

Ex-Ante Evaluation

1. Name of the Project

Country: Republic of Costa Rica

Project: Guanacaste Geothermal Development Sector Loan (Borinquen I Geothermal Project)

Loan Agreement: June 20, 2017

Loan Amount: 25,991 million Yen

Borrower: Instituto Costarricense de Electricidad (hereinafter, "ICE")

2. Background and Necessity of the Project

(1) Current State and Issues of the Power Sector in Costa Rica

The country's GDP has recently shown annual growth of 3.4% on average (2011-2015). As a result, the annual power demand has grown 1.4% on average between 2011 and 2015 (according to ICE). The power demand is estimated to increase by 2.8% annually on average between 2016 and 2040. Although the demand for power was 1,612 MW during the peak year of 2015, it is estimated to increase to 3,088 MW in 2040 (according to ICE). The power generation capacity is 3,068 MW as of 2015. Because supply exceeded demand in 2015, the surplus power was exported to neighboring countries. However, the country imports power to meet the demand in years when the amount of power generated in the country is less than the demanded amount of power due to shortages of hydroelectrically-generated power as a result of light precipitation during the rainy season. To meet the increasing demand, it is necessary to increase the power generation by developing new power sources. As for the power generation source as of 2015, hydraulic power accounts for 63% in terms of plant capacity, followed by thermal power (20%), geothermal power (7%), wind power (9%), and others (1%) in the country. Although the largest power source is hydraulic power, which is renewable energy, hydraulic power generation has a problem that the electricity generation decreases during the country's dry season in the country where the precipitation is extremely different between the rainy and dry seasons. On the other hand, unlike the other main renewable energy sources, geothermal power can be supplied stably throughout the year and is regarded as an important base-load power source that can be expected to reduce the emissions of greenhouse gases (GHG).

(2) Development Policies for the Power Sector in Costa Rica and the Priority of the Project

Besides advanced countries, Costa Rica was the first country to officially promise "carbon neutral." In 2007, the country declared its objective of entirely offsetting its CO₂ emissions by CO₂ absorption by 2021. The Costa Rica Government has

identified “Environment, energy, ocean, and orderly development (ordenamiento territorial)” as one of the 16 sectoral strategies in its National Development Plan (2015 to 2018) and aims to increase its supply of power by using renewable energy to meet power demands. In addition, the basis of the National Energy Plan (2015 to 2018) is to ensure the sustainability of energy through the control of CO2 emissions. In the Power Development Plan (2016 to 2035), the country plans to construct large-scale hydroelectric power plants and promote renewable energy, such as wind power. In this plan, the Guanacaste Geothermal Development Sector Loan (Borinquen I Geothermal Project) (hereinafter, this “Project”) is regarded as a priority project.

(3) Japan and JICA’s Policy and Operations in the Power Sector

According to the Country Assistance Policy for the Republic of Costa Rica (April 2012), the basic cooperation policy is “support sustainable development mainly in the field of the environment,” which is regarded as a climate change program in the priority field of “environmental problems.” Therefore, this Project is in line with the policy. JICA has so far carried out the following projects for the power sector in Costa Rica: an ODA loan project entitled “Miravalles Geothermal Power Project,” the first geothermal development project in the country (signed the Loan Agreement (hereinafter, “L/A”) in Dec. 1985; loan amount of 13,547 million Yen); an ODA loan project entitled “Pirris Hydroelectric Power Development Project” (signed the L/A in Apr. 2001; loan amount of 16,683 million Yen); and an ODA loan project entitled “Guanacaste Geothermal Development Sector Loan (Las Pailas II)” (signed the L/A in Aug. 2014; loan amount of 16,810 million Yen).

(4) Other Donors’ Activity

The Inter-American Development Bank (hereinafter, “IDB”) is planning to support the promotion of development of renewal energy in Costa Rica through the Power Sector Development Program Phase 2 (approved in 2012; loan amount of 250 million US dollars), and the Renewable Energy and Transmission and Distribution of Electricity Program (the effectuation procedure is in progress; the largest loan amount of 500 million US dollars). Under the latter program, IDB is planning to provide a loan (100 million US dollars) for the Las Pailas II Geothermal Power Plant and this Project. In addition, the European Investment Bank (EIB) also supports the construction of the Las Pailas II Geothermal Power Plant (approved in Nov. 2013; loan amount of 50 million euro).

(5) Necessity of the Project

This Project is in line with not only Costa Rica’s policy to achieve both economic development and environmental conservation but also to the assistance policies of both Japan and JICA. In addition, it is also in line with the Sustainable Development Goal that promotes measures against climate change and its impact (SDG 13). Therefore, it is highly necessary to support the implementation of this

Project.

3. Project Description

(1) Project Objective

This Project is one of the subprojects assumed for the Guanacaste Geothermal Development Sector Loan and aims to construct a geothermal power plant in the Borinquen field of Guanacaste Province in the northwest part of Costa Rica to increase the supply of power using renewable energy and respond to climate change impact, thereby contributing to the sustainable development of Costa Rica.

(2) Project Site/Target Area

Borinquen, Guanacaste Province

(3) Project Components

- 1) Construction of a geothermal power plant (with a capacity of 55 MW)
- 2) Consulting service (support for evaluation of the geothermal reservoir, support for both basic and detailed designs, bidding assistance, etc.)

(4) Estimated Project Cost (Loan Amount)

40,524 million Yen (loan amount: 25,991 million Yen)

(5) Schedule

Sep. 2016 to Sep. 2024 (95 months in total). The Project completion is defined as the commencement of commercial operation.

(6) Project Implementation Structure

- 1) Borrower: ICE
- 2) Guarantor: The Government of the Republic of Costa Rica
- 3) Executing Agency: ICE
- 4) Operation and Maintenance System: ICE

(7) Environmental and Social Considerations/Poverty Reduction/Social Development

1) Environmental and Social Considerations

- ① Category: A
- ② Reason for Categorization: This Project falls into the geothermal power sector category under the JICA Guidelines for Environmental and Social Considerations (published in Apr. 2010).
- ③ Environmental Permit: The environmental impact assessment (EIA) report for this Project was approved in Aug. 2014 by the Ministry of the Environment and Energy (MINAE).
- ④ Anti-Pollution Measures: Although hydrogen sulfide will be discharged into the air during construction and after the commencement of operation, the amount is estimated to be lower than the environmental standard level specified in the WHO Guidelines as a result of making the chimneys taller and other measures. The level of noise is estimated to meet the domestic standard by limiting the traffic hours for construction vehicles, dispersion of routes, introduction of

low-noise equipment, etc. Geothermal water and cooling water are not expected to have a serious impact on the water quality and level because of injections into reinjection wells. Regarding industrial waste during construction and in the operation, waste from the digging of wells will be buried back into the pits. Sludge from digging will be buried in landfills after being stored in reservoirs which incorporate pollution prevention measures. In addition, waste material and oil are planned to be sorted, recovered, and disposed of appropriately.

- ⑤ Natural Environment: Because the project site is next to Rincon de la Vieja Park, part of a UNESCO World Heritage site, measures for minimizing the impact on the animals and plants in the park will be carried out, such as the installation of pipelines with consideration for the environment regarding growth of the animals and plants, limitations on the area of land changes and the felling of trees, the planting of trees, measures to prevent accidents around access roads, provision of environmental education to those engaged in construction, and activities for conserving the ecosystem in cooperation with experts and residents. Regarding the ecosystem within the project site, ICE is carrying out a survey and is planning to continue its monitoring of the ecosystem. Regarding construction of the power plant, it is planned that efforts will be made to minimize any impact on the natural landscape and carry out design and afforestation with consideration for the landscape.
- ⑥ Social Environment: Although this Project requires the acquisition of 448 ha of land, it is planned that the procedure for land acquisition will be carried out according to domestic procedures in Costa Rica and JICA guidelines. This Project is not accompanied by the resettlement of residents and there are no minorities involved. In meetings with residents, no special objections against this Project were made by any influenced residents in the project target area.
- ⑦ Other/Monitoring: During construction and after the beginning of use, ICE will monitor the quality of air, noise, water, waste, animals and plants, tree planting, and land acquisition.

2) Promotion of Poverty Reduction

None in particular

3) Promotion of Social Development (e.g. Gender Perspectives, Measures for Infectious Diseases Including HIV/AIDS, Participatory Development, Consideration for the Person with Disabilities etc.)

None in particular

(8) Collaboration with Other Donors

The Guanacaste Geothermal Development Sector Loan, including this Project, is a co-financing project with IDB under the Co-financing for Renewable Energy and Energy Efficiency in Central America and the Caribbean (CORE scheme).

(9) Other Important Issues

This Project aims to develop renewable energy and is expected to contribute to reducing the emissions of greenhouse gases (GHG) by 115,404 tons per year.

4. Targeted Outcomes

(1) Quantitative Effects

1) Performance Indicators (Operation and Effect Indicator)

Indicator	Baseline (Actual Value in 2016)	Target (2025) [Expected value 2 years after project completion]
Maximum power generation capacity (Net MW)	-	52
Capacity factor (%)	-	90
Availability factor (%)	-	90
Auxiliary power ratio (%)	-	5 or less
Power generated at sending end (GWh/year)	-	410
Outage hours due to human error	-	0
Outage hours due to machine breakdown	-	0
Reduction in emissions of greenhouse gases (GHG) (tons/year)	-	115,404

(2) Qualitative Effects

Promotion of economic growth, development of the local economy and improvement in the living environment

(3) Internal Rate of Return

Based on the conditions indicated below, the economic internal rate of return (EIRR) of this Project is 15.8%, while the financial internal rate of return (FIRR) is 10.0%.

[EIRR]

Cost: Project cost (excluding tax), management and maintenance cost

Benefit: Cost reductions in constructing and managing a diesel thermal power plant

Project Life: 30 years

[FIRR]

Cost: Project cost, management and maintenance cost

Benefit: Revenue from sales of electric power

Project Life: 30 years

5. External Factors and Risk Control

Natural disasters in the target area of this Project (earthquake, hurricane, volcanic eruption, etc.)

6. Lessons Learned from Past Projects

(1) Lessons Learned from Similar Projects in the Past

The lesson that it is important to analyze priorly the geothermal reservoir and fully manage it at the stage of power plant operation has been gained from the result of the ex-post evaluation of geothermal development projects in other countries in the past, such as the Northern Negros Geothermal Project and the Tiwi Geothermal Power Plant Complex Rehabilitation Project in the Republic of the Philippines, etc. where securing a sufficient amount of power generation became difficult due to a failure to gain enough steam.

(2) Lessons for the Project

During the preparatory survey for cooperation, ICE carried out a simulation of the reservoir based on an experiment on steam eruptions from a test well dug at its own expense. According to the result of the simulation, this Project is expected to have a capacity of about 55 MW for the next 30 years. It is planned that the reservoir will be evaluated at the digging stage with the support of the consultants for this Project. Regarding the management of the geothermal reservoir during the power plant operation stage, it has been confirmed from an appraisal of this Project that ICE has adequate experience and technical capacities.

7. Plan for Future Evaluation

(1) Indicators to be Used

As described above in: 4. Targeted Outcomes, (1) Quantitative Effects, 1) Operation and Effect Indicator.

(2) Timing

Two years after the completion of this Project