

**Japanese ODA Loan****Ex-Ante Evaluation (for Japanese ODA Loan)**

**South America Division,  
Latin America and the Caribbean Department  
Japan International Cooperation Agency**

**1. Name of the Project**

- ( 1 ) Country: Republic of Ecuador
- ( 2 ) Project: Chachimbiro Geothermal Development Project (Phase I)
- ( 3 ) Project Site / Target Area: Imbabura Province

Loan Agreement: October 24, 2024

**2. Background and Necessity of the Project**

( 1 ) Current State and Issues of the Energy Sector and the Priority of the Project in Ecuador

The installed generation capacity in the national power system of the Republic of Ecuador (hereinafter referred to as "Ecuador") in 2022 is 7,358 MW, with a maximum power demand of 4,388 MW, and the current generation capacity is capable of meeting the domestic power demand.

The Government of Ecuador has established the National Plan for Energy Efficiency and Conservation 2016-2035 ("PLANEE"). In PLANEE, the government has set a goal of 65MtCO<sub>2</sub>e reduction by 2035 by promoting the use of low-carbon energy as an alternative to fossil fuels. Promoting the development of renewable energy is one of the basic policies for the energy sector in the "National Development Plan 2024-2025", and supporting the commercialization of the country's first geothermal power generation is a high priority project that is consistent with the Ecuadorian government's development policies.

In addition, the country's electricity is heavily dependent on hydropower, which accounts for 58.6% of the country's electricity generation in 2022 (the rest being 38.8% thermal and 2.6% other renewables). Supporting the commercialization of geothermal power generation is also expected to promote the diversification of the electricity mix while reducing the vulnerability of rainfall-dependent hydropower.

The Government of Ecuador conducted a surface survey in Chachimbiro, Imbabura Province, and confirmed the feasibility of developing geothermal resources in the area, and in October 2013, requested a feasibility study and a

Japanese ODA loan for the construction of the power plant. The " Chachimbiro Geothermal Development Project (Phase I)" (hereinafter referred to as the "Project") is Ecuador's first geothermal power development project listed in the "Electricity Plan" (2023), and is positioned as an important project in Ecuador's electricity sector as a starting point for future geothermal power development in the country.

#### ( 2 ) Japan's and JICA's Policy Cooperation Policy and Operations in the Energy Sector

Japan's Country Assistance Policy for Ecuador (April 2020) sets "contribution to sustainable development" as its basic policy and positions "energy development for sustainable development" as a development issue under the priority area of "economic infrastructure development," and implements programs to promote the development and use of renewable energy, including support measures in areas where Japan has knowledge and experience, such as geothermal power generation. This Project is also in line with the "Energy Transition" cluster of JICA's strategy (Global Agenda) for the Energy and Mining sector.

#### ( 3 ) Other Donors' Activities

The Inter-American Development Bank ("IDB") has already approved a total of US\$2,611 million in loans for 15 projects in the power sector (including 12 project loans and 3 policy support loans) from 2010 to July 2024. The " Project for Supporting the Advancement of Energy Matrix Transition" is being implemented under CORE (Cooperation for Economic Recovery and Social Inclusion), a co-financing framework between JICA and the IDB.

### **3. Project Description**

#### ( 1 ) Project Description

##### ① Project Objective

This Project will contribute to the promotion of sustainable economic and social development in Ecuador by constructing a geothermal power plant in the province of Imbabura in northern Ecuador, thereby promoting the use of renewable energy, diversifying power sources, and increasing power generation capacity, while also contributing to climate change mitigation. The current loan will cover exploratory well drilling and engineering services (E/S) related to the F/S of the Phase 2 loan (power plant construction) to promote smooth implementation of the Project.

② Project Components

- (a) Preparation work (excavation site development, access roads, etc.) (not covered by yen loans)
- (b) Procurement of drilling equipment and materials
- (c) Drilling of exploratory wells (4 exploratory wells and 1 reinjection well)
- (d) Consulting services (drilling supervision and procurement support, fumarole testing, resource evaluation, F/S preparation for power plant construction, etc.)
- (e) Temporary construction of power distribution lines (approx. 20 km) (not covered by yen loan)

( 2 ) Estimated Project Cost

7,838 million yen (Japanese ODA loan: 6,582 million en)

( 3 ) Schedule

October/2024-January/2030 (64 months)

End of consulting service is considered as the completion of the Project.

( 4 ) Project Implementation Structure

1 ) Borrower: Electricity Corporation of Ecuador (Empresa Pública Estratégica Corporación Eléctrica del Ecuador - CELEC EP; hereinafter referred to as "CELEC").

2 ) Guarantor: The Republic of Ecuador

3 ) Executing Agency: CELEC

4 ) Operation and Maintenance System : CELEC

( 5 ) Collaboration and Sharing of Roles with Other Donors

1 ) Japan's Activity

JICA conducted a preparatory study for the Chachimbiro Geothermal Development Project from February 2016 to March 2019. JICA has also hosted 15 trainees from Ecuador to the geothermal sector since 2011 until January 2024, and has strengthened the capacity of CELEC by dispatching individual expert; the Advisor of Geothermal Energy Development in Ecuador (2016-2018), etc. The technical cooperation project "Road Map for Zero Fossil Fuel in Galapagos Islands Project", for which the R/D was signed in August 2023, will identify the potential of renewable energies, including geothermal energy, in the Galapagos Islands.

2 ) Other Donors'Activity

The IDB is currently implementing the "Project for Supporting the

Advancement of Energy Matrix Transition" (co-financing with JICA) in order to expand and enhance the power transmission and distribution network and to implement programs to promote energy conservation as part of its support for the country's energy matrix transition. IDB is also financing the preparation of the "Plan de Desarrollo de la Geotermia en Ecuador" (Plan for Geothermal Development in Ecuador) by the Ecuadorian government.

(6) Environmental and Social Consideration

① Category: B

② Reason for Categorization: This loan does not fall under the large-scale geothermal sector listed in the "Japan International Cooperation Agency Guidelines for Environmental and Social Considerations" (promulgated in April 2010) (hereinafter referred to as "JICA Guidelines"), as the undesirable environmental impacts are considered to be insignificant and the project does not fall under the sensitive characteristics and sensitive areas listed in the Guidelines.

③ Environmental Permit: The environmental and social impacts of this loan have been confirmed in the Preparatory Study for Cooperation, and environmental and social considerations will be made based on the Environmental Management Plan prepared in the Preparatory Study. It has been confirmed that environmental permits for exploratory drilling and long-term fumarolic tests to be conducted during the current loan period are not required under the laws of the country concerned. An Environmental Impact Assessment (EIA) for the Phase 2 loan will be conducted under the current loan.

④ Anti-Pollution Measures: Pollution control measures for Phase 2 loans will be developed in the current round of loans. Noise pollution during the loan period is expected to meet domestic standards by restricting the passage of construction vehicles, installing soundproofing equipment, etc. Since geothermal water will be injected into the reinjection wells, no significant impact on water quality and water level is expected. Excavation sludge from the drilling work will be temporarily stored in a reservoir with anti-seepage measures, and will be properly collected and disposed of together with industrial wastes such as waste materials and waste oil. Hydrogen sulfide contained in the geothermal steam will be released into the atmosphere as a result of the drilling and

long-term fumarolic test to be conducted under the current loan, however, the amount of hydrogen sulfide released will be below the environmental standard value set by the World Health Organization (“WHO”) guidelines.

⑤ Natural Environment: The Project site is adjacent to the Cotacachi Cayapas Ecological Reserve, designated by the Ministry of Environment, Water Resources and Ecological Transition (Ministerio del Ambiente, Agua y Transición Ecológica) (distance from the nearest drilling site is approximately 200 meters), but there are no development restrictions under the country's national law. No rare species have been identified in the area surrounding the project site, and the impact of the land alteration is expected to be limited. Environmental monitoring will be conducted during the loan period to confirm the impact on flora and fauna. During the current loan period, approximately 16 hectares of forest will be cleared as a result of site development, but the project area is within a commercial forest owned by the company and the undesirable effects on the natural environment are not expected to be significant. If resettlement is required for the Project, a resettlement assistance plan (RAP) will be prepared under the current loan.

⑥ Social Environment: During the current loan period, the company plans to acquire land for approximately 18 ha of commercial forest owned by the company itself at a reacquisition price in accordance with domestic procedures and JICA Guidelines. The acquisition of the land has already been discussed with the company, and no particular objection has been confirmed.

⑦ Other/Monitoring: Monitoring during the current loan period will be conducted by the contractor under the supervision of CELEC for air quality, noise, water quality, flora and fauna, land acquisition, etc.

#### ( 7 ) Cross-Sectoral Issues

##### ① Climate change-related projects

The Project will contribute to the reduction of greenhouse gas (GHG) emissions by promoting the use of renewable energy, and may contribute to climate change mitigation measures. The climate change mitigation effect of the Project (estimated GHG emission reductions) will be calculated after confirming the scale of the power plant at the time of the Phase 2 loan review.

##### ( 8 ) Gender Category: Not Gender informed

<Details of Activities/Reason for Categorization>: The nature of the Project made it difficult to include efforts from a gender perspective.

( 9 ) Other Important Issues: None in particular

#### **4 . Targeted Outcomes**

( 1 ) Quantitative Effects

1) Outcomes (Operation and Effect Indicators)

Target values will be set at the time of the Phase 2 loan study.

( 2 ) Qualitative Effects

Mitigating climate change, diversifying energy sources and increasing generation capacity through the introduction of renewable energy and improving geothermal technology.

( 3 ) Internal Rate of Return: to be set when considering Phase 2 loans

#### **5 . External Factors and Risk Control**

( 1 ) Preconditions: the amount of steam required for the construction of the power plant must be enough.

( 2 ) External Factors: none in particular.

#### **6 . Lessons learned from previous similar projects and their application to this Project**

In the ex-post evaluation results of the "Northern Negros Geothermal Project" (evaluation year: 2009) in the Republic of the Philippines, there was a case in which the originally planned amount of power generation was not achieved due to insufficient steam. The lesson learned is that a small-scale plant should be constructed before constructing a large-scale plant, and a preliminary analysis of the geothermal reservoir should be conducted. In this Project, sufficient analysis of the geothermal reservoir will be conducted by introducing equipment and materials for long-term fumarolic tests during the current loan phase, and the size of the power plant will be determined through F/S with the drilling of an exploratory well to improve the accuracy of the design. In addition, it has been confirmed that the maintenance and management costs (including drilling of additional wells) incurred after the completion of the Project under the Phase 2 loan will be reflected in the electricity rates.

#### **7 . Evaluation Results**

The Project is in line with the country's development challenges and policies as well as the cooperation policy and analysis of Japan and JICA, and will contribute

to the stable power supply, diversification of power sources, and enhancement of power generation capacity in the country through the construction of the first geothermal power plant in the country. The Project will contribute to the SDG Goal 7 "Ensure access to affordable, reliable, sustainable and modern energy for all" and Goal 13 "Take urgent action to combat climate change and its impacts".

## **8. Plan for Future Evaluation**

### ( 1 ) Indicators to be Used

As indicated in Sections 4.

### ( 2 ) Future Evaluation Schedule

Ex-post evaluation: 2 years after the Project completion

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