PROJECT INFORMATION DOCUMENT (PID)

CONCEPT STAGE

Report No.: PIDC29269

Project Name	Geothermal Resource Risk Mitigation Project (P155197)
Region	LATIN AMERICA AND CARIBBEAN
Country	Nicaragua
Sector(s)	Other Renewable Energy (80%), General energy sector (20%)
Theme(s)	Infrastructure services for private sector development (50%), Climate change (50%)
Project ID	P155197
Borrower(s)	Republic of Nicaragua
Implementing Agency	Cerro Colorado Power S.A. (CCP)
Environmental Category	A-Full Assessment
Date PID Prepared/Updated	24-May-2017
Estimated Date of Board Approval	27-Dec-2017

I. Introduction and Context

Country Context

1. Nicaragua is a country that is richly endowed with natural resources, but remains one of the poorest countries in the Latin American and Caribbean (LAC) region. Geographically, it is the largest country in Central America, containing sizable lakes and a chain of active volcanoes. The country has a population of six million people and a per capita gross domestic product (GDP) of US$1,849,[1] making it the second poorest country in the LAC region.[2] During the last five years, gross domestic product (GDP) has grown by 5 percent per year, and the economy is expected to grow on average by 4 percent[3] from 2016 to 2019. Poverty has also decreased from 42.5 percent in 2009 to 29.6 percent[4] of the population in 2014. However, Nicaragua's high cost of electricity could sap this momentum and undermine growth and competitiveness, placing the country's poverty alleviation efforts at risk.

2. The majority of Nicaragua's GDP is fueled by the commercial and industrial sectors, where affordable and reliable power is a key ingredient to growth and sustainability. The manufacturing,

[1] GDP per capita in 2015 (constant 2010 US$). Data Bank (World Development Indicators), World Bank Group, Washington DC [Accessed on April 15, 2017] http://databank.worldbank.org/data/reports.aspx?source=world-development-indicators.

[2] Data Bank (World Development Indicators), World Bank Group, Washington DC [Accessed on April 15, 2017] http://databank.worldbank.org/data/reports.aspx?source=world-development-indicators.

[3] World Bank Group. 2017. *Global Economic Prospects*. Flagship Report, Washington DC.

[4] Instituto Nacional de Informacion de Desarrollo. 2009 and 2014. *Encuesta Nacional de Hogares sobre Medición de Niveles de Vida*.

tourism, financial services, communications, and mining sectors—in which efficient, reliable, and affordable power supply is a key input to productivity and economic sustainability—make up about 60 percent of GDP.[5] However, business enterprise surveys[6] in Nicaragua have consistently identified electricity as a constraint to doing business. Some key reasons for this constraint are the high and volatile cost of electricity, poor reliability, and difficulty getting service. Electricity supply in Nicaragua is also characterized by a low quality of service, with frequent shortages and deficiencies in voltage and frequency. There are also high government subsidies to the power sector, which divert investments that could go to other important social and economic programs. Addressing such issues will be essential if Nicaragua is to sustain economic growth and reduce poverty.

3. The high and volatile cost of electricity affects the lives of all Nicaraguans, especially the poor. With nearly 30 percent of the population still living below the poverty line[7], the poor are the least able to cope with high electricity prices.[8] While electricity subsidies make electricity more affordable for lower-income households, these subsidies are not well targeted, and it is estimated that only 23.5 percent of subsidies were received by households in the bottom 40 percent of the income distribution.[9] The subsidies are also a fiscal burden to the Government of Nicaragua (GoN), representing 1.6 percent of GDP from 2012 to 2015.[10] These subsidies reduce the resources available to invest in other important public programs. While considerable progress has been made to provide greater electricity access,[11] it will be difficult to maintain this momentum if the cost of electricity generation and resulting prices are unaffordable for the poor. Reducing and stabilizing the price of electricity and improving reliability of service is thus vital for reducing poverty and enhancing shared prosperity.

Sectoral and Institutional Context

4. **The sector has progressively expanded, but continues to depend on fuel oil to produce a considerable portion of its electricity.** Power demand in Nicaragua has grown by around 3 percent per year over the past decade due to steady economic growth and increased access to electricity and this trend is expected to continue.[12] Much of the increase in demand has been met through a progressive and significant expansion of fuel oil-based power generation

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[5] Based on official figures. "Perfiles Nacionales: Nicaragua," Comisión Económica para América Latina y el Caribe (CEPAL). [Accessed on April 15, 2017] http://estadisticas.cepal.org/cepalstat/WEB_CEPALSTAT/perfilesNacionales.asp.

[6] The Enterprise Survey for Nicaragua (2010) from the World Bank and IFC identified electricity as the top business environment constraint. Subsequent World Bank Ease of Doing Business Data (2016 and 2017) indicates that procuring electricity is becoming more difficult in terms of cost, time, and service reliability.

[7] On average, about 3 percent of the population's total expenditures go to electricity (2 percent for the poor), according to the 2014 Living Standards Measurement Study survey for Nicaragua.

[8] Based on 2014 Instituto Nacional de Información de Desarrollo/ Encuesta Nacional de Hogares sobre Medición de Niveles de Vida data.

[9] Instituto Nicaragüense de Energía, Sánchez, Sousa and Tornarolli, 2017.

[10] World Bank. "Nicaragua Systematic Country Diagnostic" Concept Note Draft. March 27, 2017.

[11] The electricity access rate, which in 2006, was at 56 percent has reached 79 percent by end 2014. Data from ENATREL website. [Accessed on April l5, 2017] www.enatrel.gob.ni.

[12] Ministry of Energy and Mines. 2017. Plan Indicativo de Expansión de la Generación Eléctrica 2016-2030: Informe Ejecutivo. Managua.

capacity[13] However, there have been efforts to develop other power generation sources including the introduction of biomass from sugarcane bagasse; the extension of an existing brownfield geothermal operation at San Jacinto-Tizate; and, a steady increase in wind power during the past several years.

5. Nicaragua faces a number of challenges in the power sector, including an urgent need to diversify the sub-optimal generation mix. Challenges facing the power sector include a significant need to rationalize pricing, to continue expansion of access to around 1.2 million people who still remain without electricity, and to take more advantage of the Central American Electrical Interconnection System (SIEPAC) regional inter-connection. Underlying many of these challenges is the sub-optimal generation mix and the need to reduce excessive reliance on fuel oil-based capacity by increasing integration of more cost effective renewable energy sources.

6. There are a number of consequences to the heavy dependence on fuel oil for power generation. Primary among them, Nicaragua had the second highest commercial and industrial tariffs among Central American countries, and tariffs that are well above the Latin America regional average. The price has also proved to be highly volatile as it is strongly correlated with the international price of oil. This undermines the competitiveness of Nicaragua within the region as well as globally. Furthermore, electricity prices for many consumers are below the actual cost of supply. This leads to fiscal pressure on the government budget where there are subsidies.[14] When the costs are unrecoverable, it leads to losses for distribution companies undermining their incentive to expand electricity access; and when the high costs are passed through they create considerable hardship for electricity consumers.

7. There is considerable scope for Nicaragua to diversify its generation mix through greater utilization of its significant renewable energy endowment. The GoN has been considering ways to reduce and stabilize the overall cost of power supply by diversifying away from fuel oil through substitution with more renewable energy generation. It aims to increase renewable energy utilization to as much as 73 percent of the overall generation mix[15]. While Nicaragua has significant potential in hydro, geothermal, wind, and biomass, overall a little over 10 percent is presently being exploited to produce electricity. The GoN is taking action to address these issues, including seeking development partner assistance. In May 2015, the GoN secured the endorsement of a US$30 million investment plan from the global Climate Investment Funds' (CIFs) Scale-Up Renewable Energy Program (SREP). These funds will be channeled through the World Bank and Inter-American Development Bank (IDB) to address barriers in areas within the renewable energy sector that can lead to a transformational impact.

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[13] Fuel oil includes heavy fuel oil (commonly referred to as bunker fuel in Nicaragua), high speed diesel, and other similar petroleum products.

[14] The fiscal cost of electricity subsidies in Nicaragua in 2012-15 period amounted to 1.6% of GDP on average according to World Bank's "Nicaragua Systematic Country Diagnostic" Concept Note Draft. March 27, 2017.

[15] MEM, 2017 – Plan Indicativo de Expansión de la Generación Eléctrica 2016-2030.

8. Geothermal is a scalable option that could provide reliable power for a transformational impact in Nicaragua. Geothermal is one of the few renewable resource options which can be used to meet base-load power requirements.[16] Once developed to industry standards, it can provide reliable, non-intermittent power on a 24/7 basis, with plant capacity factors commonly exceeding 95%. It is an indigenous resource that also serves as a natural hedge against the volatility of commodity prices. Geothermal is a clean energy that will reduce the local environmental impacts of thermal generation; and contribute towards the reduction of global pollution that leads to climate change. Nicaragua has a long history of developing geothermal since the early 70's, and considerable expertise in the sector. However, the current nominal installed capacity of 154 MW is only 10 percent of the country's total potential of more than 1,516 MW identified across twelve fields in the GoN's Geothermal Master Plan.

9. Despite the advantages of the technology and the significant potential, geothermal development in Nicaragua has faced a number of challenges. They include: a) constraints to mobilizing risk capital for geothermal exploration to confirm resources and open-up green fields for development, b) difficulty attracting technically and financially qualified developers in light of the sector and country risks, c) challenges to achieving quick closure for large scale financing even after significant investments have been made to confirm geothermal resources, and d) ensuring that developments follow industry practices and meet international standards.

10. The GoN has requested the World Bank's assistance to address some of these barriers including facilitating the mobilization of risk capital and financing for urgent development of priority investments. To this end, the GoN has allocated an initial $30 million in IDA resources and an additional $15 million in SREP funds to catalyze and leverage private funds to advance development of the Casita San-Cristobal geothermal field. The reduction of risks will allow for not only moving forward a project that has been stuck, but also the progressive expansion of the selected green field, and if successfully demonstrated this could lead to replication of the risk mitigation approach in other geothermal fields in Nicaragua. By unlocking the geothermal power generation potential in the Casita San-Cristobal field and potentially additional fields, this will ultimately help reduce and stabilize the country's electricity generation costs.

Relationship to CAS

11. The proposed project and overall focus on developing geothermal to diversify the power generation mix is fully consistent with the World Bank's Country Partnership Strategy (CPS) for Nicaragua. The overall aim of the CPS is to support the GoN's strategy for improving people's access to affordable and reliable basic services, raising incomes and improving competitiveness and productivity, for which energy is a key contributor. Specific to the energy

[16] A large part of the hydropower in Nicaragua is run-of-the-river without storage, which does not allow dispatch control. Even with storage, hydropower would not be dedicated to base load in advance, since it is dispatched based on the highest value for its electricity, while wind and solar are intermittent and cannot serve as base load power. The potential for significant additional biomass expansion is limited, and the scale-up during recent years has plateaued.

sector, the proposed project is fully aligned with the CPS goal of supporting the GoN in increasing private investments in renewable power generation. The proposed project also leverages IDA resources with SREP and private funds, as envisioned in the CPS, and does so by also creating greater synergies with IFC. The project also helps address key energy sector challenges identified in the ongoing Systematic Country Diagnostic, including the country's high and volatile electricity prices. The proposed project is also consistent with the World Bank's institutional strategies, including the World Bank Group's Energy Directions (2013) and the Climate Change Action Plan (2016). Furthermore, it is aligned with key global initiatives such as the global Sustainable Development Goals, and the Sustainable Energy for All (SE4ALL) initiative led by the United Nations, which aims to double the share of renewable energy in the global mix.

II. Proposed Development Objective(s)

Proposed Development Objective(s)

12. The development objective of the project is to help assess the viability of the resources for power generation and speed-up geothermal development by mitigating risks and leveraging funds through a PPP arrangement. The proposed project is designed to confirm the geothermal resources in the Casita-San Cristobal field to mitigate resources risks, which if successful will enable leveraging additional investment for completing steamfield development and construction of the first operational power plant in the Casita-San Cristobal field. Geothermal resource confirmation and operation of a 25-35 MW power plant would demonstrate the viability of generating electricity in this field, and increase the prospects of attracting additional investments to unlock the field's full potential, estimated to between 105 to 225 MW[17].

Key Results

13. The following are key results from the proposed project:

- Assessment of viability of geothermal resources for power generation through exploration drilling
- Leveraging of private funds through public support
- Informed decision made regarding the feasibility of the field for expansion and further development
- Expected geothermal power generation potential
- Expected Greenhouse Gas (GHG) reduction potential

III. Project Description

Project Description

[17] MEM's power generation expansion plan estimates Casita expansion in 3 phases for a total of 105 MW. According to Geothermal Master Plan (MEM 2001) the field's estimated resource potential is 225 MW.

14. The GoN's primary initiative for scaling-up geothermal in Nicaragua include the development of the Casita-San Cristobal field. Casita was identified as the most promising green field geothermal development prospect in Nicaragua. To date, the advances in project preparation/development has largely been due to the efforts and funding from Cerro Colorado Power (CCP) – a public private partnership between Polaris Infrastructure Inc. (Polaris) and the Empresa Nicaragüense de Electricidad (ENEL). CCP was awarded the exploitation concession for the Casita-San Cristobal geothermal field.

15. The proposed project is designed to confirm the resource base and to mitigate risks with the view to facilitate the development of the first operational power plant in the Casita-San Cristobal field. The resource confirmation and the operation of the first modular expansion of 25-35 MW in capacity would mitigate the development risks and increase the prospects of additional investments to unlock the potential in the field. The proposed project includes two components covering the multiple stages of the geothermal development cycle.

16. **COMPONENT 1: Exploration Drilling for Resource Confirmation** *[Estimated cost ≈$48.6 million, US$15 million SREP, ~US$24.7 million IDA, US$8.9 million private developer equity]*

- **Subcomponent 1.1: Surface Studies and Reconnaissance** – Surface reconnaissance (geological, geophysical and geochemical studies), and drilling of a slim/core hole (including associated infrastructure) confirming the availability of a high temperature steam resource. CCP, utilizing its own funds, has already completed this activity, providing a sound basis for moving forward with additional investments.

- **Subcomponent 1.2: Exploration Drilling Program –** A 3 to 5 well strategic geothermal exploration drilling program is planned to ascertain the steam capacity (i.e. resource base) for producing electricity and to estimate the cost of extracting the resource.

- **Subcomponent 1.3: Technical Assistance for Resource Confirmation** – Based on the results of the exploratory drilling, an industry standard (bankable) feasibility study and an Environmental and Social Impact Assessment (ESIA) that meets international and World Bank Performance Standards will be prepared. These important studies will evaluate and confirm the commercial viability of the project and its prospects for sustainability. It will form the basis for making an informed investment decision as to how to proceed with activities in Project Component 2.

17. **COMPONENT 2: Steam Field and Power Plant Development** *[Estimated cost ≈$101-118 million, US$5.3 million IDA, US$37.7 million private developer equity, US$58-75 million multilateral/private financing]*

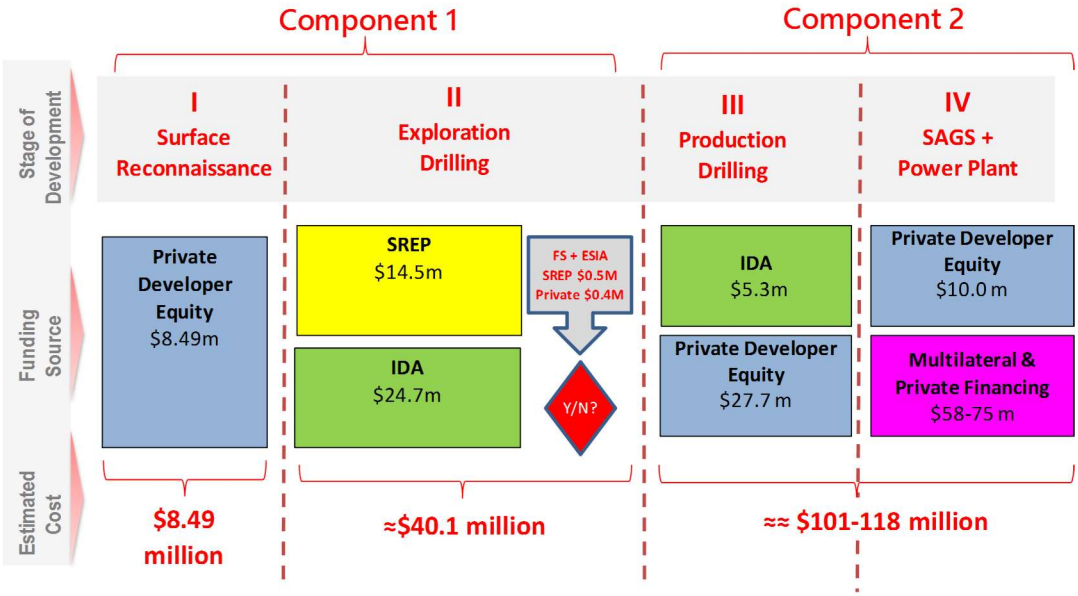
- **Subcomponent 2.1: Production Drilling and Steam Field Development –** On the basis of the feasibility assessment and the configuration for extracting the steam, the well

field would be further developed with additional drilling of production and injection wells in order to ensure there is sufficient steam at the wellhead and injection capacity to sustainably operate the first modular power plant; and construct the SAGS for transporting the steam from the wells to the power plant.

- **Subcomponent 2.2: Construction of Power Plant –** On the basis of the feasibility and ESIA studies' design and specifications, the first geothermal power plant module in the Casita-San Cristobal field, expected to be in the range of 25-35 MW, will be constructed and commissioned in-line with industry standards.

18. The activities described in the proposed project scope will be funded using a combination of World Bank (IDA) and SREP resources; and additional private equity and loans. The US$15 million of SREP funding (US$7.7 M grant and US$7.3 M loan) and up to US$24.7 million of a IDA credit will be used for Component 1 for undertaking the geothermal exploration drilling program and to carry out the feasibility study and the ESIA. Once the approach to undertaking the post-exploration activities under Component 2 is finalized on the basis of the feasibility study and ESIA, the remaining $5.3 million of IDA funding will be used to leverage additional private capital from CCP to finance the production and injection drilling to develop the steam field, and in parallel support CCP to reach financial closure for the construction of the power plant. The proposed funding arrangements, are depicted in the following figure:

Illustration of Estimated Project Funding Structure Across Multiple Geothermal Development Stages



IV. Safeguard Policies that Might Apply

Performance Standards Triggered by the Project	Yes	No
PS 1: Assessment and Management of Environmental and Social Risks and Impacts	X	
PS 2: Labor and Working Conditions	X	
PS 3: Resource Efficiency and Pollution Prevention	X	
PS 4: Community Health, Safety, and Security	X	
PS 5: Land Acquisition and Involuntary Resettlement	X	
PS 6: Biodiversity Conservation and Sustainable Management of Living Natural Resources	X	
PS 7: Indigenous Peoples		X
PS 8: Cultural Heritage	X	
Projects on International Waterways OP/BP 7.50		X
Projects in Disputed Areas OP/BP 7.60		X

V. Financing (in USD Million)

Total Project Cost:	149 - 167	Total Bank Financing:	45.00
Financing Gap:	$96 - $113 *(Component 2 additional private equity and commercial/multilateral loans)*		

Financing Source	Amount
BORROWER/RECIPIENT	0.00
International Development Association (IDA)	30.00
Scaling-up Renewable Energy Program (SREP)	15.00
Multilateral Development/Private Financing	57 - 75
Private Developer (Cerro Colorado Power)	47.00
Total	149 - 167

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