SUPPORT FOR THE PREPARATION OF LOW AND HIGH ENTHALPY GEOTHERMAL PROJECTS IN LAC REGION

RG-T3022

CERTIFICATION

I hereby certify that this operation was approved for financing under the **Ordinary Capital Strategic Development Program for Infrastructure (INF),** through a communication dated August 6, 2018 and signed by Jane Silva. Also, I certify that resources from said fund are available for up to **US$450,000** in order to finance the activities described and budgeted in this document. This certification reserves resource for the referenced project for a period of four (4) calendar months counted from the date of eligibility from the funding source. If the project is not approved by the IDB within that period, the reserve of resources will be cancelled, except in the case a new certification is granted. The commitment and disbursement of these resources shall be made only by the Bank in US dollars. The same currency shall be used to stipulate the remuneration and payments to consultants, except in the case of local consultants working in their own borrowing member country who shall have their remuneration defined and paid in the currency of such country. No resources of the Fund shall be made available to cover amounts greater than the amount certified herein above for the implementation of this operation. Amounts greater than the certified amount may arise from commitments on contracts denominated in a currency other than the Fund currency, resulting in currency exchange rate differences, representing a risk that will not be absorbed by the Fund.

Certified by: (original signed) — 11/29/2018

Sonia M. Rivera
Chief
Grants and Co-Financing Management Unit
ORP/GCM

Date

Approved by: (original signed) — 12/03/2018

Rigoberto Ariel Yepez-Garcia
Chief
Energy Division
INE/ENE

Date

TC DOCUMENT

I. BASIC PROJECT DATA

▪ Country/Region:	REGIONAL: Argentina, Chile, Bolivia, Colombia, Costa Rica, Ecuador, El Salvador, Guatemala, Honduras, México, Nicaragua and Perú.
▪ TC Name:	Support for the Preparation of Low and High Enthalpy Geothermal Projects in LAC Region
▪ TC Number:	RG-T3022
▪ Team Leader/Members:	Christiaan Gischler, Team Leader; Misa Haratsu, Alternate Team Leader; Alexandra Planas, Edwin Malagón, Sergio Ballón, Carlos Echevarria, Carlos Jácome, Héctor Baldivieso, Kenol Thys, Alberto Levy, Cecilia Correa, Camila Gonzalez, Juan Carlos Cárdenas, Rodrigo Aragón, Wilkferg Venegas, Martin Walter y Cecilia Seminario (INE/ENE); Zachary Hurwitz (VPS/ESG); Rodrigo Riquelme (INE/WSA); Enrique Nieto (IFD/CMF); Elizabeth Robberechts (INO/IEN); Carolina Lembo (VPC/PPP).
▪ Taxonomy:	Client Support
▪ Date of TC Abstract authorization:	06 August 2018
▪ Beneficiary:	Ministries of Energy or its equivalent public entities, Local Development Banks. Beneficiary countries: Argentina, Chile, Bolivia, Colombia, Costa Rica, Ecuador, El Salvador, Guatemala, Honduras, México, Nicaragua and Perú.
▪ Executing Agency:	Inter-American Development Bank (IDB)
▪ Donors providing funding:	Ordinary Capital Strategic Development Program for Infrastructure (INF)
▪ IDB Funding Requested:	US$450,000.00
▪ Disbursement period:	36 months
▪ Required start date:	December 2018
▪ Types of consultants:	Consulting firms and individual consultants
▪ Prepared by Unit:	INE/ENE
▪ Unit of Disbursement Responsibility:	INE/ENE
▪ TC Included in Country Strategy (y/n):	No
▪ TC included in CPD (y/n):	No
▪ Alignment to the Update to the Institutional Strategy 2010-2020:	Productivity and innovation, Climate Change

II. OBJECTIVES AND JUSTIFICATION OF THE TC

2.1 **Justification**. The total CO_2 emission of Latin America and the Caribbean (LAC) countries increased at an average rate of 3.2 % per annum from 2004 to 2014 and

stood at approximately 1,875 million tCO_2 with an average emission intensity of 0.63 million of barrels of oil equivalent per day per millions of dollars of Gross Domestic Product as of 2014.[1] Many of the LAC countries heavily depend on fossil fuels for electricity generation, with a regional average of over 40%. In Central America, the power sector has contributed to the increase in oil consumption in the region during the last decades due to a substantial growth in the participation of imported fossil fuels in the generation mix,[2] resulting in high generation costs and increasing their vulnerability to high and volatile international oil prices. Furthermore, 50% of Central America's installed power is Hydropower, which highly depends on the rains, and therefore, the sector has been strongly affected by draughts during the last years. To deal with this situation, many of the LAC countries are exploring new ways to reduce their dependency on fossil fuels and strong climate events, allowing for greater share of Renewable Energies (RE) in their energy matrices.

2.2 The LAC region has great potential for high enthalpy and low enthalpy Geothermal Energy (GE), which has been estimated at 70 GW according to the GE Association. However, the deployment of these technologies remains underexploited.

2.3 High enthalpy GE consists of high temperature reservoirs that allow generation of electricity with a high efficiency factor using steam turbines. High enthalpy GE is a large available RE resource that could provide reliable base load power and contribute with the electricity network stability. However, only Mexico, Chile, Costa Rica, El Salvador, Guatemala, Honduras and Nicaragua had operating plants, with a total combined installed capacity of just over 0.66 GW by 2017.[3] Geothermal power, unlike wind and solar photovoltaic power, is a baseload technology that could increase energy security and grid reliability while reducing dependence on expensive fossil fuels and Greenhouse Gas emission. Also, it is much less area intensive than Hydropower Plants, which are also capable of providing renewable baseload capacity and ancillary services and it is not affected by strong climate events such as droughts. Furthermore, GE could be developed cost-effectively and at scale, and ultimately helps making room for more intermittent renewables in the power grid.

2.4 Low enthalpy GE consists of reservoirs with lower temperature which is not enough for power generation but could be used as a direct source of heat (industrial applications and residential-district-heating). Direct, or non-electric use of GE, is common in the Scandinavia, Central and Eastern Europe and is increasingly being adopted in cities like Bordeaux, Munich, Amsterdam and Warsaw, displacing natural gas for residential district heating. The potential of geothermal for district heating is significant in cool-temperate countries in LAC, particularly in the southern cities of Chile and Argentina, where most of the heating is done by biomass (wood) and natural gas. Particularly, the Energy Route 2018-2022 recently presented by the Government of Chile, focus on the promotion of the implementation of district heating. Different technologies could be applied as heating sources such as gas, biomass and geothermal power. However, gas and biomass are not emission free technologies, so the atmospheric contamination will be just displaced to the generation site. Furthermore, gas heat generation will be subject to gas prices volatilities and supply security. It was discussed in the 5th Geothermal Congress for Latin America and the Caribbean, held in July 2018 in Mexico City, that the direct use of GE could help generate social acceptance from the local communities to the development of

[1] CEPASTAT http://estadisticas.cepal.org/cepalstat/portada.html?idioma=english
[2] 45% of the electricity in Central America is generated through fossil fuels plants.
[3] IRENA, 2018.

geothermal power projects as it benefits local households and industries by providing clean heat.

2.5 The main reasons why few of these GE projects have been developed in LAC are: (i) high-upfront costs and risks;[4] (ii) the limited specific know-how ranging from geothermal exploration to drilling and reservoir engineering for plant operation and maintenance; (iii) the limited enabling regulatory and legal frameworks, as well as fiscal and environmental policies which deters private developers or increases their perception of risk; and (iv) the limited financial models to catalyze commercial funding that fit well to the above-mentioned high-risks of geothermal development. For those countries which are willing to move forward to exploring new geothermal resources, concessional resources and technical assistance to develop preparatory studies and determine the feasibility for geothermal development could go a long way towards reducing risks and tapping into the high potential that exists in the region.

2.6 **Objective.** The general objective of this Technical Cooperation (TC) is to facilitate the development of low and high enthalpy geothermal projects and programs in Latin America (LA). The TC will catalyze the use of additional funds from bilateral, multilateral and climate funds for promoting the use of GE and develop financial and risk mitigation instruments for exploration and exploitation of geothermal power. Particularly, this TC will finance: (i) preliminary non-drilling assessments and technical support as well as (ii) dissemination events with the aim of promoting and enhancing the development of low and high enthalpy GE.

2.7 **Bank's experience in the sector.** This TC builds on and expands the Bank's experiences in the geothermal sector to other areas of the LAC region. The Bank has been supporting the geothermal development in LAC through different operations such as The Geothermal Risk Mitigation Project (ATN/TC-14928-CH) and *Cerro Pabellón* Geothermal Power Project (3875/TC-CH) in Chile; the Renewable Energy, Transmission and Distribution of Energy Program (CR-X1014) and the first RE, Transmission and Distribution of Energy Program (3589/OC-CR) in Costa Rica; The Sustainable Energy Facility (SEF) for the Eastern Caribbean (3561/OC-RG, GRT/TC-15205-RG, GRT/FM-15208-RG); the Geothermal Financing and Risk Transfer Program (3178/OC-ME,3179/TC-ME, GRT/TC-14423-ME,GRT/TC-14424-ME) in Mexico and the Geothermal exploration program, Coverage and Improved Power Transmission (3727/BL-NI,3728/KI-NI,3729/OC-NI, GRT/TC-15743-NI, GRT/SX-15741-NI, GRT/SX-15742-NI) in Nicaragua. One of the main difficulties that were identified during the projects' execution is the existence of the proper structure for getting exploration and exploitation licenses. Environmental aspects are a major concern as geothermal resources are generally located in protected and indigenous communities' areas. Furthermore, the plants construction and operation affect also other aspects such as biodiversity and use of water. Therefore, there are many governmental entities involved in the environmental licenses approval process and generally there is a lack of procedures clarity and coordination difficulties between institutions that lead to long permits' approval periods. Also, past projects have shown that, in many countries, there is reduced experience, technical knowledge and quantity of companies that can provide GE specific services.

[4] Exploration cost can reach up to the 30% of the total project costs and these must be incurred during the assessment stage without certainty that sufficient resources will be found to make the project economically viable; therefore, they represent a considerable financial risk for project developers.

2.8 Even though there are several projects currently under execution and/or preparation, there are other immediate needs for assistance from different countries in terms of GE. For example, Argentina and Ecuador are currently active in preparation/formulation of their first geothermal projects and are looking for technical and financial assistance to support the process and explore other opportunities. In Bolivia, the Japan International Cooperation Agency and the IDB are supporting the development of the *Laguna Colorada* geothermal project that includes the generation plant (100 MW) and transmission line. The plant is expected to start its operation by 2022. Bolivia and Colombia are willing to proceed with the surface studies and exploration drilling for resources evaluation. Peru needs some adjustment of its energy auction scheme to facilitate the use of GE, which would require dialogues/awareness raising among stakeholders, including policy makers. Central America could benefit from the exchange of GE baseload power through the Central American Electrical Interconnection System (SIEPAC for its Spanish acronym) while GE could also contribute and complement the role of natural gas in the electricity matrix diversification, reduce emission intensity of power generation and improve energy security. Complementing past and current Bank's programs, in Costa Rica this TC could support the government in expanding the GE fields that the Bank has supported, in Nicaragua strengthen the GE projects' offer, in El Salvador and Honduras promote new GE projects and in Mexico continue to support the ongoing GE developments. With this situation, the regional approach of this TC could provide resources where they are needed on a timely, efficiently and effectively and therefore contribute with the geothermal development in the region.

2.9 **Strategic Alignment.** The TC objective is consistent and aligned with the development challenges of productivity and innovation and with the cross-cutting themes of climate change and environmental sustainability of the Institutional Strategy 2010-2020 (AB-3008) by promoting the use of RE energy and promoting initiatives to reduce carbon emissions. This TC will contribute with the introduction of low enthalpy district heating projects in LAT as a clean alternative to high emissions and pollute heating methods, such as wet wood which is highly used in the south of the region. Furthermore, this TC will promote geothermal power which could displace traditional fossil fuel baseload power plants without being threatened by strong weather events. The TC is also consistent with the Energy Sector Framework Document (GN-2830-3) as promotion of RE is one of the principles in the energy sector. This operation will contribute to the Corporate Results Framework (CRF) 2016-2019 (GN-2727-6) by (i) reducing carbon emissions; and (ii) promoting power generation from RE sources.

2.10 This TC is aligned with the Ordinary Capital Strategic Development Program for Infrastructure as it aims to support the development of GE and, therefore, will promote investments in baseload RE power plants, district heating and enhance the quality of design and efficiency in the execution of these technologies. Furthermore, this TC has a dissemination component with the objective of deepen sector knowledge on GE technologies as good infrastructure projects to increase power quality, household comfort and reduce greenhouse gas emissions.

2.11 This TC is also aligned with the Country Strategies (CS) of Chile (CH-P1132), Bolivia (BO-P1123), Colombia (CO-P1178), Costa Rica (CR-P1068), Ecuador (EC-P1148), El Salvador (ES-P1072), Guatemala (GU-P1103), Honduras (HO-P1077) and Nicaragua (NI-P1058) by contributing with the development of renewable and low-carbon power generation technologies. Furthermore, the TC is aligned with the

CS of Argentina (AR-P1130) and Perú (PE-P1199) as GE technology fills the quality of electricity supply requirements and with the CS of Colombia (CO-P1178), Bolivia (BO-P1123), and Mexico (ME-P1118), by promoting the development of a RE baseload technology that will contribute with the reduction of the vulnerability to natural disasters and extreme weather.

III. DESCRIPTION OF ACTIVITIES/COMPONENTS AND BUDGET

3.1 **Component I: Preliminary non-drilling assessment and resource mobilization for geothermal development (US$350,000).** This component will finance preliminary assessments that will focus on promoting the mobilization of additional resources for GE projects development on the selected beneficiaries' countries. This component includes activities such as: (i) contribution with the identification of site(s) by reviewing or complementing the preliminary technical surveys that are available; (ii) contribution with the identification of sites by assessing the land use restrictions and key environmental and social issues or factors for developing geothermal projects; (iii) support during tendering processes, including structuring of Public-Private Partnership, Power Purchase Agreements and geothermal financial models; (iv) review of existing framework for geothermal development, identifying potential challenges from institutional, regulatory, technical, social and environmental perspectives; among others. The final scope of the assessments will be determined according to each country 's needs. The outputs of this component will vary according to the requirements of each country and will be, for example, the submission of prefeasibility studies and tender documents. All outputs will contribute with enabling the development of geothermal projects.

All beneficiary countries will have equal opportunity to access to the TC funding which will be available on a first-come first-served basis.

3.2 **Component II: Knowledge Dissemination and Awareness (US$100.000)** This component will finance seminars, workshops and technical publications to increase the comprehension of stakeholders on the value of GE, leading to the promotion and enhancement of low and high enthalpy GE development. Stakeholders include policymakers, energy regulators, environmental authorities, local governments, neighboring communities or industries, among others. This component will disseminate the knowledge and experiences on geothermal technology, including the results and lessons learned from Component I, creating awareness and improving the understanding on the technology and therefore contributing with further expansion of geothermal projects.

3.3 **Budget.** The TC's total budget is US$450,000 financed by the IDB Ordinary Capital Strategic Development Program for Infrastructure. The eligible expenditure for financing will be limited to: (i) consultancies (firms and individual consultants); (ii) travel cost and per-diem for consultants; (iii) workshops and seminars required for the dissemination of results and presentations. The execution and disbursement period of the TC will be 36 months. The table below shows the detailed budget:

Table 1. Indicative Budget (in USD)

Activities/Components	IDB/Fund Funding
Component I: Preliminary non-drilling assessment and resource mobilization for geothermal development	350,000.00
Component II: Knowledge Dissemination and Awareness.	100,000.00
Total	**450,000.00**

3.4 **Supervision arrangements.** The supervision of this TC will be carried out by the IDB. Christiaan Gischler (INE/ENE), based in Washington D.C., will be the Team Leader in coordination with the Energy Specialists based on each Country Office. Furthermore, the Geothermal Thematic Group of the Energy Division will provide the adequate support and contribute with the international coordination required for implementing this regional TC.

3.5 **Sustainability.** This TC, as it is established in its objective, will catalyze the use of additional funds for promoting high and low GE projects. Furthermore, the dissemination activities under Component II will attract private sector developers and additional investment from multilateral and bilateral institutions which will catalyze and mobilize further resources to move to the next stages on the development of geothermal projects.

IV. EXECUTING AGENCY AND EXECUTION STRUCTURE

4.1 The IDB, through the Energy Division (INE/ENE), will be responsible for the execution of this TC. In line with OP-1155-2, considering this is a regional TC and in the absence of a regional entity for the execution of the TC, it is appropriate that the Bank carries out the contracting of consultants vis a vis the sustainability of the implementation of the project. The IDB's experience and strong collaboration with the participating countries will enable a successful implementation of the preliminary assessments, while also facilitating the articulation among the different countries, stakeholders and donors in the region. The Bank will contribute with the harmonization of the activities at a regional level, by providing a linkage between all GE projects, guaranteeing that all countries benefit from the experience of the others. Prior to the execution of the project activities in any of the selected beneficiary countries, the Bank shall obtain the corresponding request letter and non-objection from the liaison entity of that country requesting that the bank executes the operation.

4.2 The activities to be executed are included in the Procurement Plan and will be contracted in accordance with Bank policies as follows: i) AM-650 for Individual consultants; ii) GN-2765-1 and Guidelines OP-1155-4 for Consulting Firms for Services of an Intellectual Nature and; iii) GN-2303-20 for the procurement of consulting services different from consultants. All activities under the TC will be developed in compliance with the IDB safeguards policies.

V. PROJECT RISKS AND ISSUES

5.1 Even though it has been detected a potential coordination risk due to the project having multiple beneficiaries, this risk will be mitigated with the cooperation and continuous support of the Geothermal ENE's thematic group and with close coordination with ENE's specialists based in the Country Offices (COF). Each country

specialist will be responsible of the communication with the government. The thematic group is composed of ENE's specialist and analysts located in different COF and in Head Quarter. Christiaan Gischler, Team Leader of this TC is also the Technical Secretary of the Geothermal group and will be the responsible of managing the resources and required support from the Geothermal group to contribute with the local and regional dialogue. Another identified risk are potential changes in governments that could affect the sustainability of the projects. Elections are expected during the TC execution for most of the countries and new authorities may not be aligned with the TC objectives. To mitigate this risk, key stakeholders and members of the opposition parties will be included in the dissemination activities and involved in the process. Also, some governments may not be aligned with the GE projects development, risk that will be mitigated by assigning the technical support funds on a first-come, first-served basis. On the other hand, governments could request more support than the funds available through the TC, what will be mitigated by leveraging additional funds.

VI. ENVIRONMENTAL AND SOCIAL CLASSIFICATION

6.1 According to the Environment and Safeguards Compliance Policy (OP-703), this TC has been classified as a Category C. No environmental assessment studies or consultations are required for Category "C" operations (see: Safeguard Policy Filter Report (SPF) and Safeguard Screening Form (SSF).

Required Annexes:

- Annex I. Request from the client
- Annex II. Results Matrix
- Annex III. Terms of Reference: Tendering Process and Terms of Reference: Surface Studies
- Annex IV. Procurement Plan