Project Information Document (PID)

Concept Stage | Date Prepared/Updated: 15-Apr-2019 | Report No: PIDC26518

BASIC INFORMATION

A. Basic Project Data

Country	Project ID	Parent Project ID (if any)	Project Name
El Salvador	P170089		ES Increasing power generation from geothermal resources in El Salvador (P170089)
Region	**Estimated Appraisal Date**	**Estimated Board Date**	**Practice Area (Lead)**
LATIN AMERICA AND CARIBBEAN	Sep 17, 2019	Feb 28, 2020	Energy & Extractives
Financing Instrument	**Borrower(s)**	**Implementing Agency**	
Investment Project Financing	Government of the Republic of El Salvador,Ministry of Finance	LaGeo	

Proposed Development Objective(s)

The Development Objective is to increase electricity generation from geothermal resources in El Salvador

PROJECT FINANCING DATA (US$, Millions)

SUMMARY

Total Project Cost	235.00
Total Financing	235.00
of which IBRD/IDA	200.00
Financing Gap	0.00

DETAILS

World Bank Group Financing

International Bank for Reconstruction and Development (IBRD)	200.00

Non-World Bank Group Financing

Counterpart Funding	35.00
Borrower/Recipient	35.00

Environmental and Social Risk Classification	Concept Review Decision
High	Track II-The review did authorize the preparation to continue

Other Decision (as needed)

B. Introduction and Context

Country Context

1. **El Salvador is a lower middle-income country with an underperforming economy and high levels of violence, resulting in a migratory pressure from rural areas to the cities and abroad, searching for jobs and security.** More than 25 years have passed since the end of the civil war that lasted 12 years and the Central American country still struggles with the aftermaths: an economy that has not been able to thrive, high levels of migration, limited employment opportunities and poor access to quality public services, among others. By 2015 more than 3.1 million Salvadorans were living abroad[1], primarily in the United States. The main factor[2] that influenced the decision to leave El Salvador are economy and jobs (81.1%). Within the country, the rural population migrates to urban areas where more than 70% of the population live, looking for employment opportunities and escaping from violence[3].

2. **Lowering and stabilizing energy costs will contribute to attract investments to El Salvador, support a sound economic growth, increase opportunities for the population, and ultimately reverse the vicious circle of low growth and migration**. By 2017, Foreign Direct Investment (FDI) reached US$792 million, becoming the highest investment amount in El Salvador since 2008. The main sector targeted by FDI was manufacturing which allocated US$414 million, followed by commerce with US$130 million[4]. Despite important progress, El Salvador struggles to attract FDI remaining the Central American economy with least FDI. In a very competitive environment, low and stable energy prices is a key factor to attract larger shares of FDI and dynamize the economy.

3. **El Salvador has valuable natural energy sources which, if developed, could reduce oil imports and exposure to oil international prices, reduce electricity generation cost and contribute to stabilize electricity tariffs**. El Salvador is endowed with a wealth of renewable resources, particularly solar and geothermal. Developing the potential of renewable indigenous resources would (i) reduce exposure to electricity imports and international oil prices; (ii) improve the adaptation to the effects of Climate Change –more frequent and intense droughts– by diversifying the electricity matrix and reducing exposure to hydro generation; (iii) potentially contribute to the economic development of rural areas where renewable plants are installed; and (iv) reduce oil imports.

[1] Política nacional para la protección y desarrollo de la persona migrante salvadoreña y su familia. Gobierno de El Salvador. 2017

[2] Política nacional para la protección y desarrollo de la persona migrante salvadoreña y su familia. Gobierno de El Salvador. 2017

[3] "Informe de Desarrollo Humano El Salvador 2018" -PNUD- estima que el 64.6% de los homicidios a nivel nacional en El Salvador ocurren en el área rural.

[4] La inversión extranjera directa en América Latina y el Caribe. CEPAL. 2018

Increasing the use of renewable energy is crucial to creating more sustainable and inclusive communities, resilience to environmental issues like climate change, and will result in a reduced and more stable electricity price for El Salvador.

4. **El Salvador is affected by seasonal dry periods and cyclical droughts resulted from El Niño, which are expected to be exacerbated by Climate Change effects.** Climate Change is expected to modify the rainfall regime and increase the frequency and intensity of droughts. While rural poverty and limited access to public services entail socio-economic fragilities, the weather-dependent nature of important economic sectors escalates the risks posed by climate change. High level of poverty, inequality and smallholder farming and subsistence production increase the sensitivity to climate events, as agricultural activities are particularly susceptible to weather conditions. The Climate Change Vulnerability Index for the Latin American and the Caribbean region – CAF, 2014 – ranks El Salvador as a country with extreme risk of vulnerability, becoming the third in the whole region. However, the country has made significant progress in terms of climate related policies/legislation. Increased concern with climate change, partially spurred by vulnerability to adverse climate events, has led to the adoption of various policy instruments, with significant emphasis on adaptation and mitigation, but especially on risk management. This high vulnerability to climate variability and change led to the adoption of reforms to the National Environmental Law in 2012. The amendment adds a chapter on "Adaptation to Climate Change, Institutional Strengthening and Social Responsibility", addressing the need for adaptation and mitigation, and regulating the preparation of the National Climate Change Plan[5].

Sectoral and Institutional Context

5. **El Salvador relies heavily on electricity imports from Guatemala and local thermal, hydro and geothermal power generation to supply its demand, which highly exposes the country to international oil price volatility, rainfall patterns and climate change.** With a 45% share of thermal generation in the electricity matrix, the cost of electricity in El Salvador is heavily influenced by international oil prices, exposing the country's economy to the fluctuations of this volatile commodity. Furthermore, El Salvador's electricity and oil imports negatively impact the trade balance and foreign exchange reserves. Regarding hydro, almost 30%[6] of the installed capacity in El Salvador corresponds to hydro power plants (574[7] MW), mostly located along the Lempa river basin but only one – Cerron Grande, 172 MW – counts with a reservoir large enough to store enough water during the wet season to produce electricity over the dry season and regulate the river flow all around the year. The limited aggregated water reservoir capacity of hydro power plants in El Salvador exacerbates the seasonal behavior of hydro generation and worsens the dependability on oil-fired thermal power generation and imports during the dry season. Climate change is expected to negatively impact rainfall patterns, increasing the intensity and frequency of droughts and reducing hydropower production, which already presents a seasonal behavior in a region – Corredor Seco – which already suffers from intense dry periods.

6. **El Salvador is a country with significant geothermal potential, with large reservoirs still undeveloped**. There are 204 MW of geothermal generation capacity currently installed in the country and the state-owned

[5] Climate Change Legislation in El Salvador. An excerpt from the 2015 Global Climate Legislation Study A Review of Climate Change Legislation in 99 Countries. Grantham Research Institute on Climate Change and Environment. The Global Legislator Organisation. Inter-Parliamentary Union. Nachnmany et al.

[6] "Boletin de Estadisticas Eléctricas" Avance 2018. Superintendencia General de Electricidad y Telecomunicaciones (SIGET)

[7] "Boletin de Estadisticas Eléctricas" Avance 2018. Superintendencia General de Electricidad y Telecomunicaciones (SIGET)

geothermal company LaGeo has confirmed a resource base to increase another 100 MW with repowering and expansion of existing fields and development of the Chinameca and San Vicente new fields. Several authors estimated the overall geothermal potential of the country obtaining values in a wide range of 400-4,140 MW, being commonly accepted a 500-1,000 MW range[8].

7. **The project will positively contribute to Climate Change adaptation and mitigation, to lowering the cost of electricity and to reducing oil imports by displacing polluting and inefficient thermal power generation.** Most polluting and inefficient thermal power plants will be displaced by renewable energy from geothermal resources, contributing to greening El Salvador´s energy generation matrix. Geothermal energy will provide firm base capacity and thus is expected to avoid GHG emissions by 627 tons-CO2/GWh[9] -average grid GHG emissions in El Salvador-. The economic displacement of inefficient generation will lower electricity generation costs by reducing the participation of these plants in the matrix and reduce oil imports for power generation. Moreover, geothermal energy will reduce the dependence from hydro power and thus better adapt to seasonal dry periods, cyclical droughts resulted from El Niño and climate change effects.

Relationship to CPF

8. **The CPF FY16-19 identifies the need to reduce energy costs to improve economic conditions, create opportunities and break the vicious cycle of lack of opportunities-violence-migration.** One of the main obstacles deterring private investment in El Salvador is the high cost of electricity, resulting from the high dependence on oil and its exposure to the volatility of international oil prices. Promoting private investment is key to create opportunities to the population and reduce violence and migration. The CPF identifies the need to diversify the electricity matrix and develop technical solutions contributing to reducing electricity costs.

9. **The development of geothermal energy is consistent with and supports the CPF FY16-19 for El Salvador, as well as the twin goals. T**he CPF identifies geothermal and transmission projects as potential candidates for Bank's intervention. Moreover, the provision of reliable, affordable and sustainable electricity is central to promote the inclusion of the poorest and foster shared prosperity by increasing economic competitiveness.

10. **The development of geothermal energy is critical for El Salvador to comply with its energy policy and its intended Nationally Determined Contributions (NDC).** El Salvador has set a goal to reduce up to 46% of its GHG emission by 2025 in relation to its emissions in 2015. Moreover, the NDC indicates that an additional 15% can be achieved with the financial support for the development of 92 MW of geothermal energy, namely 50 MW in Chinameca geothermal field, 30 MW in San Vicente geothermal field and 12 MW of repowering and installing new units in fields currently in operation. The energy sector is on track so far to achieve NDC's sectoral goals since most of the projects are operating or under construction, but financial support is required to achieve the goals, especially in geothermal.

[8] Campos, 1987 - The Geothermal Resources of El Salvador: Characteristics and Preliminary Assessment. United Nations Workshop on the Development and Exploitation of Geothermal Energy in Developing Countries. Pisa, Italy.
Pullinger, 2009 - Geothermal Development in Central America: Opportunities and Difficulties. Presentado al "Short Course on Surface Exploration for Geothermal Resources", organizado por UNU-GTP y LaGeo, en Ahuachapán y Santa Tecla, El Salvador, 17-30 Octubre, 2009.
CNE, 2011 - Plan Indicativo de la Expansión de la Generación Eléctrica 2012-2026. Septiembre de 2011
Cuellar, 2013 - Regional International Developments. Central America Region. Current Development and Future Plans. GRC 2013 Annual Meeting. Las Vegas, Nevada. September 29 - October 2, 2013.
[9] Source: emission factors calculated based on IEA CO2 Emissions from Fuel Combustion Statistics, extracted on February 2017

11. **Bank support to the projects will mitigate exploratory risk and enable subsequent private sector participation.** The initial exploratory stages of geothermal exploration require the mobilization of large amounts of risk capital, deterring private sector participation. Public sector participation and lead in these initial phases are key for the successful deployment of geothermal power plants. Bank´s support to mitigate exploratory risks is essential to enable potential private participation at later stages.

C. Proposed Development Objective(s)

The Development Objective is to increase electricity generation from geothermal resources in El Salvador

Key Results (From PCN)

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

a. Confirmation of total availability of geothermal resource in Chinameca and San Vicente geothermal fields: the aggregated capacity for the geothermal fields of Chinameca and San Vicente are estimated to be 80 MW, though only 32 MW have been confirmed so far. To finalize the exploratory campaign, additional 10 successful drillings and further assessments and models need to be carried out to confirm the total geothermal resource available for electricity generation. Considering an average success rates in drilling of 70%, the project will budget the drilling of 13 additional wells.
b. Power generation capacity from geothermal resource constructed (MW): Installation and commissioning of two small power plants with an aggregated power of around 20 MW (final capacity will depend on the unit power of available commercial generation units), one in Chinameca and another in San Vicente, to start producing electricity from the geothermal resource already confirmed. The analysis of the behavior of the geothermal reservoirs under production conditions will also inform the modeling of the reservoirs and the confirmation of the geothermal resource.
c. GHG emissions avoided (tons-equivalent of CO2): as result of the generation of electricity by means of geothermal energy and the displacement of polluting thermal power generation units, the project will avoid fuel-firing in thermal power plants and resulting emissions.
d. Engineering design and planning for utility scale power facilities: following up on the geothermal resource confirmation for the Chinameca and San Vicente geothermal fields, the project will support the engineering and technical design of a utility-scale facility in each geothermal field, comprising one or more generation units in each field, to exploit the total geothermal resource available.

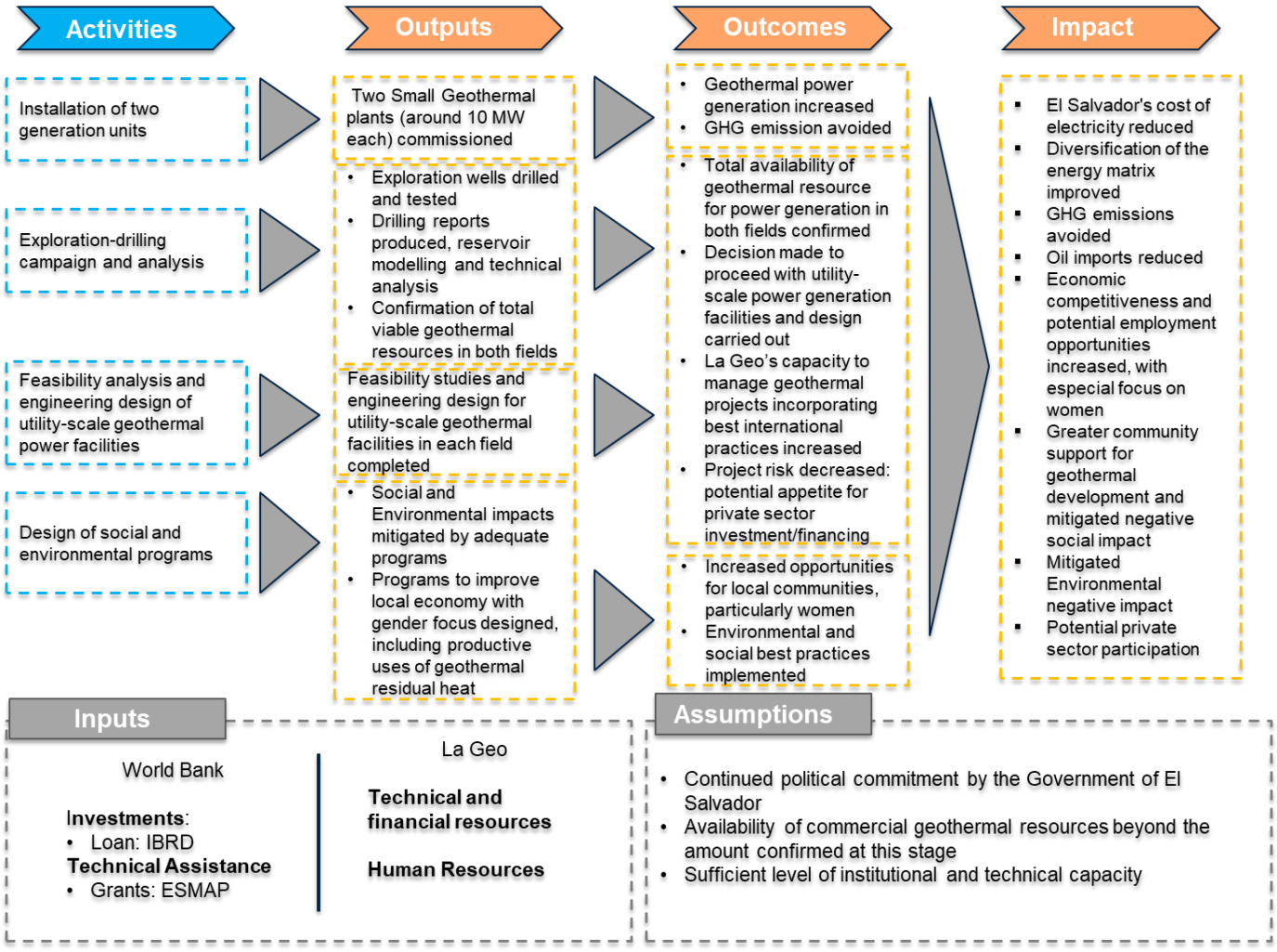

Fig. 3: Theory of Change

D. Concept Description

13. **The project will support the development of San Vicente and Chinameca geothermal fields with the purpose of advancing the diversification of the energy matrix in El Salvador, reduce energy costs for end consumers and increase the security of supply, with a positive impact in Climate Change mitigation and adaptation.** The main efforts in the exploration of San Vicente and Chinameca geothermal fields have been after 2005 but earlier studies reach back to the 1970s with initial exploratory works carried out by CEL (public power utility). So far, 18 wells have been drilled, confirming availability of geothermal resource for up to 32 MWs of power generation -22 MW in Chinameca and 10 MW in San Vicente-, although availability of up to 80 MW is expected, as result of preliminary technical analysis.

14. **Initial exploratory works have been discontinuous due to fluctuating availability of financial resources, and the high risk of geothermal exploration phase which impedes potential private sector involvement**. In order to confirm the full potential and characterization of Chinameca and San Vicente geothermal fields, additional drilling of 10 successful wells -considering a 70-80% success rate in drilling, 10 successful wells may require 13

drillings or more-, development of a numerical model of the geothermal systems and long-term production tests (3-6 months) are required. However, the lack of a continuous source of funding has resulted in a discontinuity in the exploratory works and investments in the geothermal fields. At exploration stage, large amounts of risk capital are required and the limited appetite from the private sector and availability of this type of capital require public sector intervention.

15. **The GoES will finance the full development of the geothermal fields of Chinameca and San Vicente in two stages; this project supports the first stage.** This project will provide financial resources to LaGeo –subsidiary of CEL in charge of geothermal generation– to (i) finalize the exploratory drilling campaign, carry out the needed assessments and confirm and characterize the geothermal resource available in Chinameca and San Vicente; (ii) install two small power generation plants and ancillary facilities to start producing electricity with the geothermal resource so far available in both geothermal fields; (iii) carry out the technical design and detailed engineering of the utility scale power generation facilities, to fully tap into the total available geothermal resource in both geothermal fields; and (iv) carry out initial works to advance the development of the utility scale power generation facilities, in accordance to the results obtained in the previous components. The second stage will finance all remaining works to finalize the installation and commissioning of the two utility-scale geothermal power generation facilities. A key outcome of the first stage is to carry out the final design and scope for the second stage, once the relevant information is available.

16. **The project will include a component for incentivizing productive uses of residual heat from the geothermal fluid after the power generation process, fostering the creation of job opportunities for women and the economic development of rural areas around the geothermal fields.** Fostering a sound and sustainable development of the geothermal plants, the project will assess options to support local economic development and job creation beyond direct employment opportunities during the construction and operation of the facilities. Economic development in rural areas is key to create opportunities and reduce migration and violence. In a context where mostly men migrate seeking better opportunities, women with children are frequently left behind constituting the most vulnerable population. LaGeo has deployed different pilots to develop technical solutions -in cooperation with local universities- to use the residual geothermal heat to accelerate the drying of coffee, fruit dehydration and milk pasteurization processes to support local cooperatives, farmers and small businesses. Building on the successful experience of different pilots developed by LaGeo and supported by GIZ in Ahuachapan and Berlin geothermal plants, the Bank will assess opportunities to replicate and scale up these pilots in the municipalities around Chinameca and San Vicente geothermal fields, including the design of productive uses from the residual geothermal heat as integral part of the project. In the assessment and identification of opportunities special focus will be given to gender issues and opportunities for women.

17. **At this stage, the project is expected to entail four different components which will be further defined during project preparation**. The initial scoping of the components is described as follows:

    i. *Component 1: Increasing electricity generation from geothermal resources*. This component will take over the engineering, procurement, construction and commissioning of two generating units of 10 MW along with ancillary facilities (i.e. transmission lines, substation and steam pipelines) to be installed one in San Vicente and another Chinameca, taking advantage of the existent infrastructure and confirmed resource on both fields.

ii. *Component 2: Exploratory drilling for geothermal resource confirmation and evaluation*. This component will conduct an exploratory drilling campaign, to ascertain the steam capacity for producing electricity in large scale.

iii. *Component 3: Feasibility and design engineering of the utility-scale generation plants and ancillary facilities in both geothermal fields*. This component will set the stage for Phase 2 and will carry out feasibility studies, and design engineering for the future expansion of San Vicente and Chinameca geothermal fields. The scope of this Component is contingent to the results of the exploratory phase (Components 1 and 2) and thus will start with some delay from other Components.

iv. *Component 4: Support for the execution of social programs and environmental mitigation*. This component will take care of the implementation of social programs and environmental mitigation plans within the area of impact of both projects.

Legal Operational Policies	Triggered?
Projects on International Waterways OP 7.50	TBD
Projects in Disputed Areas OP 7.60	No

Summary of Screening of Environmental and Social Risks and Impacts

The overall risk profile for this project is considered high as a result of significant direct and indirect impacts across environment and social issues. Environmental risks include: (a) significant water consumption requirements during the drilling phase, in settings of already limited (and, in the case of Chinameca, precarious) water availability for local communities during the dry season; (b) deforestation, and resulting habitat fragmentation and land use changes, from earthworks and civil works to build drilling platforms, develop and improve access roads, and install networks of pipelines to carry hot and cold process waters; (b) varied construction related impacts and risks associated with infrastructure and industrial projects, including noise, dust, road and traffic safety, occupational health and safety, and potential labor influx related issues (including the resulting additional stress on limited water resources) in the neighboring towns; and (c) potential for surface and groundwater contamination in the case of improper disposal of drilling muds. Social risks include: 1) risks to families that have already undergone a land acquisition process that includes more than 100 households and 6 families that will be resettled; 2) the management of community perceptions in order to avoid confusion between government responsibilities and LaGeo activities; 3) occupational health and safety during the construction phase considering the large number of contractors that will need to be managed; 4) labor influx management risks are also high given large number of contractors to be managed according to World Bank ESF standards and the potential for social conflict between local community and newly arrived workers; 5) and risks pertaining to insecurity because the area has gangs and delinquent groups known for extorting and engaging in violent behavior toward the local community.

Note To view the Environmental and Social Risks and Impacts, please refer to the Concept Stage ESRS Document**.**

CONTACT POINT

World Bank

Mariano Gonzalez Serrano
Senior Energy Specialist

Borrower/Client/Recipient

Government of the Republic of El Salvador

Ministry of Finance
Jerson Posada
Director of Investments and Public Credit
Jerson.posada@mh.gob.sv

Implementing Agencies

LaGeo
Diana Barillas
Financial Analyst
diana.mbarillas@gmail.com

Sebastian Villalta
Proyect Coordinator
csebastian.vm@gmail.com

Edgard Hidalgo
Financial Manager
ehidalgo91@hotmail.com

FOR MORE INFORMATION CONTACT

The World Bank
1818 H Street, NW
Washington, D.C. 20433
Telephone: (202) 473-1000
Web: http://www.worldbank.org/projects

APPROVAL

Task Team Leader(s):	Mariano Gonzalez Serrano

Approved By

Practice Manager/Manager:		
Country Director:		