the development of geothermal potential and the transmission system are both facing, the program explores the geothermal potential in the country and developing mechanisms to promote private investment in its development. Specifically: (i) develop a geothermal field exploration conducted at a feasibility level, mitigating risk and enhancing strong investment opportunities for implementation and (ii) design and implement a risk mitigation mechanism for geothermal projects. The program also raises a number of investments that seek to overcome the limitations of the transmission system in order to create an electrical service of good quality. Investments are divided into two groups: (i) improving transmission infrastructure to support increased comprehensive coverage; and (ii) improvements in the national transmission system to support the capacity of the regional system **–** SIEPAC[9]. These Investments will improve the welfare of the populations of sixteen municipalities, of which fifteen are located in the North Central region and one in the northern Caribbean Coast region[10]. Several municipalities prioritized in the program suffered, according to the latest available measurements of poverty[11], of extreme poverty levels that exceed 50% of the population, being located within 25% of the poorest municipalities in the country[12].

1.16 **Sector knowledge.** The IDB has extensive knowledge of the Nicaraguan electricity sector since 1973 when it supported a first RE program. The Bank has complemented support investments in electricity infrastructure, with ample support to reform processes that have promoted the institutional strengthening of the sector. In 1998, through the loan 1017 / SF-NI, the Bank participated in the amendments to the Electricity Act that transformed the sector and led to private investment. Through the Support Program Electrical Sector I, II and III (1933 / BL NI, 1933 / BL-NI-1 and 1933 / BL-NI-2), generating RE, the transmission area and completed a pilot project aimed to normalize service standards in settlements program. With the loan National Transmission Reinforcements for Integration with SIEPAC (1877 / BL-NI) project works were financed to strengthen the power transmission network in Nicaragua and allow its adaptation to the regional network integration with the Central American electricity market.

1.16 The expansion of electricity coverage, reduced losses on settlements, implementation of projects of Energy Efficiency (EE), care throughout isolated areas, transmission reinforcements have been covered with active participation

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9 Reliability of Transmission System plays a key role in the investment decision, above standard economic criteria. Joskow, Paul L. "Patterns of Transmission Investments". MIT. 2005.

10 Central Region: Jinotega Department (Municipalities: Jinotega, La Concordia, Santa Maria de Bloodsucker, San Rafael del Norte and San Sebastian de Yali); Madriz Department (Municipalities: San Juan del Río Coco); Matagalpa Department (Municipalities: El Cua, Rancho Grande); Nueva Segovia Department (municipalities: Old City, Jalapa, El Jicaro Murra, Quilalí, San Fernando, Wiwili of Nueva Segovia). Caribbean Coast Region: Department of the North Atlantic Autonomous Region (Municipalities: Siuna).

11 VIII National Census of Population and Housing IV 2005 and based on the Unsatisfied Basic Needs methodology. Municipal map of Extreme Poverty.

12 Before the end of 2016 new updated estimates for 2015 were published.

of the Bank through the National Sustainable Electrification and Renewable Energy (PNESER) (2342 / BL-NI and Amendments). The Bank is supporting policy actions on financial sustainability, transparency of results in management, sustainable energy matrix, promoting RE private investment, EE and promotion of the regional integration of the electricity sector through a Programmatic series of Support to Political Reforms[13].

1.17 Among the lessons learned[14] as a result of IDB interventions in the sector, the following stand out: (i) the benefit of having environmental and social assessments that provide in advance technical information and concrete action plans to enable compliance analysis of each project in conjunction with the IDB safeguard policies, especially on issues related to the availability and source water, disaster management, management of critical natural habitat areas, and treatment of solid, liquid, and gas; (ii) the need to define in advance the project profiles; (iii) the need to classify the project areas depending on the characteristics of land properties, to define appropriate sanitation strategies right of way; and (iv) the establishment of a Project Implementation Unit (PIU) to maintain a clear link with the management-decisional area of the Executing Agency (EA). This program has incorporated lessons learned through: early coordination with MEM, ENATREL and ENEL to ensure that it has completed the chain of technical and environmental studies defining the area to be operated, and establishing a Project Operational Manual (POM) defining a PIU supported in managerial and operational structure ENATREL and MEM with support from ENEL

1.18 The PNESER, which started in 2011 and was promoted by the IDB and seven multilateral agencies, it is in its final phase of execution and opens the possibility to PINIC to achieve complementary results in the development of geothermal potential improvement and strengthening of the transmission system. In the latter area, this program and the NI-L1091[15] operation, approved in 2015, are complementary because includes actions in transmission reinforcements to meet the whole demand and the new generation and transmission reinforcements for adaptation to the regional system.

1.19 **Government strategy**. As part of the actions taken by the government to address the needs of generation from renewable sources, by 2015 it was established the Investment Plan for Nicaragua (PINIC) under the Program for Promotion of Renewable Energy in Low Income Countries (Scaling up Renewable Energy Program - SPREP) from the Strategic Climate Fund (Climate Investment Fund - CIF). The PINIC includes the development of geothermal energy and the integral development of rural areas from RE and improvements in transmission[16], as its main components[17].

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13 3068 / BL-NI in 2013 and 3493 / BL-NI in 2015; the third operation has not yet been scheduled.

14 Previous experiences in the country's geothermal energy projects can be found in PNESER (NI-L1040, L1050 NI, NI-L1063) Lessons learned from other countries in the region can be found in CR-L1070 operations and ME- L1148.

15 The NI-L1091 anticipated that the transmission works were complementary to financing provided -under the Investment Plan for Nicaragua (PINIC).

16 Map of improvements in transmission: NI-L1094_Componente geographical 2_Representacion improvements in transmission.

1.20 **Strategic alignment**. The program is consistent with the IDB strategy for Nicaragua 2012-2017 (GN-2683), which states that the Bank will consider investments that seek to: (i) improve financial and operational management of the system and reduce energy losses; (ii) expand electricity service coverage, especially in rural areas; (iii) improve service reliability; and (iv) transform the energy matrix to increase the participation of RE, indispensable conditions to reduce energy costs and overcome an active constraint to growth. The operation is included in the Country Program Document 2016 (GN-2849).

1.21 The program is consistent with the Institutional Strategy Update (UIS) 2010-2020 (AB-3008) and aligned with the challenges of development: (i) productivity and innovation under the criteria of provision of infrastructure and reliable public services and accessible; and (ii) economic integration under the criteria of development of the national part of a system of multinational electric transmission. All this through developing the potential of RE in an environmentally and financially sustainable and the strengthening of national networks to achieve full availability of SIEPAC. The program also aligns with the cross sectional area relate to climate change and environmental sustainability, through the financing of activities designed to reduce or prevent GHG emissions through the development of geothermal energy, improving the connection of renewable energy projects, the reducing the use of conventional energy sources based on fossil fuels and increasing efficiency by reducing energy losses in the transmission system. In addition, the program is aligned with the Strategy for Sustainable Infrastructure for Competitiveness and Inclusive Growth (GN-2710-5), in its two strategic principles, to promote access to infrastructure services, infrastructure support for regional integration and supporting the construction and maintenance of a socially and environmentally sustainable infrastructure that contributes to increasing the quality of life. The program is consistent with the Energy Sector Framework (GN-2830) to: (i) support energy sustainability through the development of renewable energy; and (ii) promote energy security through financing energy infrastructure and regional energy integration.

1.22 Consistency with the Bank's Policies[18]. The program is aligned with the Public Utilities Policy OP-708 (GN-2716-6) (EEO # 7) in reference to the electricity subsector as it complies with: (i) the condition of financial sustaintability[19] in seeking to improve ENATREL financial indicators, as they recover through rates operating costs and maintenance (paragraph 2.14); (ii) provided economic evaluation[20], to include projects that are economically and financially profitable; (iii) the technical and operational sustainability of the sector to support policy actions of the Government of Nicaragua to help develop geothermal generation

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17 Under the PINIC, JICA is managing parallel financing non-refundable US $ 7 billion under management, for exploitation of Campo Mombacho and the World Bank is working on an initiative to support the development of the geothermal field Casita-San Cristóbal.

18 For detailed analysis of compliance with public policy consulting public utilities (EEO # 7)Financial sustainability: Striving have sufficient revenue for providing the service to the user, with input from the community and direct contributions from the government that cover the efficient costs of providing the service.

19 Financial sustainability: Striving have sufficient revenue for providing the service to the user, with input from the community and direct contributions from the government that cover the efficient costs of providing the service.

20 Economic Assessment: Projects of public services must be economically viable, according to assessment methodologies cost-benefit and cost-effectiveness used and accepted by the Bank.

and promote improvements in the transmission system; (iv) enhanced access and social sustainability through the strengthening of networks that allow the incorporation of new users; (v) the promotion of competition and private sector participation and environmental sustainability, developing geothermal exploration to reduce the risk of investment in renewable; and (vi) to improve efficiency by reducing technical losses in the transmission lines (T/L) and Substations (SS) and contribute to the adequate supply of electricity, satisfy the growing demand and increased service quality

B. Objectives, Components and Costs

1.23 **General and specific objectives.** The overall objective of the project is to contribute to the sustainability of the electricity sector in Nicaragua. The specific objectives are: (i) develop geothermal exploration potential to diversify the energy matrix; and (ii) increase the availability and reliability of electricity service by increasing the capacity of national and regional transmission network reinforcements.

1.24 **Component 1. Geothermal Development (Total US $46.1 M; IDB US$ 39.7M[21]).** This component will finance the following activities:

a. **Exploration feasibility level field with geothermal potential Cosigüina** already has surface research[22]. The use of this component is aimed to determine the technical feasibility of the exploitation of geothermal potential Cosigüina field. Accordingly, there will be exploration activities in two phases. Phase 1 includes the drilling of three exploration wells, commercial diameter, with an average depth of 2000m, in order to verify the potential of the field, obtaining information to confirm or modify the preliminary conceptual model of the geothermal system made from previous research prefeasibility including exploration wells reduced diameter "slim-holes," depth up to 1000m. The activities for Phase 1 include: (i) civil works preparation including enlargement of the 3 platforms (A,B,C) of 625m2 each used in the pre-feasibility, the improvement of 4km linear existing road of 3.5m wide and 2km of new linear gauge 3.5m wide, rehabilitated during the pre-feasibility, with safety bays, extraction and transportation of selected material from the banks of materials, installation 6.25 km water pipeline, the construction of a water pumping station size 400m2; and (ii) the drilling of three wells commercial diameter with an average depth of 2000m. If the resource were confirmed in Phase 1, Phase 2 would involve the drilling of two new wells commercial diameter (D, E). According to the results achieved, the five wells could become production or reinjection wells.
Exploratory Phases 1 and 2 will be conducted with program resources. As a consequence of this intervention it is desirable private investment for subsequent exploitation phase of the field[23]. Phase 2 will also include the construction of new roads and extension of the water supply pipe, considering the location of new wells which depends on the results of drilling

[21] It includes SREP and CTF funds.
[22] Surface investigations are those that do not include underground drilling and include geological, geochemical and geophysical studies of the site.
[23] The information so far obtained indicates that there is enough potential for geothermal utilization. It is in the process of defining the amount of MW that can be generated.

of Phase 1. Finally, from the results of the phases 1 and 2, a Final Feasibility Report will be elaborated which will allow to continue, the transmission phase to the private sector (Paragraph 1.18b). The private investor is responsible for investments in additional commercial diameter wells to define the whole setting of either production and reinjection wells for power generation; construction of a geothermal plant, transmission lines that connect the project to the nearest substation of the transmission system, a cooling tower, and storage lagoons.

b. **Development of a mechanism to attract private investment for the implementation of geothermal projects.** This component will support the MEM to call a bid in order to grant the project to private investors having demonstrated the feasibility of the geothermal resource. Documents and agreements will be developed to grant the concession, which will incorporate the obligations under the law to recover the invested resources (Art. 5), the concessionaire's obligation to establish a society in which ENEL will have 10% as required by the law and a member in the Board. In addition, this component will support the MEM to design and implement a mechanism to support geothermal research from the recovered resources, allowing further research in other fields, mitigating risks to attract private investment. This mechanism will include the development of a plan for training and dissemination of the results of Phases 1 and 2 contained in the feasibility report, which will be aimed at potential investors, the MHCP and PRONicaragua[24]. This component will add value to integrate a gender perspective with activities that promote job creation and training among women. Also, incentives will rise for access of women to technical careers or technical studies with career opportunities in the field of geothermal energy and / or creation of partnerships with technical schools and universities to promote programs of placements for female students; and will strengthen the institutions responsible for coordinating the component for inclusion of the gender perspective (Gender ANNEX).

1.25 **Component 2. Improvements in electricity transmission infrastructure (Total US $57,3M; IDB US$53,7M[25]).** This component seeks to increase the capacity of SS transformation to meet both current demand, and its long-term growth, reliably. The project will finance the construction and expansion of transmission lines and substations 138kV and 230kV which:

a. **Address the growing demand and connecting new generation**, including: (i) LT El Sauce - Villanueva: This project involves the construction of a transmission line 38km long of 138 kV between SS Villa Nueva and SS El Sauce, the construction of the new SE Villanueva and expanding SE El Sauce. This infrastructure will provide reliable and secure energy to current and future users in 10 municipalities in the department of Chinandega that are fed from the SS Villanueva, reducing energy unserved. This project will improve the service for more than 25,000 existing users and the connection of 1,440 new users; (ii) SS Sébaco: this project includes the addition of a

[24] Public entity responsible for providing free services for people and qualified companies wishing to explore business opportunities in Nicaragua.
[25] Facility includes Korean funds.

new bay / bar on the SS Sébaco in order to reduce the probability of occurrence of episodes of discontinuity of service, for the six TL of 238 kV that connect to that SS. These episodes of discontinuity leave unpowered 10 SSs connected to this node, with a load demand of 45MW and a load of hydroelectric generating about 80 MW, compromising the supply to 213,000 customers in municipalities within 7 departments; (iii) Expansion Capacity 5 SS: This project involves the replacement of 5 transformers in SE Acahualinca, Diriamba, San Benito, Ticuantepe II and Catarina) since the existing ones have completed their life cycle and also some are overloaded. This subset of projects expected to benefit more than 83,000 customers; (iv) Modernization of Ticuantepe I. This project involves the construction of a new 138kV SS, to replace the current SS Ticuantepe I of 69kV. The project includes a 2km TL of 138 kV. The project will benefit more than 12,000 customers; and (v) Acquisition of a Mobile Transformer. This project involves the acquisition of a mobile transformer of 40 MVA with voltage ratio 138 / 24.9 / 13.8 kV.

b. **Allow adaptation of the national transmission system for the SIEPAC reaches its design level transfer 300MW**. This project consists of increasing capacity of existing 230kV lines in the Lion-Border Honduras and Amayo-Frontera Costa Rica (and interconnections) sections, replacing 97km conductor with a new higher capacity and improving the transmission capacity in a length of 213km through complementary works, which along with other works will ensure the transfer of 300MW of power from north to south and vice versa.

1.26 **Cost and financing.** The total program cost is US$103,403,000 of which US$28,700,000 corresponds to Blend (US$17,220,000 charged to 60% OC resources, US $ 11,480,000 charged to FSO, 40%); US$39,694,000 as part of the Non Refundable Mechanism Leveraging IDB grants (US$22,670,000 under the GLM OC, and US$9,524,000 CTF (contingent recovery grant), US $ 6,750,000 SREP (contingent recovery grant), US$750,000 SREP (non-refundable grant), the latter three representing 42.9% return for the OC. in addition US$25,000,000 of a concessional loan under Korea Infrastructure Facility (KIF) from funds intended to infrastructure projects under the Bank's administration and US$10,009,000 will be financed with local input from MEM, ENEL and ENATREL to be primarily used to cover administrative, financial expenses and contingencies. The consolidated component budget is shown in Table 1 - Program Cost and in the detailed budget (EEO # 10). Procurement of goods, works, services and consulting will be financed by this program. The financial costs of the program and regular costs incurred will be covered by with funds from the General National Treasury. The loan will finance all costs inherent to the program.

Table 1. Cost of the program (in US $ thousands)

	BID (GLM)	BID (BL)	BID (KIF)	SREP (Ctg)	SREP (No reemb)	CTF (Ctg)	Local Contribution	TOTAL
1. Engineering Supervision and Administration	1,670	-	-	529	59	747	500	3,505
2. Direct Costs	19,031	-	-	6,035	671	8,514	-	34,251
2.1 Exploration feasibility	18,753	-	-	5,946	661	8,390	-	33,750
2.2 Implementation Strategy geothermal projects	278	-	-	88	10	124	-	500
3. Contingencies	585	-	-	186	20	263	5,796	6,850
4. Financial Expenses	1,384	-	-	-	-	-	91	1,475
Subtotal C1-GEOTHERMAL	22,670	-	-	6,750	750	9,524	6,387	46,081
1. Engineering Supervision and Administration	-	800	731	-	-	-	600	2,131
2. Direct Costs	-	25,824	23,582	-	-	-	-	49,406
2.1 Transmission to support national reinforcement	-	19,774	18,057	-	-	-	-	37,831
2.2 Transmission to support the capacity of the regional system	-	6,050	5,525	-	-	-	-	11,575
3. Contingencies	-	771	-	-	-	-	2,889	3,660
4. Financial Expenses	-	1,305	687	-	-	-	133	2,125
Subtotal C2-TRANSMISSION	-	28,700	25,000	-	-	-	3,622	57,322
TOTAL NI-L1094	22,670	28,700	25,000	6,750	750	9,524	10,009	103,403

C. Key Results Indicators

1.27 As a result of the program the following will be achieved: (i) development of the geothermal potential of Nicaragua in an environmentally and financially sustainability; (ii) ensuring supply of continuous, reliable, affordable electricity and cost effective in areas benefiting from the expansion of the electricity infrastructure of the program; and (iii) optimization of the energy capacity of SIEPAC in sections located in Nicaragua. The indicators established to measure these results are: (i) geothermal potential for additional power generation to existing, explored at a feasibility level; (ii) geothermal exploitation concessions granted; (iii) CTF financial leverage; (iv) GHG emissions avoided; (v) oil imports; (vi) unserved energy in GWh in the areas of influence of the program; and (vii) maximum capacity of regional transfer in Nicaragua-Honduras N-S section and increased in Nicaragua-Costa Rica S-N section.

II. FINANCING STRUCTURE AND MAIN RISKS

A. Financing Instruments

2.1 The proposed program will be co-financed with resources from the Bank loan and the loan proceeds of Korea Facility for infrastructure projects as well as contributions from CTF and SREP as part of PINIC for a specific investment program. The Bank resources will be charged to the following sources of funding: (i) the biennial allocation for Nicaragua (document GN-2442-42) from parallel loans of OC and FOE under the Framework MSD / SMABD (GN-2442); and (ii) the allocation of resources from OC regular financing program of the Bank (OC loan), as provided under the Grant Leverage Mechanism - GLM (document AB-2946.) In accordance with this mechanism, the Bank may finance investment financing with resources from the regular program funding of OC and grant resources provided by bilateral and multilateral donors. Each operation will consist of a combination of grant and loan from OC, to be approved and disbursed simultaneously (pari passu) in order to meet the requirements of concession. The resources provided by the CTF and SREP will be available when funding is approved as it is administered by the Bank in accordance with the agreement signed between the Bank and the World Bank as administrator of these resources. The CTF and SREP subcommittees approved the use of these resources.

2.2 As indicated in paragraph 2.1, each sum to be disbursed and charged under the loan OC, according to the GLM framework, will have a counterpart of equal amount (pari passu) of CTF and SREP resources. The resources from SREP and CTF are transferred to the country in non-reimbursable status to help mitigate and / or transfer financial risks associated with exploration and development of the Program. The MEM is obliged to call for bids to award to a private investor the future concession having demonstrated the feasibility of the geothermal resource, and in the concession granted to a private obligation it will be added the obligation to repay an amount not less than the resources invested by the State in the exploration. With the resources received from the private investor the MEM will implement a mechanism to support geothermal research (Mitigation Fund), which allows to continue to use them for research in other fields, mitigating risks to attract private investment. The resources of these contributions will continue to be used by the Fund Mitigation, and recovered from private investors repetitively. After thirty (30) years from the signing of the agreements, the Mitigation Fund established as a mandatory condition for the private winner of the last bid that the resources are returned directly to the Bank, in the account that the Bank states, to be transferred to the CTF, so that for the state the resources will be non-refundable. The Bank will not disburse the resources of OC until the resources from CTF / SREP are available for the purposes of the Program.

2.3 The resources, regardless of its source will be disbursed over a period of five years from the effective date of the loan agreement, as shown in Table 2:

Table 2. Program disbursements (US $ thousands)

SOURCE	2017	2018	2019	2020	2021	Total
BID (GLM)	196	425	4,695	12,411	4,943	22,670
SREP (Non-reimbursable Grant)	7	14	161	421	147	750
SREP (Contingent recovery grant)	61	130	1,451	3,791	1,317	6,750
CTF (Contingent recovery grant)	86	183	2,048	5,348	1,859	9,524
Local contribution (MEM-ENEL)	76	151	148	3,035	2,977	6,387
Subtotal C1-GEOTHERMAL	426	903	8,503	25,006	11,243	46,081
IDB (blend)	846	3,604	6,189	11,722	6,339	28,700
IDB (Korean Facility)	769	3,266	5,580	10,194	5,191	25,000
Local contribution (ENATREL)	179	151	145	1,579	1,568	3,622
Subtotal C2-TRANSMISSION	1,794	7,021	11,914	23,495	13,098	57,322
TOTAL NI-L1094	2,220	7,924	20,417	48,501	24,341	103,403

B. Environmental and Social Safeguard Risks

2.4 **Environmental Risks.** The Bank prepared an Environmental and Social Management Report (ESMR) presenting in detail the environmental and social risks associated with the program.

2.5 The adverse environmental and social impacts, if not mitigated would be significant, and thus the program was classified as "Category A" according to the Operational Policy OP-703 at IDB, the adverse impacts and significant risks associated with the program are: (i) habitat fragmentation and cumulative effects on forest cover caused by the conversion of habitat inside the Cosigüina Volcano Natural Reserve; (ii) a risk of cumulative effects on water availability caused by the extraction and consumption of water for Component 1, which could affect the viability of Component 1 as well as the health of surrounding communities; (iii) a high risk of natural disasters that could affect the viability of projects of Component 1 and 2 and the health and safety of surrounding communities, such as seismic activity, drought, extreme precipitation and storms, landslides, and volcanic activity; (iv) impact associated with the construction phase of projects regarding Component 1 and 2, such as pollution of surface waters and ground waters and soil by the resulting sludge caused by drilling, air pollution, the generation of noise and vibration impacts, visual impacts, potential contamination from improper waste management, and impacts associated with access and obtaining servitude, among others; and (v) negative impacts on the economic potential of neighboring owners as much as affected communities.

2.6 The mitigation measures that the Borrower shall take include conducting an Additional Assessment to determine the availability of water for Component 1 and identify appropriate management measures prior to distribution to OPC; the implementation of an Action Plan for Biodiversity to restore Cosigüina Volcano Natural Reserve during the period of disbursement; the realization of a Management Framework for Risk Management of Natural Disasters before the program is approved by the Board; the performance of a Supplemental Plan

Management for Transmission Line El Sauce-Villanueva of Component 2; the realization of a Valuation of Prior Compensation for Component 1.

2.7 A description of all the measures that the borrower must implement to mitigate the impacts and relevant risks so that the program meets the Operational Policy OP-703 during the whole validity of the contract, it is described in the Environmental Management and Social (ESMR).

2.8 The contract documents shall include requirements for this purpose, including those reflected in the ESMR, and appropriate monitoring and supervision. After approval of the project, the IDB will actively monitor the performance of the implementation of mitigation measures and environmental and social compensation.

C. Fiduciary Risk

2.9 **Risks.** While the elaboration the analysis of institutional capacity of each executant was updated, allowing the identification of the financial risk that an acceptable internal control for the Bank might not reestablished for fiduciary management. Overall, regarding the fiduciary management it is anticipated that the mitigation of risks measures is related to specific training, a close accompaniment initially and recruitment of ad-hoc personnel with appropriate operations skills necessary for the implementation of Bank's operations. Also an average risk of delays in acquisitions was identified due to the selected personnel not being updated in IDB policies. To mitigate these risks it is proposed to hold a workshop training and clinics scheduled by the IDB for technical and fiduciary staff involved in the Program. The procurement of goods, works, services different from consulting and consulting services will be carried out in accordance with the GN-2349-9 and GN-2350-9 policies.

D. Other Key Issues and Risks

2.10 Public management, governance and development. The following intermediate risk of Public Management and Governance were identified: (i) delays in the ratification of the National Assembly, delay the start of the program; and (ii) delays in fulfilling conditions precedent to the first disbursement delay the onset of the program, particularly the recruitment of the program coordinator and the key personnel of the PEU. As mitigation the following measures are proposed respectively: (i) negotiate with the Energy Commission of the National Assembly, consideration of expediting the approval of the loan agreement by the National Assembly, through a Legislative Decree duly published in the Gazette of the country; and (ii) negotiate with the government entities emissions in the short term, (a) the legal opinion of the Attorney General's Office to establish the date of effectiveness of the program; and (b) Transfer Agreements between ENATREL and MHCP and Implementation Agreement between the MEM and MHCP; and (c) must present evidence of the recruitment of program coordinator and key personnel of the PEU.

2.11 The following intermediate development risks were considered: (i) slow implementation of the Program caused by the participation of government entities; (ii) the delays in obtaining environmental permits, delay the start of

construction of the program; (iii) the limited update on Geothermal Energy, delay the preparation of technical specifications well drilling; (iv) increased costs limits the scope of Component 1; (v) delays in obtaining the results of topographic and geological studies; (vi) delay in negotiations regarding servitude; and (vii) lack of demand from the private sector to invest in the development of geothermal fields.

2.12 The proposed mitigation measures for development risks are: (i) establish a Monitoring Committee of the Program[26] for program monitoring and making important decisions and implement measures to strengthen according to the action plan resultant from the institutional capacity evaluation; (ii) Negotiate with the appropriate authorities to ensure approvals in the time provided; (iii) hire a specialist experienced in geothermal drilling to support the PEU in preparing technical specifications and timely hire the technical and environmental consultant firm considered in the program; (iv) conduct a market research of similar bids before starting the bidding process, ensure a contingency amount from the beginning of the program design, find additional resources from the MHCP and international cooperation, if any; (v) hire such studies with own resources which the Bank may finance retroactively; and (vi) EA constant coordination with local leaders, mayors and political secretaries of the affected regions. A special contractual execution condition will be that prior to the award of each contract work, the EA will show that has legal possession, easements or other rights necessary to start the work; and (vii) as part of the mechanism to attract private investment for the implementation of geothermal projects to be prepared, a plan for disseminating the results of Phases 1 and 2 contained in the feasibility report, aimed at potential investors, will be developed.

2.13 **Financial viability.** The assessment of the financial viability of the program for the Component 1 was conducted through a model of financial analysis of cash flow. The methodology uses this analysis is the evaluation of the Financial Internal Rate of Return (FIRR) using cash flow with costs and revenues, and Financial Net Present Value (FNPV). Sensitivities analysis were done with a discount rate of 12% of the factors considered, as rate energy sales agreement, interest rate debt, period, investment cost, tax rate and exemptions. Compared to the expected rate of return on capital, estimated in Nicaragua as a minimum of 18%, the cases which have a FIRR >18% and a positive FNPV are considered favorable. If confirmed by the exploration the existence of geothermal resource, the project would be financially viable from an energy price of minimum US$102 / MWh, which compares favorably with similar projects[27].

2.14 The Component 2 financial viability was analyzed from the historical evolution and projected financial statements based on financial indicators of ENATREL (EEO # 5) whose monitoring was agreed in previous operations (¶2,18). The results in 2015 were lower than expected: Cash operating margin was 28.8% compared with 30% agreed; the contribution of Net Internal generation of Funds from debt service to investments was -232% versus 35%, and the coverage of debt service reached 0.27 times versus 1.5%. The last two indicators were strongly affected by rising values of the payment of principal and interest due to

[26] In paragraph 2.2.1. Coordination Committee and Monitoring Program (CCSP) MOP contains detailed information about its composition and functioning.

[27] The geothermal project San Jacinto-Tizate, Nicaragua, currently receives a price of US $ 117 / MWh.

arrears ENATREL has registered both of repayment of principal and interest. ENATREL financial projections for the period 2016-2025 were developed considering an investment scenario of US$509 million, a normalization of accumulated debt and an average annual increase of 11% in the transmission toll.

2.15 Based on these financial projections it is estimated that ENATREL will reach the indicators defined as follows: (i) the contribution of the internal generation of net funds should be increased proportionally from that recorded in 2015 to 35% in 2020, continuing at that level in subsequent years; (ii) the cash operating margin calculated as the amount left after covering the costs of operation and maintenance, shall be at least 30%; and (iii) the coverage factor of debt service should be increased proportionally from that recorded in 2015 to 1.5 in 2019 and remain at that level in subsequent years. Monitoring of these financial indicators agreed with ENATREL and the borrower will allow to take the adequate actions to ensure that the income from the operation of ENATREL will be sufficient to cover normal operating costs and maintenance, debt service, and contribute substantially to the investment plan. In this context: The goals defined for these indicators shall be extended in its application to other existing loan operations involving ENATREL. **The monitoring of these indicators will be a special contractual execution condition and will be verified annually**. Should deviations in the indicators occur and if a deterioration of the financial situation of the company is determined, the borrower and the Executing Agency shall send the Bank an action plan that clearly identifies the causes of deviations and the financial management measures to be taken, the responsibilities of the executor and the borrower and the implementation schedule, so as to recover the financial sustainability.

2.16 **Economic viability.** A cost benefit analysis (CBA) was performed for each of the program components, obtaining an Economic Net Present Value (ENPV) cumulatively for the program of US $ 1,929,133,898 and a weighted Economic Internal Rate of Return (EIRR) of 23%. For component 1, was performed a cash flow analysis by making a comparison among the cases analyzed: with and without the existence of the project. Sensibilities were performed of the most important factors considered ("average" social cost per ton of CO2; IFO380 Bunker fuel prices, investment costs, etc.) and compared to the Discount Rate Opportunity (12%). The cases with the EIRR > 12% and positive ENPV are considered favorable. The project involves a positive ENPV and EIRR on the Base Case of 17% and variations in sensitivities ranging from 13% to 29%, (EEO # 1).

2.17 For Component 2 a CBA analysis was performed. It was performed on each of the projects in the program in which its direct and indirect effects were examined, including externalities that possibly arise using a discount rate of 12%. For this analysis projects were classified into two groups, projects reinforcing the national system and projects reinforcing of the regional system. Projects reinforcing national system generate a positive ENPV and EIRR weighted average of 42%. In terms of users, these projects involve an average of around US$5.700 per client economic benefits and include an economic aggregate local investment (adjusted for factors account) of US$41,904,080 generating an economic benefit of approximately US$1,825,000,000. This investment benefits more than 410,000

customers (over 2,000,000 people), resulting in an annual ENPV of about 585 US$/customer. In the case of projects strengthening the regional system, the economic investment of US$12,820,629 generates a ENPV of US $ 1,886,274,275 and EIRR of 23%. Component 2 has a weighted EIRR of 42% and a ENPV cumulative total of US$1,856,323,898. Details are presented in (EEO # 2).

2.18 **Technical feasibility.** Technical feasibility of the projects was analyzed for each component. For Component 1 the technical viability is ensured by a detailed priority plan of investment and work plan that includes different stages of development from the surface research to deep drilling (EEO # 3) processes. For Component 2 technical viability is ensured in the development of design and construction approval processes. The preparation of project designs follows the technical, regulatory and socio-environmental specifications in force in the sector. This process helps mitigate risks associated with social disagreements in areas of influence of the projects to be financed. The development of these projects is an integral part of the expansion plan of ENATREL for the National Transmission System (EEO # 4).

2.19 **Institutional viability.** MEM, which is responsible for formulating and promoting national policies and strategies applicable to the promotion, development, exploration and exploitation of geothermal resources in the country, also may conduct preliminary investigations of geothermal resources under the principles established in the Exploration and Exploitation of Geothermal Resources Act and its regulations (Art, 4 of Act 443). Currently performs drilling in the Cosiguina project to the prefeasibility stage financed by the PNESER. It will also have technical support from ENEL which has extensive experience in geothermal energy. Meanwhile, ENATREL has extensive experience implementing projects of expansion and reinforcement of the transmission system in the country, is it the case of the National Reinforcements of Transmission for SIEPAC (1877 / BL-NI) Project and Support Program for the Electricity Sector (1933 / BL-NI, 193A / BL-NI and NI-L1036). Likewise, is the EA responsible for the coordination and implementation of the largest running program for the electricity sector, such as PNESER (2342 / BL-NI, 2342 / BL-NI-4 and 2342 / BL-NI-5) with a comprehensive application to the sector's needs[28]. ENATREL has proven to be an executor of high management capacity, having completed execution of the first two programs with satisfactory results in 2012 and 2015 respectively, and is currently running the PNESER and NI-L1091 Program.

[28] The PNESER has seven components that have an influence on: rural electrification, standardization of networks, expansion of isolated systems, pre-investment studies, energy efficiency reinforcement of the transmission system and sustainability of isolated systems.

III. IMPLEMENTATION AND MANAGEMENT PLAN

E. Summary of Implementation Arrangements[29]

3.1 The borrower will be the Republic of Nicaragua and the executing agencies will be two (2): The MEM, with technical support from ENEL, for Component 1 and ENATREL for Component 2. A Coordination and Program Monitoring Committee is expected, integrated by the MHCP, MEM and ENATREL. ENEL's participation in the technical aspects of exploration to feasibility level (preliminary investigations) of Cosiguina project will be based on the provisions of Art, 2 of Law 882 2014 amending Act 443, which states that the public entity that will conduct preliminary investigations, must extend participation to ENEL, for which an interagency agreement participation between MEM, ENEL and MHCP will be held. The signing of such agreement establishes the terms and obligations of execution and shall stipulate the roles and responsibilities of the parties, ENATREL is a public company created by Law No. 583, and has its own legal status as Decentralized Entity dependent on the Executive Power, ENATREL will execute the program through PEU-ENATREL. The borrower, through the MHCP, will enter a resources transfer agreement with ENATREL where the terms of such transfer and the obligations regarding ENATREL's execution will be established. **Submit a signed and current inter institutional agreement between the MHCP and the MEM, and another agreement between the MHCP and ENATREL, under which the MHCP undertakes to transfer the loan proceeds and the obligations of implementing each executing agency for proper project implementation, will be a condition precedent to the first disbursement of Bank financing.**

3.2 **PEU**. The PEU will be the responsible units for the administration of each component of the program and serve as interlocutor with the Bank. To perform its tasks the PEU will have a Component Coordinator and the following key personnel: (i) an administrative-financial specialist; (ii) a procurement specialist; and (iii) a monitoring and evaluation specialist, who will work in coordination with specialized career staff in technical and administrative areas of the Ministry. **The evidence of Component Coordinators and key personnel recruiting of the PEU will be a condition prior to the first disbursement. That ENATREL, MEM and ENEL comply with environmental and social obligations included in the Environmental and Social Management and that ENATREL keep the financial indicators specified in the Financial Assessment ENATREL: State and Projection of Financial Indicators; will be considered special contractual conditions for its execution.**

3.3 **POM.** The implementation of the program shall be governed by the provisions of the POM. The POM incorporate all procedures to be used during execution of the program, including a comprehensive monitoring system, monitoring and evaluation of its actions and results, and an Environmental and Social Management Framework for the Geothermal Production Eventual Stage, as described in the PAAS. During execution, the POM may be amended with the written non-objection authorization by the Bank. **Introducing the POM, with**

[29] The section 2.*2 Coordination mechanisms for the implementation* of POM describes in detail the roles, functions and arrangements to / from program actors.

separate chapters for each executor agent, effective and approved by each agency in accordance with the terms and conditions previously agreed with the Bank, will be considered a special condition precedent to the first disbursement.

3.4 **Program Execution Plan (PEP).** The development of program activities will continue a program implemented through the PEP and its annual review that will be reflected in the respective POA. The PEP contains the equivalent POA for each year implementation detail. However, it must be modified each year taking into account the actual progress of the program. The annual reviews of PEP (for example, POA) must be submitted to the Bank.

3.5 **Procurement Plan (PP**). It has been agreed a PP for the first twelve months of implementation. The EA shall update the PP, coinciding with the annual evaluations and before the end of each calendar year or when substantial changes occur. The different types of procurement of goods, works, and consulting services will be made according to GN-2349-9 and GN-2350-9, policies respectively.

3.6 **Retroactive financing**. The Bank may finance retroactively, charging to the loans proceeds, engineering[30] costs incurred by the borrower prior to loan approval up to US $ 500.000 corresponding to 0.5% of the total amount of the transaction; provided they have complied substantially similar to those set forth in the loan agreement requirements. These expenses must have been made from 01 Jun 2016 on, date of approval of the project profile, but never made more than 18 months before the loan approval date.

3.7 **Financial Audit**. External audit services for the program will be provided by an external auditors firm acceptable to the Bank, which will be hired on the basis of the terms of reference to be agreed with the EAs. External audits will be hired under the loan proceeds and must be submitted to the Bank within 120 days after the end of each calendar year during the original disbursement period or extensions by each EA and 120 days from the date of the last disbursement.

F. Summary of Arrangements for Monitoring Results

3.8 **Monitoring**. The Bank team will make semiannual technical visits to the EA to review the program's progress and make adjustments arising from its implementation. Fiduciary oversight visits will be implemented according to the initial fiduciary risk. The amount of these visits will be adjusted according to the risk variation throughout the operation. There are accounting and operational external audits planned to validate the use of the loan proceeds and to validate the internal operational processes and controls to be implemented in the EA. The information collected will be analyzed each semester and monitoring and progress report will be made once a year (see Monitoring and Evaluation Plan).

[30] Component 1. Assessment Study of environmental and social impact. Component 2. Topographic and geological studies for TL and SS and LIDAR survey on existing transmission lines (partial).

3.9 The environmental and social monitoring will focus on compliance with environmental and social requirements contained in the Agreement, including the ESAP, according to the timing Schedule described in the ESAP.

3.10 **Evaluation.** The Evaluation Program includes an interim evaluation and a final evaluation, funded by the EAs with the loan proceeds. The interim evaluation will be hired by the EAs, within a maximum period of two months after the 50% commitment of the loan has occurred. The final assessment will include a cost - benefit analysis ex post and will be hired by the EA within a maximum period of two months after it has been paid 95% of the loan. The final evaluation will determine the degree of compliance with the goals established in the results matrix, that is to say examine the before and after program implementation. The semi-annual and annual reports will be presented by the EA under the Program Monitoring and Evaluation Plan, In addition, a workshop for elaboration for final report will be performed and an ex post cost benefit analysis will be performed as well, to verify the assumptions of the operation.

ANNEX I. RESULTS MATRIX

Objective	The objective of the project is to contribute to the sustainability of the electricity sector in Nicaragua. The specific objectives are: (i) developing exploration of the geothermal potential to diversify the energy matrix; and (ii) increase the accessibility and reliability of the electrical energy service by increasing the capacity of national and regional transmission implementing reinforcements to the grid.

Result / Indicator	Base Line 2016	Goal 2021	Observations/Means of Verification
Development of the geothermal potential of Nicaragua in an environmentally and financially sustainable manner			
Geothermal potential for the generation of additional electricity to the existing, explored at the level of feasibility, in MW	0	40	Feasibility study of the Cosigüina field approved by the MEM and ENEL
Geothermal exploitation concessions granted	0	1	Concession agreement between the MEM and a private or public-private investor, signed by both parties.
CIF financial leverage (USD million in 2021)	0	29.057	Loan Contract signed between the Government of Nicaragua and the IDB
GHG emissions avoided (tons of CO_2e/year starting in 2025)	0	197,794	Final Project Completion Report
Oil imports reduction (USD million per year starting in 2025)	0	23.6	Final Project Completion Report
Assurance of the supply of electric power in a continuous, reliable, accessible and cost effective manner in the areas benefited from the expansion of the electricity infrastructure of the program.			
Non-served energy[1] in GWh in the areas of influence[2] of the program.	1,178	0,080	The measurements of non-served energy shall be verified through technical and statistical reports of the Centro Nacional de Despacho de Carga (CNDC).
Optimization of the power load capacity of the Electrical Interconnection System of the Central America Countries (SIEPAC) in the tranches located in Nicaragua.			
Maximum Capacity of Regional Transfer in MW in the area Nicaragua-Honduras N-S increased [3].	120	300	The goal assumes that in addition to the reinforcements included under this program, all the reinforcements planned for the SIN are built. Report of the Regional Operating Entity

[1] Non-supplied energy refers to the amount of energy that is kept from delivery to users by reason of an event in the Transmission System which in turn, causes restrictions to the availability of the system's assets, preventing the transportation of energy.

[2] Central Region: Jinotega Department (Municipalities: Jinotega, La Concordia, Santa María de Pantasma, San Rafael del Norte y San Sebastián de Yalí); Madriz Department (Municipalities: San Juan de Rio Coco); Matagalpa Department (Municipalities: El Cuá, Rancho Grande); Nueva Segovia Departament (Municipalities: Ciudad Antigua, Jalapa, El Jícaro, Murra, Quilali, San Fernando, Wiwili de Nueva Segovia). Costa Caribe Region: North Atlantic Autonomous Region Departament (Municipalities: Waslala).

Maximum Capacity of Regional Transfer in MW in the area Nicaragua-Costa Rica S-N increased[4].	100	300	(EOR). The transfer capability shall be verified through technical and statistical reports of the EOR.

Products / Milestones	Base Line	Year 1	Year 2	Year 3	Year 4	Year 5	Goal	Observations/Means of Verification
Component 1.a. Exploration at a feasibility level of the Cosigüina filed with geothermal potential.								
1. Exploratory wells of commercial diameters, drilled[5].	0	0	0	3	2	0	5	Technical report approved by the MEM and the ENEL.
2. Feasibility study for the exploitation of the Cosigüina[6] field	0	0	0	0	1	0	1	Final report of the study approved by the MEM and ENEL
Component 1.b. Development of a mechanism to attract private investment for the implementation of geothermal projects.								
3. Designed mechanism for the mitigation of risk of geothermal exploration[7].	0	0	0	0	0	1	1	Study approved by the MEM
4. Designed bidding process for the concession of geothermal exploitation[8].	0	0	0	0	0	1	1	Report approved by the MEM which includes all the documentation prepared for the bidding process.
Cost								
Component 2.a. Improvement of the physical infrastructure of transmission to guarantee and increase the supply of								

[3] The increased areas of control refer to the Transmission Grid controlled by the CNDC, which also include the substations of neighboring countries to which the regional interconnection lines arrive.
[4] The increased areas of control refer to the Transmission Network controlled by the CNDC, which also include the substations of neighboring countries to which the regional interconnection lines arrive.
[5] The drilling process consists of civil works of preparation including the enlargement of platforms, the improvement of access to the wells, the construction of a water pumping station and the drilling of wells with a commercial diameter.
[6] The study shall include a detailed analysis with technical, social, environmental and financial information about the geothermal potential of the Cosigüina field.
[7] This study shall include: (i) proposal of the actions directed to support geothermal investigations from recovered resources, which allow their continued use for investigations in other fields, mitigating risks to attract private investment; (ii) a training plan and broadcasting of the results obtained in Phases 1 and 2 directed to potential investors, the MHCP and PRONicaragua.
[8] Includes the preparation of the documents necessary to call biddings and the agreements that may be required.

continuous electric power to meet the demand for electricity and the generation of power in the areas of intervention of the program.								
5. Substations (S/S) Villa Nueva and El Sauce built and in operation (S/S).	0	0	0	0	0	2	2	Minutes of receipt of works, supply, installation and start-up of equipment approved by ENATREL including as annexes, the technical-environmental supervision reports.
6. Transmission line in 138 kV El Sauce – Villanueva Sauce built and in operation.[9] (km).	0	0	0	0	0	38	38	
7. S/S Sebaco expanded and in operation (S/S).	0	0	0	0	1	0	1	
8. S/S San Benito, Catarina, Diriamba, Acahualinca and Ticuantepe II built and in operation (S/S).	0	0	0	0	5	0	5	
9. S/S Ticuantepe I built and in operation (S/S).	0	0	0	0	0	1	1	
10. Transmission line related to the S/S Ticuantepe I built[10] (km).	0	0	0	0	0	2	2	
11. Mobile transformer of 40 MVA acquired (transformer).	0	0	0	1	0	0	1	
Component 2.b. Improvement of the physical infrastructure of transmission to optimize the load capacity of the regional T/L in the tranches located in Nicaragua.								
12. 230kV transmission lines with an increased transmission capacity through the replacement of conductors in the area Leon – Honduras Border and Amayo – Costa Rica Border, in operation. (km)	0	0	0	0	97	0	97	Technical report approved by the CNDC.
13. 230 kV transmission lines with an increased transmission capacity through a LIDAR survey and the re-tightening of conductor, in operation. (km)	0	0	0	0	0	213	213	

[9] Includes the construction, assembly and start-up of the 138kV output bay of the S/S La Dalia.
[10] Includes the construction, assembly and start-up of the 138kV output line bay of the S/S La Dalia.

Document of the Inter-American Development Bank

NICARAGUA

RENEWABLE ENERGY WIDENING PROGRAM IN LOW INCOME COUNTRIES (SREP)

(NI-L 1094)

ANNEX II: Economic Analysis for Component 1

This document was prepared by PELICAN, S.A., Consulting Firm

PROGRAM FOR THE WIDENING OF RENEWABLE ENERGY IN LOW INCOME COUNTRIES (SREP)

(NI-L 1094)

1. INTRODUCTION

The SREP program promotes initiatives to widen access to energy and stimulate economic growth by means of the use of renewable energies, as well as initiatives aiming at the energy market's transformation and dynamism by means of public policies. The program is financed by the Strategic Climate Fund (SCF), one of the Investment Fund's Strategic Funds for Climate (CIF). The CIF provides financing for developing countries under concessional terms, concessional loans or else risk mitigation instruments, in order to foster renewable energies' generation projects promoting a development based on low emissions. The SCF, as a strategy, focuses on financing pilot projects with potential replication at a larger scale or at national scaling level, the focus of the SREP Program, as part of the SCF, aims at two lines of work:

- Line 1: Initiatives to widen access to energy and stimulate economic growth by means of larger use of renewable energy, and,
- Line 2: Transformation of the renewable energy market through public policies, eliminating hurdles and allowing greater availability of capital and income: support to governments for the creation of markets, private sector participation and productive use of energy.

SREP PROGRAM IN NICARAGUA

Nicaragua was declared illegible to have access to funds of the SREP program in the year 2014. In the year 2015, the country submitted its proposal for an Investment Plan (PINIC) up to the amount of US$30.0 millions. Projects eligible for SREP funds, derive from the PINIC, corresponding to two specific components:

- Component 1: Development of Nicaragua's geothermal sector's development
- Component 2: Integral development of rural zones, isolated zone's energizing by means of rural electrifying, and promotion of renewable energies for productive uses. Three kinds of projects derive from this component:
    - 2A: Photovoltaic Solar Systems (PVS) for rural electrifying and promotion of rural energies service enterprises (ESCOs),
    - 2B: Adoption and transfer of Clean Kitchens for residential uses, and,
    - 2C: Development of renewable energies' technologies for productive uses supporting the micro, small and medium enterprises (MSMEs), hydroelectric, firewood, biomass, SFV and solar energy.

Under these two components, the SREP program comprises projects aimed at four renewable energy sectors: Geothermal, Photovoltaic Systems, Clean Kitchens and renewable energy for productive uses.

This Attached document of the Nicaragua SREP Program, consists in the cost-benefit analysis (CBA) for the type of projects of the Geothermal sector (Component 1) in 3 potential exploitation fields: Mombacho, Apoyo and Cosigüina.

2. COMPONENT 1 COST – BENEFIT ANALYSIS

The ABC for geothermal energy projects was done to prioritize projects selected by the Government of Nicaragua, those requiring investment in depth studies, as well as additional excavation investments, as a condition to move forward large scale investments, allowing to unblock the geothermal sector at the country. For such end three primary fields have been analyzed, in order to facilitate the decision on which of them is the most attractive for investments in this sector.

- Mombacho Volcano
- Caldera de Apoyo and
- Cosigüina Volcano

The budget requested for SREP in May 2015 for component 1 was the following:

Components / Sub-components	SREP	SREP-IDB		SREP-World Bank	
		Grant	Reimbur-sable	Grant	Reimbur-sable
Surface studies and slim-holes (Resource's identification)	4.00	0.75	3.25		
Production wells (resource's Confirmation)	17.25		3.50	7.00	6.75
Feasibility studies	0.50			0.50	
Investment	0.00				
Technical assistance	0.75	0.00		0.75	
Subtotal Component #1	**22.50**	**0.75**	**6.75**	**8.25**	**6.75**

Table 1: SREP Investment's summary – Component 1

ECONOMIC ANALYSIS METHODOLOGY

The economic evaluation has the purpose to determine the economic impact of the considered project, which considered both the social and national points of view.

For this purpose, the cash flow was analyzed comparing to cases, the existence and the non-existence of the project. The methodology used in this analysis is the financial internal rate of return (IRR_f), and the net current present value (NPVe) similar to the financial net present value (NPV_f).

The considered factors' sensibilities are compared at the Opportunity Discount Rate (12%).

Are deemed favorable, cases that:

- Have a TIR_E > 12%
- Have a positive VAN_E

Economic cost

The total economic cost consists of the net cost, taxes and subsidies. However, taxes and subsidies, at the national economy, are simply transferred between the Project and the Government, for which reason, they are eliminated from total cost. Then, the net cost is the economic cost's basis. Accordingly, in order to obtain economic costs one must adjust the domestic cost with the frontier cost, an adjustment for which a conversion factor is used, one assumed discounting at 10% of DAI.

The considered project's assumed investment costs are summarized at the following table:

Initial investment cost

The initial investment's cost is estimated based on two elements:

a) the generation plant's cost by installed gross power and;
b) the quantity of wells required in order to achieve the project's estimated size, excluding taxes and converting the total cost into frontier cost.

Operation and maintenance cost (O&M)

In the same manner as for the financial analysis, one assumes that the O&M cost will reach 3% of the initial investment.

Reposition wells during the project's life

In geo-thermoelectric generation projects additional wells are needed in order to replace those in which the geothermal fluid's production capacity diminishes. In this project one has considered the Reposition Wells' drilling chronogram (also mentioned in the TIR_E analysis) and an estimate of its economic cost.

Definition of Economic Benefit

The economic benefits consist of:

a) additional benefits granted to consumers by means of the project's incorporation "incremental benefits"

In this case one must measure the value added by the energy excess generated by the project vs. the case without the project. At the contemplated scenario, if the project were not made, there would not be a generation deficit in view of the fact that Nicaragua's Expansion Plan contemplates other available technologies in order to satisfy the demand. The benefit from incremental energy is then null.

b) those benefits implying savings in costs, or "non incremental benefits"

In this case, substitution of imported fossil fuel (Heavy Fuel Oil), created by the substitution of a fossil thermal plant of equal size which would be fully displaced on the day when the geothermal project begins to operate reaches more than 50% of the energy sold in 2015 (INE's 2016 electrical statistics), and still represented 54% of the country's installed capacity at the end of 2015.

The additional benefits to consumers may be estimated starting from the installed gross energy generated by the geo-thermoelectric plant. The benefits implying savings under the effect of the Project's implementation include oil imports' reduction, since the geothermal one is an alternative energy source, part of the current thermal generation by means of fossil fuels would be replaced.

The type of thermal generation, of which the consumption is going to be reduced is the Bunker Co oil, equivalent to IFO380m whose price is estimated at US$268/ton in 2023, with basis on the 2015 Study of The United States' EAI[1]

The historical data in the European market (Rotterdam harbor, see source) and are projected at future with "low" and "high" was generated using the same evolution annual rates starting from an initial price +/- 20% in 2016.

c) the effect of CO_2 gas reduction, also a product of the project's incorporation and of the substitution of a thermal fossil plant of the same size that would be displaced.

[1] Source: http://www.eia.gov/forecasts/aeo/data/browser/#/?id-12-=AEO2016

The effect of CO_2 gas reduction means that if there were not this geothermal project, electricity would have been provided by oil thermal plants, with a substitution factor depending on the Expansion Plan foreseen for the country. It is assumed that it is 100%.

That is to say that with the project we may reduce the CO_2 gas and we include monetary terms in this effect. An oil thermal plant generates 726 tons of CO_2 by GWh annually. In the case of 40 MW we have 217,504 tons per year. On another hand, a 40 MW capacity geo-thermal plant typically generates non-condensable gases in a proportion of 1% of the vapor it consumes, within which 75% is CO_2. In accordance with it, the emission will reach 19.710 equivalent tons yearly. They are converted into a monetary value using Carbon's social price. Indicated by the projection study of the EPA[2] agency of the United States, proposing a "medium" social cost per CO_2 ton in 2015 and projected until 2050. The same study proposes alternate scenarios with several discount rates at future cost.

Revised Social Cost of CO_2, 2010 – 2050 (in 2007 dollars per metric ton of CO_2)

Discount Rate Year	5.0% Avg	3.0% Avg	2.5% Avg	3.0% 95th
2010	10	31	50	86
2015	11	36	56	105
2020	12	42	62	123
2025	14	46	68	138
2030	16	50	73	152
2035	18	55	78	168
2040	21	60	84	183
2045	23	64	89	197
2050	26	69	95	212

Table 2: Social CO_2 cost (at US$2007 per t)

Source: Interagency Working Group on Social Cost of Carbon, United States Government, 2015

The medium scenario was considered with an average of 3%, and so were the "low" and "high" price scenarios at 5% and 3% 95th, respectively.

THE FINANCIAL ANALYSIS' METHODOLOGY

The financial analysis' objective is to analyze the project's financial feasibility, In other words, it is analyzing if the project will generate profits or will have losses. The methodology used by this analysis is the evaluation of the Financial Internal Rate of Return (IRR_F) using the cash flow with costs and benefits, and a financial NPV (NPV_F).

The considered factors' sensibilities are compared to the Capital's anticipated Rate of Return, estimated in Nicaragua as a minimum of 18%. Are considered favorable, the cases that:

- Have a $IRR_F > 18\%$
- Have a positive NPV_F

Financial cost

The cost consists of initial investments, operation and maintenance and additional drilling costs. Detailed costs are used in SREP report.

[2] https://www3.epa.gov/climatechange/EPAactivities/economic/scc.html

Initial investment's cost

The necessary cost is different if the cost is leveraged or not. The research, wells development, plant's construction, etc. costs are distributed throughout the years according to the chronogram shown at the financial flag.

If the project is leveraged, one must add the interests incurred during the construction period (at a rate that may be different from the Senior rate) and the transaction expenses.

Operation and maintenance cost

Estimated as 3% of the initial investment

Additional wells' cost

In the case of geothermal projects, in order to adjust against the wells' productivity's drop, it becomes necessary to drill additional wells. The costs are detailed at the financial flag.

Financial Benefit's definition

The project's financial benefits consist of the income obtained from the sales of electricity and they may escalate under the terms of the offered IPP. This amount is the sum of the energy sale (which is the tradable generated volume (GWh) multiplied by its estimated unitary price) and the premium for the facility's capacity, is applied.

In the case of a 40MW plant, the tradable volume is 299.59 GWh annually, considering 10 percent of the plant's interior use and a plant factor of i90%.

The estimated "all-in" price is defined by the MEM (2015) prices' band. This estimated unitary price basis is US$0.092/kWh which corresponds to the price maximum established at the range of 0.074 to 0.092 US$/kW that the government established as unitary price in 2015. The effect of inflation has been taken into account to a certain point by means of the implementation of its 3% adjustment (half the real figure) effective for up to eight (8) years after the operation's initiation. With this adjustment, the estimated unitary price reaches US$ 116.54/MWh in2003.

Adding these factors one gets the annual financial benefit, taking into account the following relevant factors:

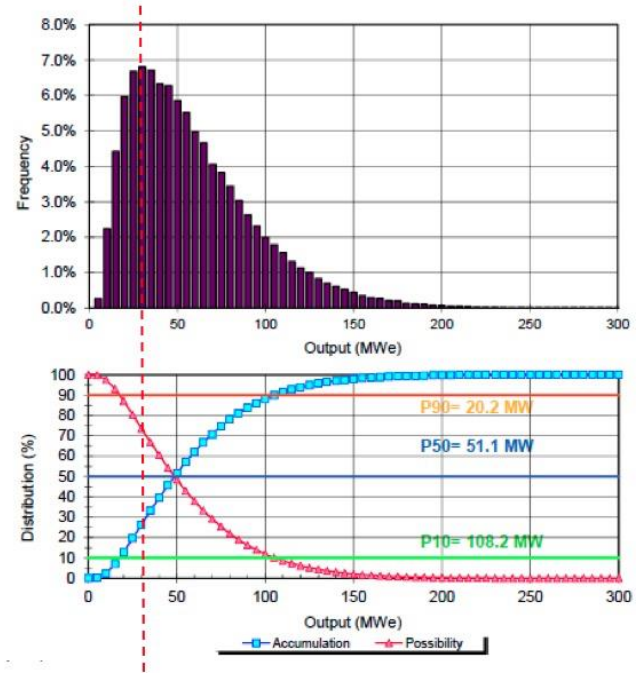
- The benefits and incentives of Law 532 (bearing in mind that they be extended beyond he law's current life until 2018): 7 years income tax exemption, and a progressive exemption of municipal taxes. The total exemption on Value Added Tax (VAT, 15%) and import taxes.
- The payment of charge for transmission to ENATREL, estimated at 50% of the total price escalated at 1% annually.
- A straight line fiscal depreciation over 10 years
- The possibility of cashing the interests during the construction phase at a rate lower than the senior debt rate.
- A variable recovery rate by the GNI by the private developer of the total exploration costs. Including the reduced diameter wells' drilling phase within the PNESER frame. A progressive calendar, also, for these costs' repayment, which may be added to the financing plan (senior debt).
- The possibility of exempting, from the project's investment cost, the construction of the 77 km transmission line up to the geothermal site.

MOMBACHO VOLCANO

Cost-benefit analysis methodology and results: Mombacho Volcano

For the Mombacho Volcano, a detailed study of the secondary information obtained was made, considering two exploration scenarios (Mombacho 1 and Mombacho 2). In both scenarios the exploration was analyzed in order to know the distribution of the geothermal potential.

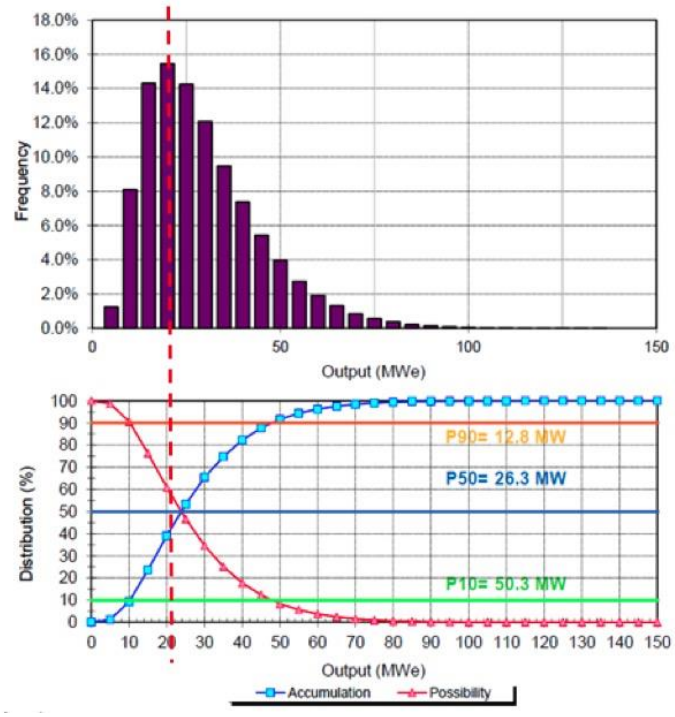
For both fields, an estimate was made under the stored heat volumetric method combined with the Monte Carlo method, proposing the following described resource probabilities:



Input

Parameter	min.	most likely	max.
Reservoir Area (km^2)	1.76	-	11.10
Reservoir Thickness (m)	1000	-	2000
Rock Density (kg/m^3)	2400	2500	2600
Porosity (-)	0.05	0.10	0.15
Recovery factor (-)	0.125	0.250	0.375
Rock Specific Heat (kJ/kg°C)	-	1.00	-
Reservoir Average Temperature (°C)	200	250	300
Reservoir Average Pressure (MPa)	-	15.0	-
Heat-Electricity Conversion Factor (-)	0.045	0.087	0.116
Plant Life (year)	-	30	-
Load Factor (-)	-	0.85	-
Abandonment Temperature (°C)	-	160	-

Figure 1: Distribution of resource probabilities of Mombacho-1 field (Monte Carlo)
Source: Pre-feasibility study West JEC, 2015



Input

Parameter	min.	most likely	max.
Reservoir Area (km^2)	1.73	-	6.06
Reservoir Thickness (m)	1000	-	2000
Rock Density (kg/m^3)	2400	2500	2600
Porosity (-)	0.05	0.10	0.15
Recovery factor (-)	0.125	0.250	0.375
Rock Specific Heat (kJ/kg°C)	-	1.00	-
Reservoir Average Temperature (°C)	200	240	280
Reservoir Average Pressure (MPa)	-	15.0	-
Heat-Electricity Conversion Factor (-)	0.045	0.080	0.105
Plant Life (year)	-	30	-
Load Factor (-)	-	0.85	-
Abandonment Temperature (°C)	-	160	-

Figure 2: Distribution of resource probabilities of Mombacho-2 field (Monte Carlo)
Source: Pre-feasibility study West JEC, 2015

For analysis purpose, only one case: 40 MW scenario was used, as one having a higher than 80% probability.

Project Mombacho's Economic Costs

The total economic cost consists of the net cost, taxes and subsidies. However, taxes and subsidies, at national economy, are simply transferred between the Project and the Government, for which reason, they are eliminated from total cost. Then, the net cost is the economic cost's basis. Besides, there is the tendency of over estimating the domestic costs by reason of the over valued rate of exchange type, one that was assumed discounting 10% of DAI.

A summary of the economic costs of the project can be found in the following table:

Investment detail			Cost	Local cost	With VAT	% ext.
Development	**Slim wells.**	**Commercial wells**				
Environmental and social consultancies			0.5	0.45	0.58	0%
Civil works for development stage			1.256	1.13	1.44	0%
Drilling for resource's evaluation (JICA)	0	4	26	26	29.90	100%
SREP support in drilling	0	0	2.55	2.55	2.93	100%
Feasibility study			1	1	1.15	100%
Other wells (estimated)	0	9	63.60	63.60	73.14	100%
Construction						
Geothermal plant			60	58.68	69.00	78%
Fluids system			19.3	18.91	22.20	80%
Access ways			4.6	4.14	5.29	0%
Site			1	0.9	1.15	0%
Transmission line			7.381	7.00	8.49	48.3%
Administration			5	4.5	5.75	0%
Consultancy services			10	10	11.50	100%
		Cost	202.19	198.86	232.52	
Contingency			10.1	9.943	11.63	
Total CAPEX			**212.30**	**208.81**	**244.14**	
Wells during all the Project						
Mobile/Withdrawal			20.25	20.25	23.29	100%
Production wells			84.5	84.50	97.18	100%
Reinjection wells			45.5	45.50	52.33	100%
Pumps			2.4	2.40	2.76	100%
Platform			1.26	1.26	1.45	100%
Total wells			**153.91**	**153.91**	**177.00**	

Table 3: Investment costs of the 40 MWe (gross) project – Mombacho
Source: ACB model of Mombacho volcano – PELICAN, S.A

Project Mombacho's Economic Benefits

The investments' economic analyses, income and expenditures were made for two scenarios, with the construction of 30 and 40MWe generation plants. From the analysis made only one case was selected, that of 40MWe.

The project's assumed economic benefits are summarized as follows:

Benefits	Value
HFO price / IF0380 (oil invoice savings)	263 US$/ton (2016)
Thermal plant (HFO consumption, efficiency 38%)	226 ton/GWh
Substitution factor	100%
Emission factor	100%
Thermal plants' CO_2 emission	726 tCO2/GWh
Consumed vapor (geothermal efficiency)	300 TPH
Geothermal plants' CO_2 emissions	0.75%
Coal's social cost (tCO_2)	Under EPA scenario

Table 4: geothermal project's assumed economic benefits

The project's economic return is shown as follows, IRR_E *(Economical IRR, EIRR)*

Mombacho		Características			Inversión					Total de costos económicos	Beneficios económicos										Total de beneficios económicos
											Incrementales (con el proyecto)				No incremental: reducción CO2		No incrementales: ahorro de importaciones			Total	
N°	Año	Potencia bruta	Generación Bruta	Generación Neta	CAPEX Inicial	# pozos adicionales	Reinversión	Total inversión	O&M												
	Año	1.1	1.2	1.3	3	4.1	4.2	5 = 3 + 4.2	6	7 = 5 + 6	8.1 MW incr.	8.2 MW base	8.3 Balance energ.	8.4 Valor $/MWh	9.1	9.2	10.1	10.2	10.3 HFO	11=8+9+10	8 = 11 - 7
		MW	GWh	GWh	MUS$	#	MUS$	MUS$	MUS$	MUS$					MUS$	$/tCO2	MUS$	% sub	US$/t		MUS$
C1	2016				1.86			1.86		1.86											-1.86
C2	2017				23.54			23.54		23.54											-23.54
C3	2018				3.44			3.44		3.44											-3.44
C4	2019				2.91			2.91		2.91											-2.91
C5	2020				52.51			52.51		52.51											-52.51
C6	2021				79.90			79.90		79.90											-79.90
C7	2022				44.64			44.64		44.64											-44.64
1	2023	40 MW	315.36	299.59		0	0	0.00	6.26	6.26	40.00	40.00	0	N/A	8.31	42.00	42.21	100%	622.59	50.51	44.25
2	2024	40 MW	315.36	299.59		0	0	0.00	6.26	6.26	40.00	40.00	0	N/A	8.47	42.80	43.19	100%	637.18	51.66	45.40
3	2025	40 MW	315.36	299.59		0	0	0.00	6.26	6.26	40.00	40.00	0	N/A	8.62	43.60	44.38	100%	654.64	53.00	46.74
4	2026	40 MW	315.36	299.59		2	15.67	15.67	6.26	21.93	40.00	40.00	0	N/A	8.78	44.40	45.85	100%	676.40	54.63	32.70
5	2027	40 MW	315.36	299.59		0	0	0.00	6.26	6.26	40.00	40.00	0	N/A	8.94	45.20	47.09	100%	694.62	56.03	49.76
6	2028	40 MW	315.36	299.59		0	0	0.00	6.26	6.26	40.00	40.00	0	N/A	9.10	46.00	48.13	100%	709.97	57.23	50.96
7	2029	40 MW	315.36	299.59		0	0	0.00	6.26	6.26	40.00	40.00	0	N/A	9.26	46.80	49.53	100%	730.66	58.79	52.52
8	2030	40 MW	315.36	299.59		1	8.87	8.87	6.26	15.13	40.00	40.00	0	N/A	9.41	47.60	50.39	100%	743.31	59.80	44.67
9	2031	40 MW	315.36	299.59		0	0	0.00	6.26	6.26	40.00	40.00	0	N/A	9.57	48.40	51.95	100%	766.40	61.53	55.26
10	2032	40 MW	315.36	299.59		0	0	0.00	6.26	6.26	40.00	40.00	0	N/A	9.73	49.20	53.54	100%	789.76	63.27	57.01
11	2033	40 MW	315.36	299.59		0	0	0.00	6.26	6.26	40.00	40.00	0	N/A	9.89	50.00	55.16	100%	813.71	65.05	58.79
12	2034	40 MW	315.36	299.59		2	15.67	15.67	6.26	21.93	40.00	40.00	0	N/A	10.05	50.80	56.88	100%	839.01	66.92	44.99
13	2035	40 MW	315.36	299.59		0	0	0.00	6.26	6.26	40.00	40.00	0	N/A	10.21	51.60	57.97	100%	855.15	68.18	61.91
14	2036	40 MW	315.36	299.59		0	0	0.00	6.26	6.26	40.00	40.00	0	N/A	10.36	52.40	59.74	100%	881.21	70.10	63.84
15	2037	40 MW	315.36	299.59		0	0	0.00	6.26	6.26	40.00	40.00	0	N/A	10.52	53.20	60.81	100%	897.08	71.34	65.07
16	2038	40 MW	315.36	299.59		0	0	0.00	6.26	6.26	40.00	40.00	0	N/A	10.88	55.00	62.61	100%	923.53	73.48	67.22
17	2039	40 MW	315.36	299.59		1	8.87	8.87	6.26	15.13	40.00	40.00	0	N/A	10.84	54.80	64.00	100%	944.05	74.84	59.70
18	2040	40 MW	315.36	299.59		0	0	0.00	6.26	6.26	40.00	40.00	0	N/A	11.00	55.60	66.00	100%	973.58	77.00	70.73
19	2041	40 MW	315.36	299.59		0	0	0.00	6.26	6.26	40.00	40.00	0	N/A	11.16	56.40	69.18	100%	1020.56	80.34	74.08
20	2042	40 MW	315.36	299.59		0	0	0.00	6.26	6.26	40.00	40.00	0	N/A	11.31	57.20	72.52	100%	1069.80	83.84	77.57
21	2043	40 MW	315.36	299.59		0	0	0.00	6.26	6.26	40.00	40.00	0	N/A	11.87	60.00	76.02	100%	1121.42	87.89	81.62
22	2044	40 MW	315.36	299.59		2	15.67	15.67	6.26	21.93	40.00	40.00	0	N/A	11.63	58.80	79.69	100%	1175.53	91.32	69.39
23	2045	40 MW	315.36	299.59		0	0	0.00	6.26	6.26	40.00	40.00	0	N/A	11.79	59.60	83.53	100%	1232.24	95.32	89.06
24	2046	40 MW	315.36	299.59		0	0	0.00	6.26	6.26	40.00	40.00	0	N/A	11.95	60.40	87.56	100%	1291.70	99.51	93.25
25	2047	40 MW	315.36	299.59		0	0	0.00	6.26	6.26	40.00	40.00	0	N/A	12.10	61.20	91.79	100%	1354.03	103.89	97.63
26	2048	40 MW	315.36	299.59		0	0	0.00	6.26	6.26	40.00	40.00	0	N/A	12.66	64.00	96.22	100%	1419.36	108.88	102.61
27	2049	40 MW	315.36	299.59		2	15.67	15.67	6.26	21.93	40.00	40.00	0	N/A	12.42	62.80	100.86	100%	1487.84	113.28	91.35
28	2050	40 MW	315.36	299.59		0	0	0.00	6.26	6.26	40.00	40.00	0	N/A	12.58	63.60	105.73	100%	1559.63	118.31	112.04
29	2051	40 MW	315.36	299.59		0	0	0.00	6.26	6.26	40.00	40.00	0	N/A	12.74	64.40	110.83	100%	1634.88	123.57	117.30
30	2052	40 MW	315.36	299.59		0	0	0.00	6.26	6.26	40.00	40.00	0	N/A	12.90	65.20	116.18	100%	1713.77	129.07	122.81
Total					208.80	10	162.91	289.22	187.93						319.04		2049.54			2368.58	1891.43
																				TIRE	17.69%
																				VANE	80.02

Table 5: Geothermal –Mombacho- project's economic return calculation

The project's financial return calculation is shown as follows, taking into account the project's real costs in order to calculate the IRR_E (*Financial IRR, FIRR)*, without taking into account an investor's IRR, with the possible positive effect that the project's financing could have (Project Finance).

Mombacho		Generación y Ventas			Ingresos			Inversión					O&M	Financiamiento					Impuestos				Gastos		Flujos proyecto	Flujos Equity
N°	Año	Potencia	Generación		PPA (Tarifa)	Peaje (Tarifa)	Total	CAPEX Inicial	CAPEX Desarrollador	# pozos adicionales	Reinversión	Total inversión	Costos	Deuda Const	Gastos de transacción	Repago al GNI	Deuda Sr	Depreciación fiscal	IR apalancado	IR sin apalanc.	IMI	Totales apalancados	Totales sin apalanc.	Netos sin apalanc.	Netos apalancados
		bruta	Bruta	Neta																						
		1.1	1.2	1.3	2.1	2.2	2.3	3.1	3.2	4.1	4.2	5 = 3 + 4.2	6	7.1	7.2	7.3	7.4	8	8.1a	8.1b	8.2	9 = 6+7+8	10 = 5+6+8	8 = 2 - 7	8 = 2 - 7
		MW	GWh	GWh	$/MWh		MUS$	MUS$	MUS$	#	MUS$	MUS$	MUS$	MUS$	MUS$	MUS$	MUS$	MUS$	MUS$	MUS$	MUS$	MUS$	MUS$	MUS$	MUS$	MUS$
C1	2016							1.89	0.00			1.89		0.00		0.00	0					0.00	1.89	-1.89	0.00
C2	2017							23.94	0.00			23.94		0.00		0.00	0					0.00	23.94	-23.94	0.00
C3	2018							3.50	0.00			3.50		0.00		0.00	0					0.00	3.50	-3.50	0.00
C4	2019							2.96	45.25			2.96		1.13		0.00	0					9.28	2.96	-2.96	-9.28
C5	2020							53.39	45.25			53.39		2.26		0.00	0					9.50	53.39	-53.39	-9.50
C6	2021							81.23	45.25			81.23		3.39		0.00	0					9.73	81.23	-81.23	-9.73
C7	2022							45.38	45.25			45.38		4.52	7.10	31.31	0					17.63	45.38	-45.38	-17.63
1	2023	40 MW	315.36	299.59	116.54	4.63	33.53			0	0.00	0.00	6.37	0.00		0.00	19.93	10.61	0.00	0.00	0.08	26.38	6.45	27.08	7.15
2	2024	40 MW	315.36	299.59	120.04	4.68	34.56			0	0.00	0.00	6.56	0.00		0.00	19.93	10.61	0.00	0.00	0.09	26.57	6.65	27.92	7.99
3	2025	40 MW	315.36	299.59	123.64	4.72	35.63			0	0.00	0.00	6.76	0.00		0.00	19.93	10.61	0.00	0.00	0.09	26.77	6.85	28.78	8.85
4	2026	40 MW	315.36	299.59	127.35	4.77	36.72			2	18.02	18.02	6.96	0.00		0.00	19.93	10.61	0.00	0.00	0.18	45.09	25.16	11.56	-8.37
5	2027	40 MW	315.36	299.59	131.17	4.82	37.85			0	0.00	0.00	7.17	0.00		0.00	19.93	10.61	0.00	0.00	0.19	27.28	7.36	30.50	10.57
6	2028	40 MW	315.36	299.59	135.11	4.87	39.02			0	0.00	0.00	7.38	0.00		0.00	19.93	10.61	0.00	0.00	0.20	27.51	7.58	31.44	11.51
7	2029	40 MW	315.36	299.59	139.16	4.91	40.22			0	0.00	0.00	7.60	0.00		0.00	19.93	10.61	0.00	0.00	0.20	27.73	7.81	32.41	12.49
8	2030	40 MW	315.36	299.59	143.33	4.96	41.45			1	10.20	10.20	7.83	0.00		0.00	19.93	10.61	3.69	10.09	0.21	41.86	28.33	13.13	-0.41
9	2031	40 MW	315.36	299.59	147.63	5.01	42.73			0	0.00	0.00	8.07	0.00		0.00	19.93	10.61	4.00	10.40	0.32	32.32	18.79	23.94	10.41
10	2032	40 MW	315.36	299.59	152.06	5.06	44.04			0	0.00	0.00	8.31	0.00		0.00	19.93	10.61	4.32	10.72	0.33	32.89	19.36	24.68	11.15
11	2033	40 MW	315.36	299.59	156.62	5.11	45.39			0	0.00	0.00	8.56	0.00		0.00	19.93	10.61	4.66	11.05	0.45	33.60	20.06	25.33	11.80
12	2034	40 MW	315.36	299.59	160.00	5.17	46.39			2	18.02	18.02	8.82	0.00		0.00	19.93	10.61	4.88	11.27	0.46	52.10	38.57	7.82	-5.72
13	2035	40 MW	315.36	299.59	160.00	5.22	46.37			0	0.00	0.00	9.08	0.00		0.00	19.93	10.61	4.79	11.19	0.46	34.26	20.73	25.64	12.11
14	2036	40 MW	315.36	299.59	160.00	5.27	46.36			0	0.00	0.00	9.35	0.00		0.00	19.93	10.61	4.71	11.10	0.46	34.45	20.92	25.44	11.91
15	2037	40 MW	315.36	299.59	160.00	5.32	46.34			0	0.00	0.00	9.63	0.00		0.00	19.93	10.61	4.62	11.01	0.46	34.64	21.11	25.23	11.70
16	2038	40 MW	315.36	299.59	160.00	5.38	46.32			0	0.00	0.00	9.92	0.00		0.00	19.93	10.61	4.53	10.92	0.46	34.84	21.31	25.02	11.49
17	2039	40 MW	315.36	299.59	160.00	5.43	46.31			1	10.20	10.20	10.22	0.00		0.00	19.93	10.61	4.43	10.83	0.46	45.24	31.71	14.60	1.07
18	2040	40 MW	315.36	299.59	160.00	5.48	46.29			0	0.00	0.00	10.53	0.00		0.00	19.93	10.61	4.34	10.73	0.46	35.25	21.72	24.57	11.04
19	2041	40 MW	315.36	299.59	160.00	5.54	46.28			0	0.00	0.00	10.84	0.00		0.00	19.93	10.61	4.24	10.63	0.46	35.47	21.94	24.34	10.81
20	2042	40 MW	315.36	299.59	160.00	5.59	46.26			0	0.00	0.00	11.17	0.00		0.00	19.93	10.61	4.13	10.53	0.46	35.69	22.16	24.10	10.57
21	2043	40 MW	315.36	299.59	160.00	5.65	46.24			0	0.00	0.00	11.50	0.00		0.00	0.00	0.00	10.42	10.42	0.46	22.39	22.39	23.86	23.86
22	2044	40 MW	315.36	299.59	160.00	5.71	46.23			2	18.02	18.02	11.85	0.00		0.00	0.00	0.00	10.31	10.31	0.46	40.64	40.64	5.58	5.58
23	2045	40 MW	315.36	299.59	160.00	5.76	46.21			0	0.00	0.00	12.20	0.00		0.00	0.00	0.00	10.20	10.20	0.46	22.87	22.87	23.34	23.34
24	2046	40 MW	315.36	299.59	160.00	5.82	46.19			0	0.00	0.00	12.57	0.00		0.00	0.00	0.00	10.09	10.09	0.46	23.12	23.12	23.07	23.07
25	2047	40 MW	315.36	299.59	160.00	5.88	46.17			0	0.00	0.00	12.95	0.00		0.00	0.00	0.00	9.97	9.97	0.46	23.38	23.38	22.80	22.80
26	2048	40 MW	315.36	299.59	160.00	5.94	46.16			0	0.00	0.00	13.34	0.00		0.00	0.00	0.00	9.85	9.85	0.46	23.64	23.64	22.51	22.51
27	2049	40 MW	315.36	299.59	160.00	6.00	46.14			2	18.02	18.02	13.74	0.00		0.00	0.00	0.00	9.72	9.72	0.46	41.94	41.94	4.20	4.20
28	2050	40 MW	315.36	299.59	160.00	6.06	46.12			0	0.00	0.00	14.15	0.00		0.00	0.00	0.00	9.59	9.59	0.46	24.20	24.20	21.92	21.92
29	2051	40 MW	315.36	299.59	160.00	6.12	46.10			0	0.00	0.00	14.57	0.00		0.00	0.00	0.00	9.46	9.46	0.46	24.49	24.49	21.61	21.61
30	2052	40 MW	315.36	299.59	160.00	6.18	46.08			0	0.00	0.00	15.01	0.00		0.00	0.00	0.00	9.32	9.32	0.46	24.79	24.79	21.29	21.29
Total							1309.70	212.29	180.99	10	197.55	304.78	303.00	11.31	7.10	31.31	398.53	212.29	156.27	239.39	11.13	1007.55	858.29	Sin apalanc.	Con apalanc.
																								TIRF	8.92%	13.84%
																								VANF	-29.00	5.01

CAPEX apalacando desarrollador 230.70

Table 6: Report on the geothermal project's financial return – Mombacho

Scenario	Production (gross)	Initial Investment CAPEX (local cost) US$ Millions	Tariff US/MWh	Economic Internal Rate of Return IRR_E %	Financial Internal Rate of Return IRR_F %
Mombacho 40 MW	40 MWe	US$ 212.29 M Over 30 years US$ 304.78 M	Energy $92/MWh Power: 0 All-in (2016): 92/MWh	17.69%	13.84%

Table 7: ACB Summary Mombacho

Source: Our own preparation based on studies and application of ACB models

Project Mombacho's sensibility analysis

The performed sensibility analysis allows concluding that the Mombacho 40 MW project turns out being economically feasible, even when facing changes in key variables assumed in the analysis. Independently, variations were analyzed in: the established tariff, and its impact on (a) the IRR_E , the average VAN_E by user and (c) the total VAN_E. The following are the analyzed variables and their impact:

Sensibilidad financiera: deuda senior

TIRf	Caso base 13.84%	Tasa de Deuda Senior (%) 7%	8%	9%	10%	11%
Tarifa 2015 "All-In" del PPA	74 US$/MWh	9.3%	8.1%	7.0%	5.9%	4.9%
	83 US$/MWh	13.1%	11.7%	10.3%	8.9%	7.7%
	92 US$/MWh	17.0%	15.4%	13.8%	12.2%	10.7%
	102 US$/MWh	21.4%	19.7%	18.0%	16.2%	14.4%
	120 US$/MWh	27.4%	25.7%	23.9%	22.0%	20.0%

TIRf	Caso base 13.84%	Plazo de Deuda Senior (años) 30	25	20	15	10
Tarifa 2015 "All-In" del PPA	74 US$/MWh	6.7%	6.9%	7.0%	7.1%	7.1%
	83 US$/MWh	11.4%	10.8%	10.3%	9.7%	9.3%
	92 US$/MWh	15.9%	15.0%	13.8%	12.6%	11.5%
	102 US$/MWh	20.5%	19.5%	18.0%	16.0%	14.0%
	120 US$/MWh	26.7%	25.6%	23.9%	21.2%	17.8%

Sensibilidad financiera: inversión

TIRf	Caso base 13.84%	Costo de inversión (Planta - $/W) 1.3	1.4	1.5	1.6	1.7
Tarifa 2015 "All-In" del PPA	74 US$/MWh	8.1%	7.6%	7.0%	6.5%	6.0%
	83 US$/MWh	11.7%	11.0%	10.3%	9.6%	9.0%
	92 US$/MWh	15.6%	14.7%	13.8%	13.0%	12.3%
	102 US$/MWh	20.0%	19.0%	18.0%	17.0%	16.1%
	120 US$/MWh	26.2%	25.1%	23.9%	22.8%	21.7%

TIRf	Caso base 13.84%	Costo de perforación (MUS$/pozo) 4.5	5.5	6.5	7.5	8.5
Tarifa 2015 "All-In" del PPA	74 US$/MWh	12.0%	9.3%	7.0%	5.0%	3.2%
	83 US$/MWh	16.3%	13.1%	10.3%	7.8%	5.7%
	92 US$/MWh	20.8%	17.1%	13.8%	10.9%	8.3%
	102 US$/MWh	25.5%	21.6%	18.0%	14.6%	11.4%
	120 US$/MWh	32.1%	27.9%	23.9%	20.0%	16.2%

Sensibilidad financiera: impuestos

TIRf	Caso base 13.84%	Tasa de IR (%) 0.0%	10%	20%	25%	30%
Tarifa 2015 "All-In" del PPA	74 US$/MWh	9.2%	8.6%	7.8%	7.4%	7.0%
	83 US$/MWh	12.6%	11.9%	11.1%	10.7%	10.3%
	92 US$/MWh	16.1%	15.4%	14.7%	14.3%	13.8%
	102 US$/MWh	20.0%	19.4%	18.7%	18.3%	18.0%
	120 US$/MWh	25.4%	24.9%	24.4%	24.2%	23.9%

TIRf	Caso base 13.84%	Años de exoneración de IR 30	25	20	15	10
Tarifa 2015 "All-In" del PPA	74 US$/MWh	9.2%	8.8%	8.1%	7.6%	7.2%
	83 US$/MWh	12.6%	12.4%	11.8%	11.4%	10.7%
	92 US$/MWh	16.1%	16.0%	15.6%	15.3%	14.5%
	102 US$/MWh	20.0%	19.9%	19.7%	19.5%	18.8%
	120 US$/MWh	25.4%	25.3%	25.2%	25.1%	24.7%

Sensibilidad económica: inversión

TIRe	Caso base 17.69%	Costo de inversión (Planta - $/W) 1.3	1.4	1.5	1.6	1.7
Costo de perforación (MUS$/pozo)	4.50	20.6%	20.2%	19.9%	19.5%	19.2%
	5.50	19.3%	19.0%	18.7%	18.4%	18.1%
	6.50	18.2%	18.0%	17.7%	17.4%	17.2%
	7.50	17.3%	17.0%	16.7%	16.5%	16.3%
	8.50	16.4%	16.1%	15.9%	15.7%	15.5%

Sensibilidad económica: HFO

VANe	80.02 MUS$	Precios tCO2 - Escenarios bajo, medio, alto Bajo	Medio	Alto
Tasa de descuento	8%	194.6 MUS$	238.8 MUS$	370.2 MUS$
	10%	109.3 MUS$	141.5 MUS$	236.1 MUS$
	12%	56.1 MUS$	80.0 MUS$	149.9 MUS$
	14%	22.3 MUS$	40.5 MUS$	93.3 MUS$
	16%	0.6 MUS$	14.7 MUS$	55.3 MUS$

Sensibilidad económica: HFO vs tCO2

TIRe	Caso base 17.69%	Precio tCO2 - Escenarios bajo, medio, alto Bajo	Medio	Alto
Precio HFO - Escenarios bajo, medio, alto	Bajo	13.35%	15.12%	19.71%
	Medio	16.08%	17.69%	21.90%
	Alto	18.53%	20.02%	23.94%

Sensibilidad económica: HFO

VANe	80.02 MUS$	Precio HFO - Escenarios bajo, medio, alto Bajo	Medio	Alto
Tasa de descuento	8%	164.4 MUS$	238.8 MUS$	313.2 MUS$
	10%	88.6 MUS$	141.5 MUS$	194.3 MUS$
	12%	41.4 MUS$	80.0 MUS$	118.6 MUS$
	14%	11.6 MUS$	40.5 MUS$	69.4 MUS$
	16%	-7.3 MUS$	14.7 MUS$	36.8 MUS$

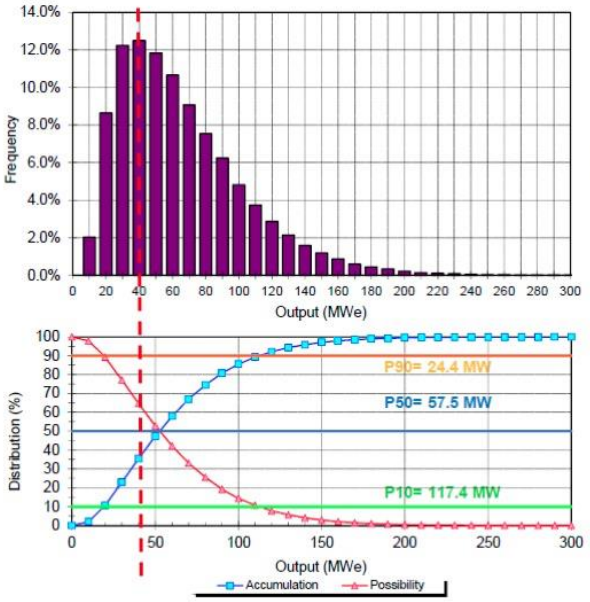
Table 8: Sensibility analysis - Mombacho

Source: Our own elaboration based on studies and application of ACB models

CALDERA DE APOYO

Cost-benefit analysis' methodology and results: Caldera de Apoyo (Spreadsheet)

For the **Caldera de Apoyo** field an estimate was made under the volumetric stored heat method combined with the Monte Carlo method, which proposes the following resource probabilities:



Input

Parameter	min.	most likely	max.
Reservoir Area (km^2)	2.98	-	15.79
Reservoir Thickness (m)	1000	-	2000
Rock Density (kg/m^3)	2400	2500	2600
Porosity (-)	0.05	0.10	0.15
Recovery factor (-)	0.125	0.250	0.375
Rock Specific Heat (kJ/kg°C)	-	1.00	-
Reservoir Average Temperature (°C)	200	230	280
Reservoir Average Pressure (MPa)	-	15.0	-
Heat-Electricity Conversion Factor (-)	0.045	0.072	0.105
Plant Life (year)	-	30	-
Load Factor (-)	-	0.85	-
Abandonment Temperature (°C)	-	160	-

Figure 3: Distribution of probabilities of the Caldera de Apoyo field (Monte Carlo)
Source: Pre-feasibility study West JEC, 2015

However, it was decided to minimize the geothermal potential's probability distribution, in view of the fact that half of the zone detected as source of resource is located outside the concession potential's zone and below the lake, at gross production of 20MW. This scenario has a higher than 90% probability.

Economic costs of the Caldera de Apoyo Project

The total economic cost consists of the net cost, taxes and subsidies. However, taxes and subsidies, at national economy, are simply transferred between the Project and the Government, for which reason, they are eliminated from total cost. Then, the net cost is the economic cost's basis. Besides, there is the tendency of over estimating the domestic costs by reason of the over valued rate of exchange type. Accordingly, in order to obtain economic costs it is necessary to adjust the type of exchange to the frontier's price, adjustment for which a conversion factor is used, one that was assumed discounting 10% of DAI

The considered project's investment assumptions are summarized in the following table:

Development	Slimholes Wells	Commercial Wells				
Environmental and social consultancies			0.5	0.45	0.58	0%
Civil works for the development stage			1.256	1.13	1.44	0%
Drilling for resource's evaluation (JICA)	0	0	0	0	0.00	100%
SREP support in drilling	0	0	0	0.00	0.00	100%
Feasibility study			1	1	1.15	100%
Other development wells (estimated)	0	10	70.10	70.10	80.62	100%
Construction						
Geothermal plant			44	43.032	50.60	78%
Fluids system			8.2	8.04	9.43	80%
Access ways			0.36	0.324	0.41	0%
Site			0.7	0.63	0.81	0%
Transmission line			4.703	4.46	5.41	48.3%
Administration			5	4.5	5.75	0%
Consultancy services			10	10	11.50	100%
		Cost	145.82	143.66	167.69	
Contingency			7.3	7.183	8.38	
Total CAPEX			**153.11**	**150.85**	**176.08**	
Wells during all the project						
Mobile/Withdrawal			15.75	15.75	18.11	100%
Production wells			71.5	71.50	82.23	100%
Reinjection wells			19.5	19.50	22.43	100%
Pumps			1.68	1.68	1.93	100%
Platform			0.54	0.54	0.62	100%
Total wells			**108.97**	**108.97**	**125.32**	

Table 9: Investment costs of 20 MWe (gross) project - Caldera de Apoyo
Source: ACB model of Caldera de Apoyo volcano – PELICAN, S.A.

Caldera de Apoyo Project's Economic Benefits

The investments' economic analyses, income and expenditures were made for two scenarios, with the construction of 30 and 40MWe generation plants. From the analysis made only one case was selected, that of 20MWe, in view of the awarded concession's actual size. The economic benefits' assumptions are summarized as follows:

Benefits	Value
HFO price / IF0380 (oil invoice savings)	263 US$/ton (2016)
Thermal plant (HFO consumption, efficiency 38%)	226 ton/GWh
Substitution factor	100%
Emission factor	100%
Thermal plants' CO_2 emissions	726 tCO2/GWh
Consumed vapor (geothermal efficiency)	300 TPH
Geothermal plants' CO_2 emissions	0.75%
Coal's social cost (tCO_2)	Under EPA scenario

Table 10: geothermal project's assumed economic benefits

The project's economic return is shown as follows: IRR_E (*Economical IRR, EIRR)*

Apoyo		Características			Inversión					Total de costos económicos	Beneficios económicos										Total de beneficios económicos
N°	Año	Potencia bruta	Generación		CAPEX Inicial	# pozos adicionales	Reinversión	Total inversión	O&M		Incrementales (con el proyecto)				No incremental: reducción CO2		No incrementales: ahorro de importaciones			Total	
			Bruta	Neta							8.1 MW incr.	8.2 MW base	8.3 Balance energ.	8.4 Valor $/MWh	9.1	9.2	10.1	10.2	10.3 HFO US$/t	11=8+9+10	8 = 11 - 7
	Año	1.1	1.2	1.3	3	4.1	4.2	5 = 3 + 4.2	6	7 = 5 + 6											
		MW	GWh	GWh	MUS$	#	MUS$	MUS$	MUS$	MUS$					MUS$	$/tCO2	MUS$	% sub			MUS$
C1	2016				1.34			1.34		1.34											-1.34
C2	2017				17.01			17.01		17.01											-17.01
C3	2018				2.48			2.48		2.48											-2.48
C4	2019				2.10			2.10		2.10											-2.10
C5	2020				37.93			37.93		37.93											-37.93
C6	2021				57.72			57.72		57.72											-57.72
C7	2022				32.25			32.25		32.25											-32.25
1	2023	20 MW	157.68	149.80		0	0	0.00	4.53	4.53	20.00	20.00	0	N/A	4.15	42.00	21.10	100%	622.59	25.26	20.73
2	2024	20 MW	157.68	149.80		0	0	0.00	4.53	4.53	20.00	20.00	0	N/A	4.23	42.80	21.60	100%	637.18	25.83	21.30
3	2025	20 MW	157.68	149.80		0	0	0.00	4.53	4.53	20.00	20.00	0	N/A	4.31	43.60	22.19	100%	654.64	26.50	21.98
4	2026	20 MW	157.68	149.80		1	8.87	8.87	4.53	13.40	20.00	20.00	0	N/A	4.39	44.40	22.93	100%	676.40	27.32	13.92
5	2027	20 MW	157.68	149.80		0	0	0.00	4.53	4.53	20.00	20.00	0	N/A	4.47	45.20	23.54	100%	694.62	28.01	23.49
6	2028	20 MW	157.68	149.80		0	0	0.00	4.53	4.53	20.00	20.00	0	N/A	4.55	46.00	24.06	100%	709.97	28.61	24.09
7	2029	20 MW	157.68	149.80		0	0	0.00	4.53	4.53	20.00	20.00	0	N/A	4.63	46.80	24.77	100%	730.66	29.39	24.87
8	2030	20 MW	157.68	149.80		1	8.87	8.87	4.53	13.40	20.00	20.00	0	N/A	4.71	47.60	25.19	100%	743.31	29.90	16.51
9	2031	20 MW	157.68	149.80		0	0	0.00	4.53	4.53	20.00	20.00	0	N/A	4.79	48.40	25.98	100%	766.40	30.76	26.24
10	2032	20 MW	157.68	149.80		0	0	0.00	4.53	4.53	20.00	20.00	0	N/A	4.87	49.20	26.77	100%	789.76	31.63	27.11
11	2033	20 MW	157.68	149.80		0	0	0.00	4.53	4.53	20.00	20.00	0	N/A	4.94	50.00	27.58	100%	813.71	32.53	28.00
12	2034	20 MW	157.68	149.80		0	0	0.00	4.53	4.53	20.00	20.00	0	N/A	5.02	50.80	28.44	100%	839.01	33.46	28.94
13	2035	20 MW	157.68	149.80		0	0	0.00	4.53	4.53	20.00	20.00	0	N/A	5.10	51.60	28.99	100%	855.15	34.09	29.56
14	2036	20 MW	157.68	149.80		0	0	0.00	4.53	4.53	20.00	20.00	0	N/A	5.18	52.40	29.87	100%	881.21	35.05	30.53
15	2037	20 MW	157.68	149.80		2	15.67	15.67	4.53	20.20	20.00	20.00	0	N/A	5.26	53.20	30.41	100%	897.08	35.67	15.47
16	2038	20 MW	157.68	149.80		0	0	0.00	4.53	4.53	20.00	20.00	0	N/A	5.44	55.00	31.30	100%	923.53	36.74	32.22
17	2039	20 MW	157.68	149.80		0	0	0.00	4.53	4.53	20.00	20.00	0	N/A	5.42	54.80	32.00	100%	944.05	37.42	32.89
18	2040	20 MW	157.68	149.80		0	0	0.00	4.53	4.53	20.00	20.00	0	N/A	5.50	55.60	33.00	100%	973.58	38.50	33.97
19	2041	20 MW	157.68	149.80		0	0	0.00	4.53	4.53	20.00	20.00	0	N/A	5.58	56.40	34.59	100%	1020.56	40.17	35.64
20	2042	20 MW	157.68	149.80		0	0	0.00	4.53	4.53	20.00	20.00	0	N/A	5.66	57.20	36.26	100%	1069.80	41.92	37.39
21	2043	20 MW	157.68	149.80		1	8.87	8.87	4.53	13.40	20.00	20.00	0	N/A	5.93	60.00	38.01	100%	1121.42	43.94	30.55
22	2044	20 MW	157.68	149.80		0	0	0.00	4.53	4.53	20.00	20.00	0	N/A	5.82	58.80	39.84	100%	1175.53	45.66	41.13
23	2045	20 MW	157.68	149.80		0	0	0.00	4.53	4.53	20.00	20.00	0	N/A	5.89	59.60	41.77	100%	1232.24	47.66	43.14
24	2046	20 MW	157.68	149.80		0	0	0.00	4.53	4.53	20.00	20.00	0	N/A	5.97	60.40	43.78	100%	1291.70	49.76	45.23
25	2047	20 MW	157.68	149.80		0	0	0.00	4.53	4.53	20.00	20.00	0	N/A	6.05	61.20	45.89	100%	1354.03	51.95	47.42
26	2048	20 MW	157.68	149.80		0	0	0.00	4.53	4.53	20.00	20.00	0	N/A	6.33	64.00	48.11	100%	1419.36	54.44	49.91
27	2049	20 MW	157.68	149.80		0	0	0.00	4.53	4.53	20.00	20.00	0	N/A	6.21	62.80	50.43	100%	1487.84	56.64	52.12
28	2050	20 MW	157.68	149.80		1	8.87	8.87	4.53	13.40	20.00	20.00	0	N/A	6.29	63.60	52.86	100%	1559.63	59.15	45.76
29	2051	20 MW	157.68	149.80		0	0	0.00	4.53	4.53	20.00	20.00	0	N/A	6.37	64.40	55.41	100%	1634.88	61.78	57.26
30	2052	20 MW	157.68	149.80		0	0	0.00	4.53	4.53	20.00	20.00	0	N/A	6.45	65.20	58.09	100%	1713.77	64.54	60.01
Total					**150.84**	**6**	**117.97**	**201.99**	**135.76**						**159.52**		**1024.77**			**1184.29**	**846.54**
																				TIRE	**12.88%**
																				VANE	**8.03**

Table 11: Caldera de Apoyo – geothermal project's economic return report

The project's financial report calculation is shown as follows, taking into account the project's real costs in order to calculate the IRR_E (*Economical IRR, EIRR)*, without taking into account an investor's IRR, with the possible effect that would have the project's financing (Project Finance).

Apoyo		Generación y Ventas			Ingresos			Inversión					O&M	Financiamiento				Impuestos				Gastos		Flujos proyecto	Flujos Equity
N°	Año	Potencia bruta	Generación		PPA (Tarifa)	Peaje (Tarifa)	Total	CAPEX Inicial	CAPEX Desarrollador	# pozos adicionales	Reinversión	Total inversión	Costos	Deuda Const	Gastos de transacción	Repago al GNI	Deuda Sr	Depreciación fiscal	IR apalancado	IR sin apalanc.	IMI	Totales apalancados	Totales sin apalanc.	Netos sin apalanc.	Netos apalancados
		1.1	Bruta 1.2	Neta 1.3	2.1	2.2	2.3	3.1	3.2	4.1	4.2	5 = 3 + 4.2	6	7.1	7.2	7.3	7.4	8	8.1a	8.1b	8.2	9 = 6+7+8	10 = 5+6+8	8 = 2 - 7	8 = 2 - 7
		MW	GWh	GWh	$/MWh		MUS$	MUS$	MUS$	#	MUS$	MUS$	MUS$	MUS$	MUS$	MUS$	MUS$	MUS$	MUS$	MUS$	MUS$	MUS$	MUS$	MUS$	MUS$
C1	2016							1.36	0.00			1.36		0.00		0.00	0					0.00	1.36	-1.36	0.00
C2	2017							17.26	0.00			17.26		0.00		0.00	0					0.00	17.26	-17.26	0.00
C3	2018							2.52	0.00			2.52		0.00		0.00	0					0.00	2.52	-2.52	0.00
C4	2019							2.14	37.59			2.14		0.94		0.00	0					7.71	2.14	-2.14	-7.71
C5	2020							38.50	37.59			38.50		1.88		0.00	0					7.89	38.50	-38.50	-7.89
C6	2021							58.59	37.59			58.59		2.82		0.00	0					8.08	58.59	-58.59	-8.08
C7	2022							32.73	37.59			32.73		3.76	5.67	2.76	0					9.96	32.73	-32.73	-9.96
1	2023	20 MW	157.68	149.80	116.54	4.63	16.76			0	0.00	0.00	4.59	0.00		0.00	14.53	7.66	0.00	0.00	0.04	19.16	4.64	12.13	-2.40
2	2024	20 MW	157.68	149.80	120.04	4.68	17.28			0	0.00	0.00	4.73	0.00		0.00	14.53	7.66	0.00	0.00	0.04	19.30	4.77	12.51	-2.02
3	2025	20 MW	157.68	149.80	123.64	4.72	17.81			0	0.00	0.00	4.87	0.00		0.00	14.53	7.66	0.00	0.00	0.04	19.44	4.92	12.90	-1.63
4	2026	20 MW	157.68	149.80	127.35	4.77	18.36			1	10.20	10.20	5.02	0.00		0.00	14.53	7.66	0.00	0.00	0.09	29.84	15.31	3.05	-11.48
5	2027	20 MW	157.68	149.80	131.17	4.82	18.93			0	0.00	0.00	5.17	0.00		0.00	14.53	7.66	0.00	0.00	0.09	19.79	5.26	13.66	-0.86
6	2028	20 MW	157.68	149.80	135.11	4.87	19.51			0	0.00	0.00	5.32	0.00		0.00	14.53	7.66	0.00	0.00	0.10	19.95	5.42	14.09	-0.44
7	2029	20 MW	157.68	149.80	139.16	4.91	20.11			0	0.00	0.00	5.48	0.00		0.00	14.53	7.66	0.00	0.00	0.10	20.11	5.59	14.52	0.00
8	2030	20 MW	157.68	149.80	143.33	4.96	20.73			1	10.20	10.20	5.65	0.00		0.00	14.53	7.66	0.00	4.52	0.10	30.48	20.48	0.25	-9.75
9	2031	20 MW	157.68	149.80	147.63	5.01	21.36			0	0.00	0.00	5.82	0.00		0.00	14.53	7.66	0.03	4.66	0.16	20.53	10.64	10.72	0.83
10	2032	20 MW	157.68	149.80	152.06	5.06	22.02			0	0.00	0.00	5.99	0.00		0.00	14.53	7.66	0.17	4.81	0.17	20.86	10.97	11.05	1.16
11	2033	20 MW	157.68	149.80	156.62	5.11	22.70			0	0.00	0.00	6.17	0.00		0.00	14.53	7.66	0.32	4.96	0.23	21.25	11.36	11.34	1.45
12	2034	20 MW	157.68	149.80	160.00	5.17	23.19			0	0.00	0.00	6.36	0.00		0.00	14.53	7.66	0.41	5.05	0.23	21.53	11.64	11.55	1.66
13	2035	20 MW	157.68	149.80	160.00	5.22	23.19			0	0.00	0.00	6.55	0.00		0.00	14.53	7.66	0.35	4.99	0.23	21.66	11.77	11.41	1.52
14	2036	20 MW	157.68	149.80	160.00	5.27	23.18			0	0.00	0.00	6.75	0.00		0.00	14.53	7.66	0.29	4.93	0.23	21.80	11.91	11.27	1.38
15	2037	20 MW	157.68	149.80	160.00	5.32	23.17			2	18.02	18.02	6.95	0.00		0.00	14.53	7.66	0.23	4.87	0.23	39.96	30.07	-6.90	-16.79
16	2038	20 MW	157.68	149.80	160.00	5.38	23.16			0	0.00	0.00	7.16	0.00		0.00	14.53	7.66	0.17	4.80	0.23	22.08	12.19	10.97	1.08
17	2039	20 MW	157.68	149.80	160.00	5.43	23.15			0	0.00	0.00	7.37	0.00		0.00	14.53	7.66	0.10	4.73	0.23	22.23	12.34	10.82	0.93
18	2040	20 MW	157.68	149.80	160.00	5.48	23.15			0	0.00	0.00	7.59	0.00		0.00	14.53	7.66	0.03	4.67	0.23	22.38	12.49	10.66	0.77
19	2041	20 MW	157.68	149.80	160.00	5.54	23.14			0	0.00	0.00	7.82	0.00		0.00	14.53	7.66	0.00	4.60	0.23	22.58	12.65	10.49	0.56
20	2042	20 MW	157.68	149.80	160.00	5.59	23.13			0	0.00	0.00	8.05	0.00		0.00	14.53	7.66	0.00	4.52	0.23	22.81	12.81	10.32	0.32
21	2043	20 MW	157.68	149.80	160.00	5.65	23.12			1	10.20	10.20	8.30	0.00		0.00	0.00	0.00	4.45	4.45	0.23	23.18	23.18	-0.05	-0.05
22	2044	20 MW	157.68	149.80	160.00	5.71	23.11			0	0.00	0.00	8.54	0.00		0.00	0.00	0.00	4.37	4.37	0.23	13.15	13.15	9.97	9.97
23	2045	20 MW	157.68	149.80	160.00	5.76	23.10			0	0.00	0.00	8.80	0.00		0.00	0.00	0.00	4.29	4.29	0.23	13.32	13.32	9.78	9.78
24	2046	20 MW	157.68	149.80	160.00	5.82	23.10			0	0.00	0.00	9.07	0.00		0.00	0.00	0.00	4.21	4.21	0.23	13.51	13.51	9.59	9.59
25	2047	20 MW	157.68	149.80	160.00	5.88	23.09			0	0.00	0.00	9.34	0.00		0.00	0.00	0.00	4.12	4.12	0.23	13.69	13.69	9.39	9.39
26	2048	20 MW	157.68	149.80	160.00	5.94	23.08			0	0.00	0.00	9.62	0.00		0.00	0.00	0.00	4.04	4.04	0.23	13.89	13.89	9.19	9.19
27	2049	20 MW	157.68	149.80	160.00	6.00	23.07			0	0.00	0.00	9.91	0.00		0.00	0.00	0.00	3.95	3.95	0.23	14.09	14.09	8.98	8.98
28	2050	20 MW	157.68	149.80	160.00	6.06	23.06			1	10.20	10.20	10.20	0.00		0.00	0.00	0.00	3.86	3.86	0.23	24.49	24.49	-1.43	-1.43
29	2051	20 MW	157.68	149.80	160.00	6.12	23.05			0	0.00	0.00	10.51	0.00		0.00	0.00	0.00	3.76	3.76	0.23	14.50	14.50	8.55	8.55
30	2052	20 MW	157.68	149.80	160.00	6.18	23.04			0	0.00	0.00	10.82	0.00		0.00	0.00	0.00	3.67	3.67	0.23	14.72	14.72	8.32	8.32
Total							**654.85**	**153.11**	**150.35**	**6**	**135.67**	**211.93**	**218.53**	**9.40**	**5.67**	**2.76**	**290.53**	**153.11**	**42.82**	**102.83**	**5.56**	**649.90**	**538.85**	**Sin apalanc.**	**Con apalanc.**
																								TIRF	**3.98%**	**0.31%**
																								VANF	**-47.38**	**-23.90**

CAPEX apalacando desarrollador: 168.18

Table 12: Caldera de Apoyo – geothermal project's financial return calculation report

Scenario	Production (gross)	Initial Investment CAPEX (local cost) US$ Millions	Tariff US/MWh	Economic Internal Rate of Return IRR_E %	Financial Internal Rate of Return IRR_F %
20 MW	20 MWe	US$ 153.11M Over 30 years: US$ 211.93M	Energy: $92/MWh Power: 0/kW-m All-in 2016: $92/MWh	12.88%	0.31%

Table 13: ACB Summary - Caldera de Apoyo

Source: Our own elaboration based on studies and ACB models application

Caldera de Apoyo Project's sensibility analysis

The performed sensibility analysis allows concluding that the Caldera de Apoyo 20 MW project turns out being economically feasible, even when facing changes in key variables assumed in the analysis. Independently, variations were analyzed in: (i) the investment cost; and (ii) the established tariff. And its impact on (a) the IRR_E , the average VAN_E by user and (c) the total VAN_E.

The following are the analyzed variables and their impact:

Sensibilidad financiera: deuda senior

TIRf	Caso base 0.31%	Tasa de Deuda Senior (%) 7%	8%	9%	10%	11%
Tarifa 2015 "All-In" del PPA	74 US$/MWh	N/A	N/A	N/A	N/A	N/A
	83 US$/MWh	0.9%	N/A	N/A	N/A	N/A
	92 US$/MWh	2.6%	1.4%	0.3%	N/A	N/A
	102 US$/MWh	4.4%	3.0%	1.7%	0.4%	N/A
	120 US$/MWh	7.0%	5.1%	3.4%	1.8%	0.2%

TIRf	Caso base 0.31%	Plazo de Deuda Senior (años) 30	25	20	15	10
Tarifa 2015 "All-In" del PPA	74 US$/MWh	N/A	N/A	N/A	N/A	0.5%
	83 US$/MWh	N/A	N/A	N/A	0.6%	1.8%
	92 US$/MWh	N/A	N/A	0.3%	1.9%	2.9%
	102 US$/MWh	N/A	N/A	1.7%	3.0%	3.9%
	120 US$/MWh	N/A	1.0%	3.4%	4.5%	5.2%

Sensibilidad financiera: inversión

TIRf	Caso base 0.31%	Costo de inversión (Planta - $/W) 1.8	2.0	2.2	2.4	2.6
Tarifa 2015 "All-In" del PPA	74 US$/MWh	N/A	N/A	N/A	N/A	N/A
	83 US$/MWh	0.3%	N/A	N/A	N/A	N/A
	92 US$/MWh	1.9%	1.1%	0.3%	N/A	N/A
	102 US$/MWh	3.5%	2.6%	1.7%	0.8%	N/A
	120 US$/MWh	5.8%	4.6%	3.4%	2.4%	1.3%

TIRf	Caso base 0.31%	Costo de perforación (MUS$/pozo) 4.5	5.5	6.5	7.5	8.5
Tarifa 2015 "All-In" del PPA	74 US$/MWh	1.4%	N/A	N/A	N/A	N/A
	83 US$/MWh	3.5%	1.1%	N/A	N/A	N/A
	92 US$/MWh	5.5%	2.7%	0.3%	N/A	N/A
	102 US$/MWh	7.8%	4.5%	1.7%	N/A	N/A
	120 US$/MWh	11.3%	7.0%	3.4%	0.2%	N/A

Sensibilidad financiera: impuestos

TIRf	Caso base 0.31%	Tasa de IR (%) 0.0%	10%	20%	25%	30%
Tarifa 2015 "All-In" del PPA	74 US$/MWh	N/A	N/A	N/A	N/A	N/A
	83 US$/MWh	1.0%	0.4%	N/A	N/A	N/A
	92 US$/MWh	2.4%	1.8%	1.1%	0.7%	0.3%
	102 US$/MWh	3.8%	3.2%	2.5%	2.1%	1.7%
	120 US$/MWh	5.6%	4.9%	4.3%	3.9%	3.4%

TIRf	Caso base 0.31%	Años de exoneración de IR 30	25	20	15	10
Tarifa 2015 "All-In" del PPA	74 US$/MWh	N/A	N/A	N/A	N/A	N/A
	83 US$/MWh	1.0%	0.1%	N/A	N/A	N/A
	92 US$/MWh	2.4%	1.6%	0.4%	0.4%	0.3%
	102 US$/MWh	3.8%	3.1%	1.9%	1.9%	1.8%
	120 US$/MWh	5.6%	4.9%	3.8%	3.8%	3.6%

Sensibilidad económica: inversión

TIRe	Caso base 12.88%	Costo de inversión (Planta - $/W) 1.3	1.4	1.5	1.6	1.7
Costo de perforación (MUS$/pozo)	4.50	16.8%	16.6%	16.3%	16.1%	15.9%
	5.50	15.6%	15.3%	15.1%	14.9%	14.7%
	6.50	14.4%	14.3%	14.1%	13.9%	13.7%
	7.50	13.4%	13.3%	13.1%	12.9%	12.8%
	8.50	12.5%	12.4%	12.2%	12.1%	12.0%

Sensibilidad económica: HFO

VANe	8.03 MUS$	Precios tCO2 - Escenarios bajo, medio, alto Bajo	Medio	Alto
Tasa de descuento	8%	54.8 MUS$	76.9 MUS$	142.6 MUS$
	10%	18.1 MUS$	34.2 MUS$	81.5 MUS$
	12%	-3.9 MUS$	8.0 MUS$	43.0 MUS$
	14%	-17.1 MUS$	-8.0 MUS$	18.4 MUS$
	16%	-24.9 MUS$	-17.9 MUS$	2.4 MUS$

Sensibilidad económica: HFO vs tCO2

TIRe	Caso base 12.88%	Precio tCO2 - Escenarios bajo, medio, alto Bajo	Medio	Alto
Precio HFO - Escenarios bajo, medio, alto	Bajo	9.23%	10.69%	14.54%
	Medio	11.56%	12.88%	16.40%
	Alto	13.63%	14.86%	18.13%

Sensibilidad económica: HFO

VANe	8.03 MUS$	Precio HFO - Escenarios bajo, medio, alto Bajo	Medio	Alto
Tasa de descuento	8%	39.7 MUS$	76.9 MUS$	114.2 MUS$
	10%	7.7 MUS$	34.2 MUS$	60.6 MUS$
	12%	-11.3 MUS$	8.0 MUS$	27.3 MUS$
	14%	-22.5 MUS$	-8.0 MUS$	6.4 MUS$
	16%	-28.9 MUS$	-17.9 MUS$	-6.8 MUS$

Table 14: Sensibility Analysis – Caldera de Apoyo

Source: Our own elaboration based on studies and application of ACB models

COSIGÜINA VOLCANO

Cost-Benefit analysis' methodology and results: Cosigüina Volcano. (Spreadsheet)

For the **Cosigüina** field, important previous studies were considered.

An estimate was made under the stored heat volumetric method combined with the Monte Carlo method, which proposes the below-described resource probabilities:

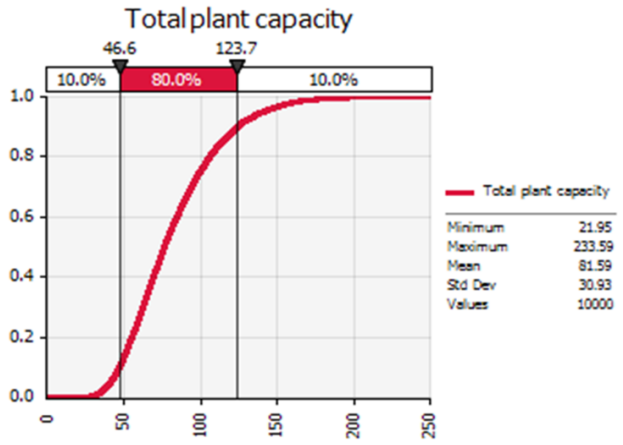


Figure 4: Distribution of probabilities of the Cosigüina field (Monte Carlo)
Source: Pre-feasibility study ACU-CAN/JACOBS. 2015

For this cost-benefit analysis, a 40 MWe scenario is selected, which has a higher than 90% probability.

Cosigüina Volcano's Project's Economic Costs

The total economic cost consists of the net cost, taxes and subsidies. However, taxes and subsidies, at national economy, are simply transferred between the Project and the Government, for which reason, they are eliminated from total cost. Then, the net cost is the economic cost's basis. Besides, there is the tendency of over estimating the domestic costs by reason of the over valued rate of exchange type, one that was assumed discounting 10% of DAI (it may be adjusted at 10%).

The considered project's investment costs are summarized at the following table:

Investment detail			Cost	Local coast	With VAT	% ext.
Development	**Slim wells**	**Commercial wells**				
Environmental and social consultancies			0.5	0.45	0.58	0%
Civil works for the development stage			1.256	1.13	1.44	0%
Drilling for resource's evaluation (PNESER)	3	0	3	3	3.45	100%
SREP support in drilling	0	5	35.05	35.05	40.31	100%
Feasibility Study			1	1	1.15	100%
Other development wells (estimated)	0	8	57.10	57.10	65.67	100%
Construction						
Geothermal plant			60	58.68	69.00	78%
Fluids system			19.3	18.91	22.20	80%
Access ways			3	2.7	3.45	0%
Site			1	0.9	1.15	0%

Transmission line (77 km to SE El Viejo)		16.7	15.84	19.21	48.3%
Administration		5	4.5	5.75	0%
Consultancy services		10	10	11.50	100%
	Cost	212.91	209.26	244.84	
Contingency		10.6	10.463	12.24	
Total CAPEX		**223.55**	**219.72**	**257.08**	
Wells during all the process					
Mobile/Withdrawal		20.25	20.25	23.29	100%
Production wells		104	104.00	119.60	100%
Reinjection wells		45.5	45.50	52.33	100%
Pumps		2.76	2.76	3.17	100%
Platform		1.26	1.26	1.45	100%
Total wells		**173.77**	**173.77**	**199.84**	

Table 15: Investment costs of 40 MWe (gross) – Cosigüina

Source: ACB model of Cosigüina volcano – PELICAN, S.A

Project Cosigüina's Economic Benefits

The economic analyses, benefits, the investments' income and expenditures were made for a sole case, that 40 MWe, in view of the actual awarded concession's and the estimated resource.

The project's assumed economic benefits are summarized as follows:

Benefits	**Value**
HFO price / IF0380 (oil invoice savings)	263 US$/ton (2016)
Thermal plant (HFO consumption, efficiency 38%)	226 ton/GWh
Substitution factor	100%
Emission factor	100%
Geothermal plants CO_2 emissions	726 tCO2/GWh
Consumed vapor (geothermal efficiency)	300 TPH
Geothermal plants' CO_2 emissions	0.75%
Coal's social; cost (tCO_2)	Under EPA scenario

Table 16: Geothermal project's assumed economic benefits

The project's economic return calculations is shown below, TIR_E (*Economical IRR, EiRR*)

Cosigüina		Características			Inversión					Total de costos económicos	Beneficios económicos										Total de beneficios económicos
N°	Año	Potencia bruta	Generación		CAPEX Inicial	# pozos adicionales	Reinversión	Total inversión	O&M		Incrementales (con el proyecto)				No incremental: reducción CO2		No incrementales: ahorro de importaciones			Total	
			Bruta	Neta							8.1 MW incr.	8.2 MW base	8.3 Balance energ.	8.4 Valor $/MWh	9.1	9.2	10.1	10.2	10.3 HFO US$/t		
	Año	1.1	1.2	1.3	3	4.1	4.2	5 = 3 + 4.2	6	7 = 5 + 6										11=8+9+10	8 = 11 - 7
		MW	GWh	GWh	MUS$	#	MUS$	MUS$	MUS$	MUS$											MUS$
C1	2016				1.96			1.96		1.96											-1.96
C2	2017				24.77			24.77		24.77											-24.77
C3	2018				3.62			3.62		3.62											-3.62
C4	2019				3.07			3.07		3.07											-3.07
C5	2020				55.26			55.26		55.26											-55.26
C6	2021				84.08			84.08		84.08											-84.08
C7	2022				46.97			46.97		46.97											-46.97
1	2023	40 MW	315.36	299.59		0	0	0.00	6.59	6.59	40.00	40.00	0	N/A	8.31	42.00	42.21	100%	622.59	50.51	43.92
2	2024	40 MW	315.36	299.59		0	0	0.00	6.59	6.59	40.00	40.00	0	N/A	8.47	42.80	43.19	100%	637.18	51.66	45.07
3	2025	40 MW	315.36	299.59		0	0	0.00	6.59	6.59	40.00	40.00	0	N/A	8.62	43.60	44.38	100%	654.64	53.00	46.41
4	2026	40 MW	315.36	299.59		2	15.67	15.67	6.59	22.26	40.00	40.00	0	N/A	8.78	44.40	45.85	100%	676.40	54.63	32.37
5	2027	40 MW	315.36	299.59		0	0	0.00	6.59	6.59	40.00	40.00	0	N/A	8.94	45.20	47.09	100%	694.62	56.03	49.44
6	2028	40 MW	315.36	299.59		0	0	0.00	6.59	6.59	40.00	40.00	0	N/A	9.10	46.00	48.13	100%	709.97	57.23	50.64
7	2029	40 MW	315.36	299.59		0	0	0.00	6.59	6.59	40.00	40.00	0	N/A	9.26	46.80	49.53	100%	730.66	58.79	52.20
8	2030	40 MW	315.36	299.59		1	8.87	8.87	6.59	15.46	40.00	40.00	0	N/A	9.41	47.60	50.39	100%	743.31	59.80	44.34
9	2031	40 MW	315.36	299.59		0	0	0.00	6.59	6.59	40.00	40.00	0	N/A	9.57	48.40	51.95	100%	766.40	61.53	54.94
10	2032	40 MW	315.36	299.59		0	0	0.00	6.59	6.59	40.00	40.00	0	N/A	9.73	49.20	53.54	100%	789.76	63.27	56.68
11	2033	40 MW	315.36	299.59		0	0	0.00	6.59	6.59	40.00	40.00	0	N/A	9.89	50.00	55.16	100%	813.71	65.05	58.46
12	2034	40 MW	315.36	299.59		2	15.67	15.67	6.59	22.26	40.00	40.00	0	N/A	10.05	50.80	56.88	100%	839.01	66.92	44.66
13	2035	40 MW	315.36	299.59		0	0	0.00	6.59	6.59	40.00	40.00	0	N/A	10.21	51.60	57.97	100%	855.15	68.18	61.59
14	2036	40 MW	315.36	299.59		0	0	0.00	6.59	6.59	40.00	40.00	0	N/A	10.36	52.40	59.74	100%	881.21	70.10	63.51
15	2037	40 MW	315.36	299.59		0	0	0.00	6.59	6.59	40.00	40.00	0	N/A	10.52	53.20	60.81	100%	897.08	71.34	64.74
16	2038	40 MW	315.36	299.59		0	0	0.00	6.59	6.59	40.00	40.00	0	N/A	10.88	55.00	62.61	100%	923.53	73.48	66.89
17	2039	40 MW	315.36	299.59		1	8.87	8.87	6.59	15.46	40.00	40.00	0	N/A	10.84	54.80	64.00	100%	944.05	74.84	59.37
18	2040	40 MW	315.36	299.59		0	0	0.00	6.59	6.59	40.00	40.00	0	N/A	11.00	55.60	66.00	100%	973.58	77.00	70.40
19	2041	40 MW	315.36	299.59		0	0	0.00	6.59	6.59	40.00	40.00	0	N/A	11.16	56.40	69.18	100%	1020.56	80.34	73.75
20	2042	40 MW	315.36	299.59		0	0	0.00	6.59	6.59	40.00	40.00	0	N/A	11.31	57.20	72.52	100%	1069.80	83.84	77.24
21	2043	40 MW	315.36	299.59		0	0	0.00	6.59	6.59	40.00	40.00	0	N/A	11.87	60.00	76.02	100%	1121.42	87.89	81.30
22	2044	40 MW	315.36	299.59		2	15.67	15.67	6.59	22.26	40.00	40.00	0	N/A	11.63	58.80	79.69	100%	1175.53	91.32	69.06
23	2045	40 MW	315.36	299.59		0	0	0.00	6.59	6.59	40.00	40.00	0	N/A	11.79	59.60	83.53	100%	1232.24	95.32	88.73
24	2046	40 MW	315.36	299.59		0	0	0.00	6.59	6.59	40.00	40.00	0	N/A	11.95	60.40	87.56	100%	1291.70	99.51	92.92
25	2047	40 MW	315.36	299.59		0	0	0.00	6.59	6.59	40.00	40.00	0	N/A	12.10	61.20	91.79	100%	1354.03	103.89	97.30
26	2048	40 MW	315.36	299.59		0	0	0.00	6.59	6.59	40.00	40.00	0	N/A	12.66	64.00	96.22	100%	1419.36	108.88	102.29
27	2049	40 MW	315.36	299.59		2	15.67	15.67	6.59	22.26	40.00	40.00	0	N/A	12.42	62.80	100.86	100%	1487.84	113.28	91.02
28	2050	40 MW	315.36	299.59		0	0	0.00	6.59	6.59	40.00	40.00	0	N/A	12.58	63.60	105.73	100%	1559.63	118.31	111.72
29	2051	40 MW	315.36	299.59		0	0	0.00	6.59	6.59	40.00	40.00	0	N/A	12.74	64.40	110.83	100%	1634.88	123.57	116.98
30	2052	40 MW	315.36	299.59		0	0	0.00	6.59	6.59	40.00	40.00	0	N/A	12.90	65.20	116.18	100%	1713.77	129.07	122.48
Total					219.72	10	189.52	300.14	197.75						319.04		2049.54			2368.58	1870.69
																				TIRE	16.99%
																				VANE	72.81

Table 17: Geothermal project's economic return calculation report– Cosigüina

The project's financial return is shown below, taking into account the project's real costs in order to calculate the IRR_F (*Financial IRR, FIRR)*, without taking into account an investor's IRR, with the possible positive effect that the project's financing (Project Finance). In the present case, it is deemed that the GNI only tries to recover 50% of the exploration costs (suported by PNESER and SREP)

Cosigüina		Generación y Ventas			Ingresos			Inversión					O&M	Financiamiento				Impuestos				Gastos		Flujos proyecto	Flujos Equity
N°	Año	Potencia bruta	Generación		PPA (Tarifa)	Peaje (Tarifa)	Total	CAPEX Inicial	CAPEX Desarrollador	# pozos adicionales	Reinversión	Total inversión	Costos	Deuda Const	Gastos de transacción	Repago al GNI	Deuda Sr	Depreciación fiscal	IR apalancado	IR sin apalanc.	IMI	Totales apalancados	Totales sin apalanc.	Netos sin apalanc.	Netos apalancados
		1.1	1.2	1.3	2.1	2.2	2.3	3.1	3.2	4.1	4.2	5 = 3 + 4.2	6	7.1	7.2	7.3	7.4	8	8.1a	8.1b	8.2	9 = 6+7+8	10 = 5+6+8	8 = 2 - 7	8 = 2 - 7
		MW	GWh	GWh	$/MWh		MUS$	MUS$	MUS$	#	MUS$	MUS$	MUS$	MUS$	MUS$	MUS$	MUS$	MUS$	MUS$	MUS$	MUS$	MUS$	MUS$	MUS$	MUS$
C1	2016							1.99	0.00			1.99		0.00		0.00	0					0.00	1.99	-1.99	0.00
C2	2017							25.21	0.00			25.21		0.00		0.00	0					0.00	25.21	-25.21	0.00
C3	2018							3.68	0.00			3.68		0.00		0.00	0					0.00	3.68	-3.68	0.00
C4	2019							3.12	45.69			3.12		1.14		0.00	0					9.37	3.12	-3.12	-9.37
C5	2020							56.22	45.69			56.22		2.28		0.00	0					9.59	56.22	-56.22	-9.59
C6	2021							85.54	45.69			85.54		3.43		0.00	0					9.82	85.54	-85.54	-9.82
C7	2022							47.79	45.69			47.79		4.57	7.37	20.40	0					15.60	47.79	-47.79	-15.60
1	2023	40 MW	315.36	299.59	116.54	4.63	33.53			0	0.00	0.00	6.71	0.00		0.00	19.17	11.18	0.00	0.00	0.08	25.96	6.79	26.74	7.57
2	2024	40 MW	315.36	299.59	120.04	4.68	34.56			0	0.00	0.00	6.91	0.00		0.00	19.17	11.18	0.00	0.00	0.09	26.16	6.99	27.57	8.40
3	2025	40 MW	315.36	299.59	123.64	4.72	35.63			0	0.00	0.00	7.11	0.00		0.00	19.17	11.18	0.00	0.00	0.09	26.37	7.20	28.42	9.25
4	2026	40 MW	315.36	299.59	127.35	4.77	36.72			2	18.02	18.02	7.33	0.00		0.00	19.17	11.18	0.00	0.00	0.18	44.70	25.53	11.19	-7.98
5	2027	40 MW	315.36	299.59	131.17	4.82	37.85			0	0.00	0.00	7.55	0.00		0.00	19.17	11.18	0.00	0.00	0.19	26.91	7.74	30.12	10.95
6	2028	40 MW	315.36	299.59	135.11	4.87	39.02			0	0.00	0.00	7.77	0.00		0.00	19.17	11.18	0.00	0.00	0.20	27.14	7.97	31.05	11.88
7	2029	40 MW	315.36	299.59	139.16	4.91	40.22			0	0.00	0.00	8.01	0.00		0.00	19.17	11.18	0.00	0.00	0.20	27.38	8.21	32.01	12.84
8	2030	40 MW	315.36	299.59	143.33	4.96	41.45			1	10.20	10.20	8.25	0.00		0.00	19.17	11.18	3.52	9.96	0.21	41.35	28.62	12.84	0.11
9	2031	40 MW	315.36	299.59	147.63	5.01	42.73			0	0.00	0.00	8.50	0.00		0.00	19.17	11.18	3.83	10.27	0.32	31.81	19.09	23.64	10.91
10	2032	40 MW	315.36	299.59	152.06	5.06	44.04			0	0.00	0.00	8.75	0.00		0.00	19.17	11.18	4.15	10.59	0.33	32.40	19.67	24.37	11.64
11	2033	40 MW	315.36	299.59	156.62	5.11	45.39			0	0.00	0.00	9.01	0.00		0.00	19.17	11.18	4.47	10.91	0.45	33.11	20.38	25.01	12.28
12	2034	40 MW	315.36	299.59	160.00	5.17	46.39			2	18.02	18.02	9.28	0.00		0.00	19.17	11.18	4.69	11.13	0.46	51.63	38.90	7.49	-5.24
13	2035	40 MW	315.36	299.59	160.00	5.22	46.37			0	0.00	0.00	9.56	0.00		0.00	19.17	11.18	4.60	11.04	0.46	33.80	21.07	25.30	12.57
14	2036	40 MW	315.36	299.59	160.00	5.27	46.36			0	0.00	0.00	9.85	0.00		0.00	19.17	11.18	4.51	10.95	0.46	33.99	21.26	25.09	12.36
15	2037	40 MW	315.36	299.59	160.00	5.32	46.34			0	0.00	0.00	10.14	0.00		0.00	19.17	11.18	4.42	10.86	0.46	34.19	21.47	24.87	12.15
16	2038	40 MW	315.36	299.59	160.00	5.38	46.32			0	0.00	0.00	10.45	0.00		0.00	19.17	11.18	4.32	10.76	0.46	34.40	21.67	24.65	11.92
17	2039	40 MW	315.36	299.59	160.00	5.43	46.31			1	10.20	10.20	10.76	0.00		0.00	19.17	11.18	4.22	10.66	0.46	44.82	32.09	14.22	1.49
18	2040	40 MW	315.36	299.59	160.00	5.48	46.29			0	0.00	0.00	11.08	0.00		0.00	19.17	11.18	4.12	10.56	0.46	34.84	22.11	24.18	11.45
19	2041	40 MW	315.36	299.59	160.00	5.54	46.28			0	0.00	0.00	11.42	0.00		0.00	19.17	11.18	4.02	10.46	0.46	35.07	22.34	23.94	11.21
20	2042	40 MW	315.36	299.59	160.00	5.59	46.26			0	0.00	0.00	11.76	0.00		0.00	19.17	11.18	3.91	10.35	0.46	35.30	22.57	23.69	10.96
21	2043	40 MW	315.36	299.59	160.00	5.65	46.24			0	0.00	0.00	12.11	0.00		0.00	0.00	0.00	10.24	10.24	0.46	22.81	22.81	23.43	23.43
22	2044	40 MW	315.36	299.59	160.00	5.71	46.23			2	18.02	18.02	12.48	0.00		0.00	0.00	0.00	10.12	10.12	0.46	41.08	41.08	5.14	5.14
23	2045	40 MW	315.36	299.59	160.00	5.76	46.21			0	0.00	0.00	12.85	0.00		0.00	0.00	0.00	10.01	10.01	0.46	23.32	23.32	22.89	22.89
24	2046	40 MW	315.36	299.59	160.00	5.82	46.19			0	0.00	0.00	13.24	0.00		0.00	0.00	0.00	9.89	9.89	0.46	23.58	23.58	22.61	22.61
25	2047	40 MW	315.36	299.59	160.00	5.88	46.17			0	0.00	0.00	13.63	0.00		0.00	0.00	0.00	9.76	9.76	0.46	23.86	23.86	22.32	22.32
26	2048	40 MW	315.36	299.59	160.00	5.94	46.16			0	0.00	0.00	14.04	0.00		0.00	0.00	0.00	9.63	9.63	0.46	24.14	24.14	22.02	22.02
27	2049	40 MW	315.36	299.59	160.00	6.00	46.14			2	18.02	18.02	14.46	0.00		0.00	0.00	0.00	9.50	9.50	0.46	42.45	42.45	3.69	3.69
28	2050	40 MW	315.36	299.59	160.00	6.06	46.12			0	0.00	0.00	14.90	0.00		0.00	0.00	0.00	9.37	9.37	0.46	24.73	24.73	21.39	21.39
29	2051	40 MW	315.36	299.59	160.00	6.12	46.10			0	0.00	0.00	15.34	0.00		0.00	0.00	0.00	9.23	9.23	0.46	25.03	25.03	21.07	21.07
30	2052	40 MW	315.36	299.59	160.00	6.18	46.08			0	0.00	0.00	15.80	0.00		0.00	0.00	0.00	9.08	9.08	0.46	25.35	25.35	20.73	20.73
Total							1309.70	223.55	182.75	10	217.95	316.03	319.07	11.42	7.37	20.40	383.39	223.55	151.62	235.35	11.13	1002.07	881.57	Sin apalanc.	Con apalanc.
																								TIRF	8.25%	14.67%
								CAPEX apalacando desarrollador	221.94															VANF	-36.52	7.07

Table 18: Cosigüina – geothermal project's financial return calculation

Scenario	Production (gross)	Initial Investment CAPEX (local cost) US$ Millions	Tariff US/MWh	Economic Internal Rate of Return IRR_E %	Financial Internal Rate of Return IRR_F %
40 MW	40 MWe	US$ 223.55 M Over 30 years: US$ 316.03M	Energy: $92/MWh Power: 0/kW-m All-in 2016: 92/MWh	16.99%	14.67%

Table 19: ACB Summary – Cosigüina

Source: Our own elaboration based on studies and ACB models' application

Cosigüina Project's sensibility analysis

The performed sensibility allows concluding that the Cosigüina 40 MW project turns out being economically feasible, even when facing changes in variable keys assumed in the analysis. Variations were independently analyzed at: (i) the investment cost; and (ii) the established tariff, and its impact on (a) the IRR_E, (b) the average VAN_E by user and (c) the total VAN_E. The following are the analyzed variations and their impact:

Sensibilidad financiera: deuda senior

TIRf / Caso base 14.67%	Tasa de Deuda Senior (%) 7%	8%	9%	10%	11%
Tarifa 2015 "All-In" del PPA 74 US$/MWh	9.3%	8.1%	7.0%	5.9%	4.9%
83 US$/MWh	13.1%	11.7%	10.3%	8.9%	7.7%
92 US$/MWh	17.0%	15.4%	13.8%	12.2%	10.7%
102 US$/MWh	21.4%	19.7%	18.0%	16.2%	14.4%
120 US$/MWh	27.4%	25.7%	23.9%	22.0%	20.0%

TIRf / Caso base 14.67%	Plazo de Deuda Senior (años) 30	25	20	15	10
Tarifa 2015 "All-In" del PPA 74 US$/MWh	6.7%	6.9%	7.0%	7.1%	7.1%
83 US$/MWh	11.4%	10.8%	10.3%	9.7%	9.3%
92 US$/MWh	15.9%	15.0%	13.8%	12.6%	11.5%
102 US$/MWh	20.5%	19.5%	18.0%	16.0%	14.0%
120 US$/MWh	26.7%	25.6%	23.9%	21.2%	17.8%

Sensibilidad financiera: inversión

TIRf / Caso base 14.67%	Costo de inversión (Planta - $/W) 1.3	1.4	1.5	1.6	1.7
Tarifa 2015 "All-In" del PPA 74 US$/MWh	8.1%	7.6%	7.0%	6.5%	6.0%
83 US$/MWh	11.7%	11.0%	10.3%	9.6%	9.0%
92 US$/MWh	15.6%	14.7%	13.8%	13.0%	12.3%
102 US$/MWh	20.0%	19.0%	18.0%	17.0%	16.1%
120 US$/MWh	26.2%	25.1%	23.9%	22.8%	21.7%

TIRf / Caso base 14.67%	Costo de perforación (MUS$/pozo) 4.5	5.5	6.5	7.5	8.5
Tarifa 2015 "All-In" del PPA 74 US$/MWh	12.0%	9.3%	7.0%	5.0%	3.2%
83 US$/MWh	16.3%	13.1%	10.3%	7.8%	5.7%
92 US$/MWh	20.8%	17.1%	13.8%	10.9%	8.3%
102 US$/MWh	25.5%	21.6%	18.0%	14.6%	11.4%
120 US$/MWh	32.1%	27.9%	23.9%	20.0%	16.2%

Sensibilidad financiera: impuestos

TIRf / Caso base 14.67%	Tasa de IR (%) 0.0%	10%	20%	25%	30%
Tarifa 2015 "All-In" del PPA 74 US$/MWh	9.2%	8.6%	7.8%	7.4%	7.0%
83 US$/MWh	12.6%	11.9%	11.1%	10.7%	10.3%
92 US$/MWh	16.1%	15.4%	14.7%	14.3%	13.8%
102 US$/MWh	20.0%	19.4%	18.7%	18.3%	18.0%
120 US$/MWh	25.4%	24.9%	24.4%	24.2%	23.9%

TIRf / Caso base 14.67%	Años de exoneración de IR 30	25	20	15	10
Tarifa 2015 "All-In" del PPA 74 US$/MWh	9.2%	8.8%	8.1%	7.6%	7.2%
83 US$/MWh	12.6%	12.4%	11.8%	11.4%	10.7%
92 US$/MWh	16.1%	16.0%	15.6%	15.3%	14.5%
102 US$/MWh	20.0%	19.9%	19.7%	19.5%	18.8%
120 US$/MWh	25.4%	25.3%	25.2%	25.1%	24.7%

Sensibilidad económica: inversión

TIRe / Caso base 18.33%	Costo de inversión (Planta - $/W) 1.3	1.4	1.5	1.6	1.7
Costo de perforación (MUS$/pozo) 4.50	20.6%	20.2%	19.9%	19.5%	19.2%
5.50	19.3%	19.0%	18.7%	18.4%	18.1%
6.50	18.2%	18.0%	17.7%	17.4%	17.2%
7.50	17.3%	17.0%	16.7%	16.5%	16.3%
8.50	16.4%	16.1%	15.9%	15.7%	15.5%

Sensibilidad económica: HFO

VANe / 86.24 MUS$	Precios tCO2 - Escenarios bajo, medio, alto Bajo	Medio	Alto
Tasa de descuento 8%	194.6 MUS$	238.8 MUS$	370.2 MUS$
10%	109.3 MUS$	141.5 MUS$	236.1 MUS$
12%	56.1 MUS$	80.0 MUS$	149.9 MUS$
14%	22.3 MUS$	40.5 MUS$	93.3 MUS$
16%	0.6 MUS$	14.7 MUS$	55.3 MUS$

Sensibilidad económica: HFO vs tCO2

TIRe / Caso base 18.33%	Precio tCO2 - Escenarios bajo, medio, alto Bajo	Medio	Alto
Precio HFO - Escenarios bajo, medio, alto Bajo	13.35%	15.12%	19.71%
Medio	16.08%	17.69%	21.90%
Alto	18.53%	20.02%	23.94%

Sensibilidad económica: HFO

VANe / 86.24 MUS$	Precio HFO - Escenarios bajo, medio, alto Bajo	Medio	Alto
Tasa de descuento 8%	164.4 MUS$	238.8 MUS$	313.2 MUS$
10%	88.6 MUS$	141.5 MUS$	194.3 MUS$
12%	41.4 MUS$	80.0 MUS$	118.6 MUS$
14%	11.6 MUS$	40.5 MUS$	69.4 MUS$
16%	-7.3 MUS$	14.7 MUS$	36.8 MUS$

Table 20: Sensibility analysis – Cosigüina

Source: Our own elaboration based on studies and application of ACB models

Conclusions on the Geothermal Sector's Projects

In summary, the making of investments in the studied and proposed projects, promise reactivation of Nicaragua's geothermal sector. One may determine that the geophysical results are promising, due to the fact that they suggest the presence of high temperature geothermal reservoirs at each considered site.

If the required studies and the subsequent excavation of wells were developed, as foreseen, the Mombacho and Cosigüina sites would generate a promising cost effectiveness, the VAN_E is positive at a discount rate of 12% and the IRR_E at the order of 18% is attractive, generating long-term benefits enabling to recover the investment. The Caldera de Apoyo site is punished for its lower size, one that does not allow the generation of scale economies.

It is worth noticing that the geothermal resource at any of these sites may only be considered as viable for the production of electricity, once having been drilled and tested by means of deep wells' exploration, allowing to confirm the deposit conditions and the wells' productive capacity.

The introduction of geothermal generation would offer the opportunity of displacing the burning of fuels and would have the reduction of electrical tariff as a benefit, something that would help the population's lowest income sector of society and, when reducing the subsidy, would contribute to Nicaragua's economy's growth.

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