

Harnessing geothermal potential in Latin America and The Caribbean

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**A perspective
on the road ahead**

INTER-AMERICAN DEVELOPMENT BANK

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Prologue



Christiaan Gischler

**Co-Leader, Special Group
on Mining, Geothermal and
Hydrocarbons, Inter-American
Development Bank**

For the Inter-American Development Bank (IDB), geothermal energy is a key strategic area. Since July 2018, we have taken important measures to contribute to the development of geothermal energy in Latin America and the Caribbean (LAC). The first measure was to develop a Special Group within IDB to focus on the promotion and development of geothermal projects and initiatives across the region. On March 21st, 2019 the Mining, Geothermal and Hydrocarbon (MGH) Special Group within the Infrastructure and Energy Department of the IDB was officially created by its senior management. The MGH Special Group has been staffed with 15 professionals and oversees geothermal projects in 15 countries.

This document summarizes all the key actions that have stemmed over the course of the last three years. Organized by country, includes policy recommendations arising out of conversations and presentations for countries in the region seeking to develop geothermal.

Geothermal energy is a baseload, climate-resilient, and renewable source of energy, capable not only of providing as much as 50-70 GW power to countries in Latin America and the Caribbean, but also of providing heat for agricultural purposes (e.g. dehydration of crops, heat for greenhouses), cooling, and district heating in cooler areas like the southern cities of Chile and Argentina, thus avoiding the use of wood and fossil fuels.

Our mission for the years to come, is to showcase the benefits of geothermal energy and its direct uses, support countries as they harness their potential, and in doing so promote local development.

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in Latin America and the
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Installed Geothermal Capacity in Latin America and the Caribbean June 2020



Market Commentary from **ThinkGeoEnergy**



MEXICO

25 MW Los Azufres III-2 Phase 2 geothermal plant in construction, is expected to start in 2019. Around 25 additional projects with permits for exploration.



GUATEMALA

Up to 5 projects in early stages of development that could add 30 MW.



EL SALVADOR

The expansion of Berlin and Ahuachapan is under study, with the collaboration of JICA and the IDB. The construction of Chinameca and San Vincente are being designed by the World Bank.



HONDURAS

There are 3 projects in early stages of development that could add more than 150 MW.



NICARAGUA

Up to 3 projects in early stage of development that could add more than 150 MW.



COSTA RICA

The Las Pailas Plant became operational in 2019 and is generating an additional 55MW.



PANAMA

Potential being explored for development.



COLOMBIA

The country's potential is being explored as well as the possible development of two projects.



ECUADOR

There is early initial exploration of four potential projects, that could add up to 50 MW. There are also transnational opportunities with the Tufiño project with Colombia.



PERU

Up to 17 identified prospects, specifically in the southern part of the country, in the Tacna region, some of them with exploration permits.



BOLIVIA

10 MW pilot project tender for drilling and EPC contract awarded for Laguna Colorada. There is potential in the Empeza and Sajama fields.



CHILE

33 MW Cerro Pabellon expansion project under way with expected COD second half of 2021. Several other prospects and one project were recently awarded an exploration permit.



ARGENTINA

A tender was discussed for the Copahue field, but nothing has been reported since.



GUADELOUPE (France)

10 MW Bouillante expansion planned with planned COD 2021.



DOMINICA

Funding announced for 10 MW geothermal power plant project, Drilling concluded and tender for power plant expected soon



ST. VINCENT & GRENADINES

The project has begun, three wells have already been drilled.



MONTSERRAT (UK)

Geothermal project expecting a decision. Drilling in one of three wells expected to begin as well.



ST. KITTS & NEVIS

10 MW Project on Nevis concluded tests on exploratory well drilled in 2018, funding being sought.



— SECTION ONE —

**Around
the region**

1

Latin America and the Caribbean show huge promise for the development of geothermal. The region has geothermal potential of between 55 GW and 70 GW (Berman, 2018) which remains mostly untapped. With, however, a few notable exceptions—Mexico, El Salvador, and Costa Rica, for example—progress has been sluggish. At present only Mexico, Central America, the Caribbean and Chile have operating power generation plants with an installed capacity that barely exceeds 1.8GW (IRENA, 2017). Alongside perennial discussions about long-standing hurdles such as exploration and resource risk, there were broader discussions about how the industry could better advocate for itself in the face of a rapidly evolving regional energy matrix.

ARGENTINA

Argentina does not have a consolidated national framework to promote geothermal development. Each province within the country has the autonomy to define its own approach and allocate concessions. Nationally, 70% of the energy matrix is from non-renewables. Argentina has made considerable progress towards the inclusion of Non-Conventional Renewable Energies (NCRE) in its electricity matrix since the approval of Law 27,191. The law establishes a goal of 20% of NCRE by 2025. Gaston Siroit from the Ministry of Energy and Mines presented the RENOVAR energy auction program in July 2018, which seeks to diversify the country's energy mix. The program works through concessionary Power Purchase Agreements (PPA) where plants are built and operated by private companies. A total of 4,466MW on NCRE have been awarded under RENOVAR. However, geothermal power projects were not included in the program.

BOLIVIA

There are 42 geothermal manifestations in Bolivia, of which three (Sajama, Campo Geotérmico Empexa and Laguna Colorada) have potential for development. Bolivia's geothermal resources are located at high elevations and far from the nearest densely populated areas, which adds a layer of complexity for developers. The IDB is currently exploring how it could support the development of transmission lines to connect Laguna Colorada with the interconnected system. Notwithstanding the sometimes challenging operating environment, Patricia Claros, Interim Head of the Laguna Colorada Geothermal Project at the National Electricity Company (ENDE), reported in 2018 that the plant had moved into the con-

struction phase with the support of concessional funding from JICA. The objective is to build wells in 2019 and power plants in 2021. The project aims to generate 100 MW, contributing to the country's shift to renewables and providing electricity to nearby communities.

CHILE

Chile became the first South American country to implement a carbon tax in 2014. In the last decade, it has made significant strides in renewable energy. Specifically as it pertains to geothermal, Gabriel Prudencio Flaño, Head of the Renewable Energy Division of the Ministry of Energy, shared that the government plans to adopt and implement an energy roadmap that includes a regulatory amendment to facilitate geothermal for baseload and direct use. As part of that plan, Prudencio said the country would amend the law for geothermal concessions, digitize the concessional system, implement a program for direct uses, and renew and update the capacity payment mechanism.

COSTA RICA

Costa Rica signed an agreement with JICA in June 2017 for approximately US\$240 million for construction of the Borinquen I geothermal energy plant. It will be the third plant after the Miravalles and the Las Pailas projects. The 55-MW facility in the northern Guanacaste province is slated to be up-and-running in 2023. In June, President Carlos Alvarado signed into law a line of credit for US\$500 million from the IDB for the development of sustainable electricity projects. Costa Rica's legislative assembly had unanimously approved the bill. From the credit line, individual loan contracts will be offered for

an eight-year term and must be executed within a 25-year period.

ECUADOR

Matilde Urquiza, Specialist in Geothermal Projects at Corporación Eléctrica de Ecuador S.A. (CELEC EP,) explained that the development of geothermal energy is aligned with the transformation of Ecuador's energy matrix. Initial exploratory drilling for the Chachimbiro Project concluded in 2017 with support from JICA. The expectation is that Ecuador will have its first geothermal

plant within a 5 to 10 year period. There are four additional prospective projects, as well—Baños de Cuenca, Binacional Tufiño-Chiles-Cerro Negro, Chalpatán, and Chacana. Of these, the Chacana project was scheduled for temperature gradient studies in the last quarter of 2018, with 40 % of funding provided by the GDF. Public sector support is key to fill the financial and policy gap, while the involvement of the private sector is important to fulfill financial needs.



Cerro Pabellon Geothermal Plant, the first geothermal plant in South America (CHILE).

Source: Geolac Presentations (2018)



EL SALVADOR

José Estévez, Commercial Director of LaGeo, pointed to the recent fall in oil prices, the uncontrolled growth of energy imports, and the growing number of solar and wind energy contracts as factors that may hinder additional investment in geothermal energy in El Salvador. He reiterated the importance of PPPs as key for developing geothermal.

In addition, Akihiro Miyazaki, Director of Central America and the Caribbean for JICA, shared that they would soon start a project in El Salvador in collaboration with LaGeo, the University of El Salvador and a Japanese University, which offers a new approach to geothermal exploration techniques and an integrated evaluation system of geothermal reservoirs. The government is studying the possibility of building the new Chinameca and San Vicente plants, as well as the potential to expand Berlin and Ahuachapan.

MEXICO

The Ministry of Energy (SENER) announced the Mexican government's new risk transfer program in collaboration with various entities including the Inter-American Development Bank. In order to support this program, a new policy framework that seeks to regulate exploration and streamline the process of awarding concessions to permit holders of geothermal exploration was also announced.

NICARAGUA

Bruce Leighton, a Special Assets Specialist at IDB Invest, presented the underwriting of the first major geothermal project in Nicaragua, the San Jacinto private geothermal project. Due to production problems derived from insufficient geothermal fluid, the PPA was amended to include a reduction of capacity threshold and restructuring of terms and debt repayment plan with creditors. Leighton reported that the Nicaraguan government's willingness to amend the terms—despite the fact that the San Jacinto project is owned and operated by a private entity—were critical to the successful operation of the plant.

PERU

Franklin Acevedo, Head of Legal and Regulatory Affairs of EDC Peru, explored the potential role for geothermal in Peru. Acevedo emphasized the potential for geothermal development in the southern part of the country, an area with an energy deficit where geothermal resources have already been confirmed. Acevedo suggested that

the government needed to participate more fully in the market to promote geothermal through policy and regulatory programs. Other fundamental questions around the ownership of projects (i.e., will they be developed by state-owned entities, by IPPs, or by both) are still to be resolved. Lastly, Acevedo questioned whether there will be a process for the delivery of a bankable power purchase agreement (PPA).

ST. KITTS AND NEVIS

Ian Liburd, Minister of Public Infrastructure, Post, Urban Development, and Transport, for St. Kitts, shared that the island had begun the process of development of its geothermal resources with a foreign developer in 2015. Since no progress has been made and the developer wanted the concession agreement prior to successful confirmation of the resource, the government has sought the assistance of the government of New Zealand and the Caribbean Development Bank (CDB). CDB is the executing agency of the Sustainable Energy Facility (SEF) for the Eastern Caribbean, an IDB program that aims to reduce financial, technical, and institutional barriers for geothermal development in the five independent nations in the Eastern Caribbean with geothermal potential. IDB's SEF Program provides different financial instruments (grants, contingent recovery grants, and concessional loans) to support all stages of geothermal development for projects in Dominica, Grenada, St. Lucia, St. Kitts and Nevis, and St. Vincent and the Grenadines. An assessment of these projects indicates that the projects generate net economic benefits for each of the countries by reducing generation costs and carbon emissions (Gischler et al. 2017).

On neighboring Nevis, Jervan Swanston, General Manager of the utility, NEVLEC, reported that the island had successfully confirmed sufficient geothermal resources to meet the total demand of St. Kitts and Nevis combined. Funding for development, he reported, is pending due diligence. Swanston said reported that construction was scheduled to begin in 2020.

Source: Geolac Presentations (2018)



Source: Geolac Presentations (2018)



Source: Presidencia de la República de Costa Rica
<https://presidencia.go.cr>



Source: Polaris Infrastructure

Top Left: Laguna Colorada Geothermal Project (BOLIVIA).
Top Right: Chachimbiro Project (ECUADOR).
Bottom Left: Las Pailas Geothermal Plant (COSTA RICA)
Bottom Right: San Jacinto-Tizate Geothermal Plant (NICARAGUA)



— SECTION TWO —

**Financing
Programs**

2

● In Latin America and the Caribbean, one of the better-known barriers to successful geothermal development is that geological exploration, a necessary and often years-long process, costs close to US\$4 million per MW, can last up to three years and has a 60% success rate¹. Grant and concessional funding programs will continue to play a key role in enhancing the viability of regional geothermal projects. According to the World Bank, during the next 10 years, the LAC region will require an estimated US\$ 2.4 billion to US\$ 3.1 billion to finance the cost of developing about 776 MW of geothermal power generation capacity (Berman, 2018). We examined existing and new financing programs and explored which opportunities could successfully maximize geothermal in the region.

“ In order to mitigate investor risk, multilateral financing programs continue to play a key role in generating investment flows in each country.

THE WORLD BANK GROUP

The World Bank Group funds projects in Latin America and the Caribbean through its multiple funds and ES-MAP which leads the Global Geothermal Development Plan (GGDP), an initiative that mobilizes new funds for the initial phases of geothermal investment and exploration. Thus far, the fund has raised US\$235 million, of which US\$70 million has been allocated to the LAC region (Berman, 2018). During 2018, the World Bank announced it would soon start supporting Mexico through the GGDP. The World Bank has also stated that it is working on US\$115 million in concessional, traditional loans and grants from other organizations for Dominica, St. Lucia, and Nicaragua, slated for approval by 2019 (Berman, 2018).

“ The World Bank has also stated that it is working on US\$115 million in concessional, traditional loans and grants from other organizations for St. Lucia.

INTER-AMERICAN DEVELOPMENT BANK

IDB has implemented an innovative financing scheme for geothermal projects that consists of using grants and contingent recovery grants to finance the early exploration stage of projects. Subsequently, and once the geothermal resource has been proven in sufficient quantity and quality for the development of a generation plant, concessional loans are used for the construction of plants and transmission lines. Such IDB programs are currently being implemented in Colombia, Mexico, and the Eastern Caribbean, as are stand-alone loans to finance specific geothermal investments in Costa Rica and Nicaragua.

Perhaps one of the most significant programs announced was Mexico's geothermal development funding package, which included the IDB-Mexico Financing and Risk Transfer Program. Developed by the IDB with the generous contribution of the Climate Investment Fund / Clean Technology Fund (CTF) with large-scale, low-cost, long-term financing, the program was rolled out in partnership with the Ministry of Energy (SENER), the National Institute of Clean Electricity and Clean Energy (INEEL) and Nacional Financiera (NAFIN). The new initiative facilitates resources to reduce risks and costs in well-drilling activities at the initial exploratory stage and in the construction of geothermal energy plants and transmission lines, said IDB Lead Energy Specialist Christiaan Gischler during the announcement.

Anatomy of a financing program

The National Institute of Electricity and Clean Energies (INEEL) presented the new financing and risk transfer program that enables existing permit-holders to secure

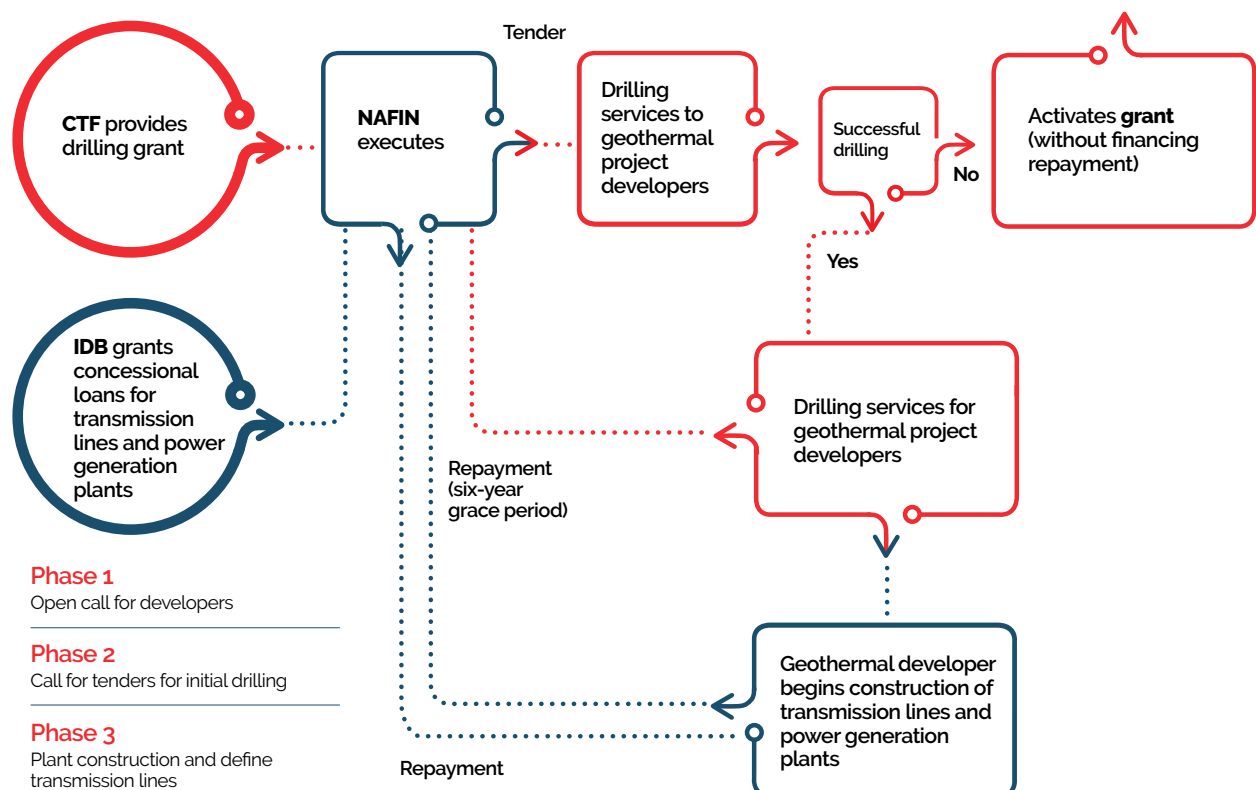
funding for up to four projects with three perforated wells each and access to a steady flow of resources, whether each well is successful or not. The financing program was approved in July. To ensure execution, INEEL said geothermal developers will also be asked to contribute² at least 25% of the total geothermal development cost toward well development. If the developer later discontinues the project, INEEL takes over the concession until the Ministry of Energy can make a new bid for development.

Though Nacional Financiera (NAFIN) already has financing programs for geothermal development, the support of the IDB makes it possible to offer a line of credit for geothermal resource exploration and plant construction phases. The developer can access this funding for up to two different projects. For the second component, NAFIN will finance the secondary drilling phase with a financing scheme and the developer will be granted a

six-year grace period for repayment. NAFIN will administer non-reimbursable financing if geothermal exploration is unsuccessful. If results are positive, it will be converted to a concessional loan and the developer will repay it through income from energy sales. NAFIN may also finance restoration and/or expansions of existing geothermal plants, and transmission lines associated with the geothermal project.

- ¹ The success rate averaged over the first five wells drilled was 59 %, based on global database of wells in geothermal fields which together supply power to 71 % of the world's installed geothermal electricity generating capacity, IFC 2013
- ² The 25% may be in costs associated with drilling, preparation of access roads to drilling sites, earth moving to facilitate drilling, contribution of funds for drilling or deeper drilling extensions or a letter of credit executable in the exploration phase, etc.

RISK TRANSFER FINANCING PROGRAM FOR GEOTHERMAL ENERGY



Render based on information provided by the IDB (2020).

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

JICA emphasized its longstanding commitment to financing geothermal across the region. US\$241 million has been committed, for example, to develop a third geothermal plant in Costa Rica, while a US\$552 million loan was approved last year for the construction of the Laguna Colorada Geothermal Power Plant in Bolivia. JICA is also in advanced negotiations for co-financing programs for the Eastern Caribbean. Shohei Tada, Director of Latin America for JICA, stated that in order to promote regional geothermal initiatives, collaboration with other donors is critical.

“In order to promote regional geothermal initiatives, collaboration with other donors is critical so we can effectively mobilize and leverage grant and concessional funding.”



Shohei Tada
Director of Latin America
for JICA (2019)

KFW

KfW presented updates on the rollout of the Geothermal Development Facility (GDF), which launched in 2017. Open to both public and private sectors, the goal of the facility is to catalyze the development of 350 MW of installed geothermal power capacity in Latin America over the next ten years.

GEOTHERMAL DEVELOPMENT FACILITY FOR LATIN AMERICA (GDFLA)

In Latin America and the Caribbean, the first round of project selection received more than 25 inquiries, according to Arndt Wierheim, Senior Project Manager at KfW Development Bank. Wierheim discussed the positive results of the GDF design and shared that since the first round, three agreements for surface studies or drilling were signed. He added that two additional agreements for surface studies were in the pipeline. More specifically, after Round 1, GDF committed as much as

€600,000 in feasibility study funding, as well as exploratory drilling funding for up to €5.8 million per project to qualified applicants in Chile, Bolivia, Ecuador, Colombia, Costa Rica, Nicaragua, Honduras, and Guatemala.

Overall, the main challenge of the program was obtaining non-reimbursable funds or those with high concessionality—a necessary risk in the exploration stage. Wierheim said that awareness on the part of both politicians and donors was key, as well as the competitiveness of projects. However, Wierheim emphasized that a large part of GDF's success is predicated on the fact that several projects are already in the implementation stage. And to further promote geothermal development through GDF, additional funding from third-party donors is crucial. Lastly, Wierheim made a call for proposals for the second round of funding.

GEOTHERMAL DEVELOPMENT FACILITY Results - CFP - Round 1

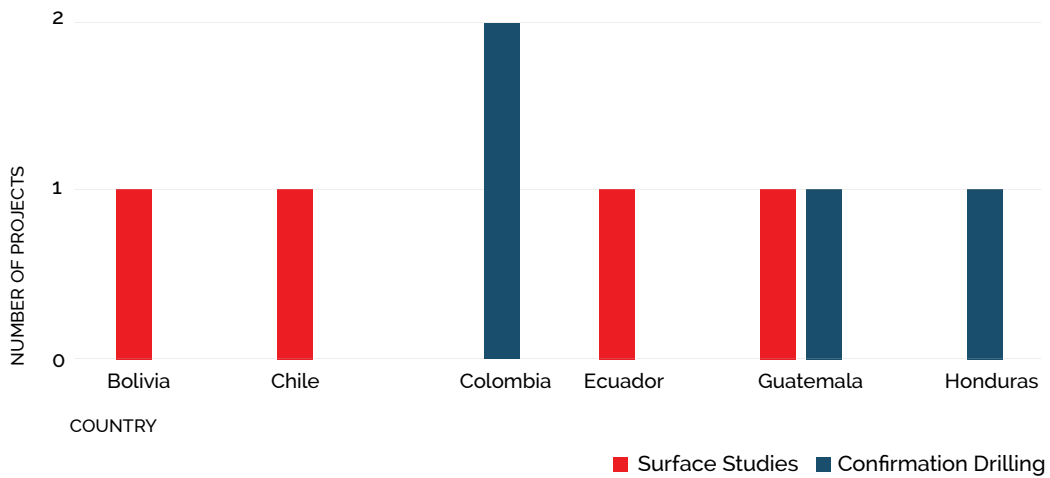
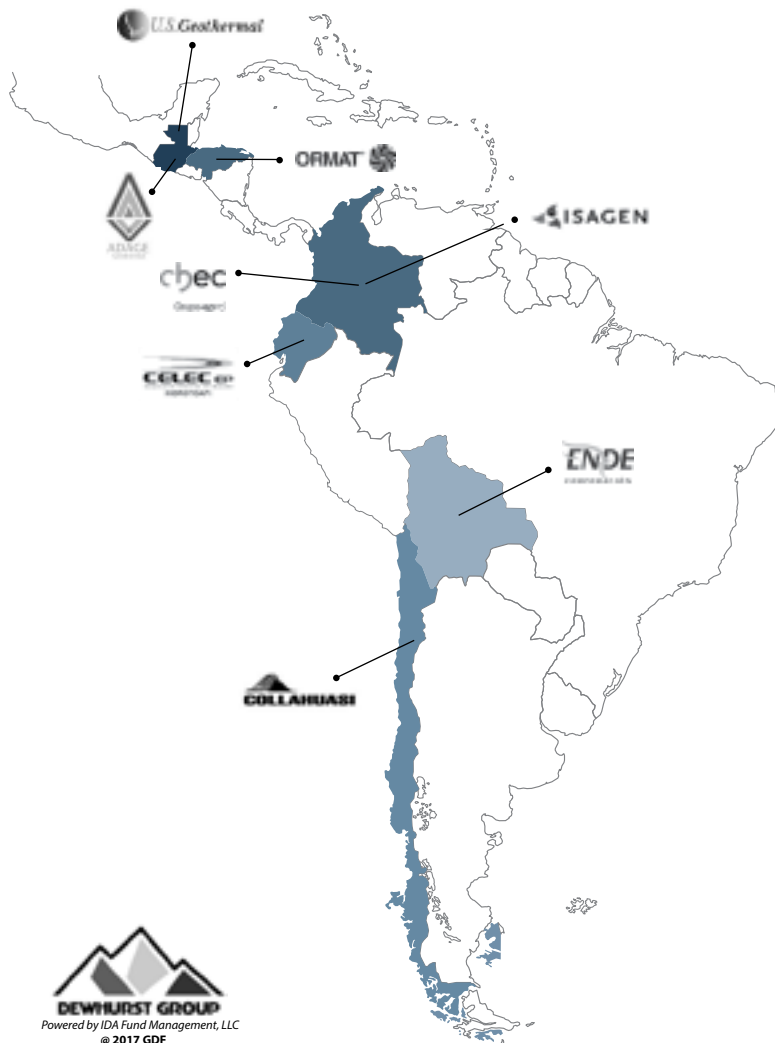
4 PROGRAMS FOR DRILLING EXPLORATION

- **Colombia**
Central Hidroeléctrica de Caldas S.A ESP-ISAG
- **Guatemala**
U.S. Geothermal Guatemala
- **Honduras**
ORMAT, Honduras

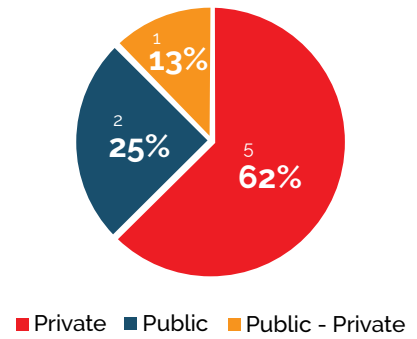
4 PROGRAMS FOR SURFACE STUDIES

- **Bolivia**
Empresa Nacional de Electricidad
- **Ecuador**
Corporación Eléctrica del Ecuador
- **Chile**
Compañía Minera Doña Inés de Collahuasi
- **Guatemala**
Adage Geothermal Guatemala

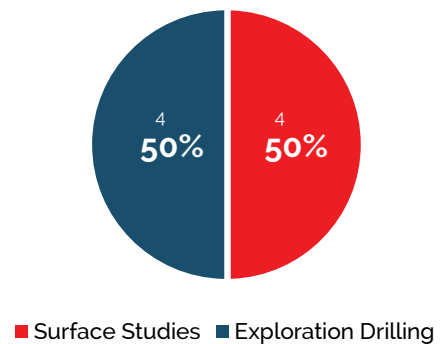
PROJECT COUNTRY SUMMARY



ORGANIZATION TYPE



GRANT TYPE



TAKEAWAYS: GDF Q&A WITH KFW'S ARNDT WIERHEIM

Question 1: Can countries like Bolivia, which do not have a regulatory framework for geothermal energy, apply for GDF funds?

GDF: Bolivia was the first country to be awarded funds from the GDF to finance surface studies and GDF is happy with the results. GDF is trying to support early technical assistance and trying to promote lines of credit for the following stages.

Question 2: What kind of economic guarantees will be requested to grant funds to refinance, in the event the exploration is successful?

GDF: It will depend on the disbursement plan. The applicant must always present a guarantee of repayment. If the project is successful and they want to move forward with the following stages, you must have repaid the debt with GDF before applying for financing with a bank. Repayment is important in order to secure other sources of financing.

Question 3: This scheme seems problematic because repayment cannot be guaranteed without a PPA in place. And it's nearly impossible to get a PPA unless the viability of the resource has been proven. It's a vicious cycle. It seems that the most important phase is not exploration but production. Can repayment be deferred until a PPA is executed?

GDF: The GDF funds aim to mitigate the risk of drilling, not production. It is not intended to ensure the entire project and there is no other role in that area.



Arndt Wierheim
KfW DEVELOPMENT BANK
Senior Project Manager

GEOHERMAL DEVELOPMENT FACILITY³

Results - CFP - Round 2

2 PROGRAMS FOR CONFIRMATION DRILLING

● **Guatemala**
Blue Stone Resources Inc

● **Chile**
Transmark Chile SPA

5 PROGRAMS FOR SURFACE STUDIES

● **Chile**
Compañía de Energía SPA
Transmark Chile SPA

● **Guatemala**
Geotermia Centroamericana, S.A

● **Nicaragua**
Polaris Energy Nicaragua, S.A (PENSA)

● **Perú**
EDC Energía Verde Perú

CARIBBEAN DEVELOPMENT BANK (CDB)

The Eastern Caribbean is a critical area for CDB intervention to support the development of geothermal. There are a number of projects in the pipeline across the region but none— with the exception of Guadeloupe in the French Caribbean—have made it beyond the exploratory drilling phase.

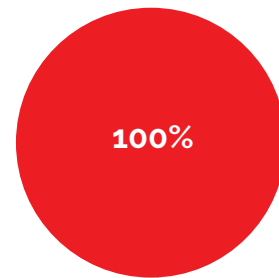
The CDB highlighted the benefit of developing a program in collaboration with several donors.⁴ In particular, the CDB identified the partnership of the IDB as very important. This has enabled them to support governments through technical assistance during the process and especially with provision of legal support for negotiating contracts, setting exploration fees and environmental impact studies.

³ <http://gdflac.com/results/>

⁴ <https://1point5.info/images/documents/Climate20Finance-20Fact20Sheet.pdf>

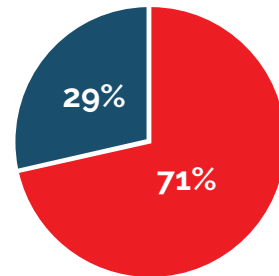


ORGANIZATION TYPE



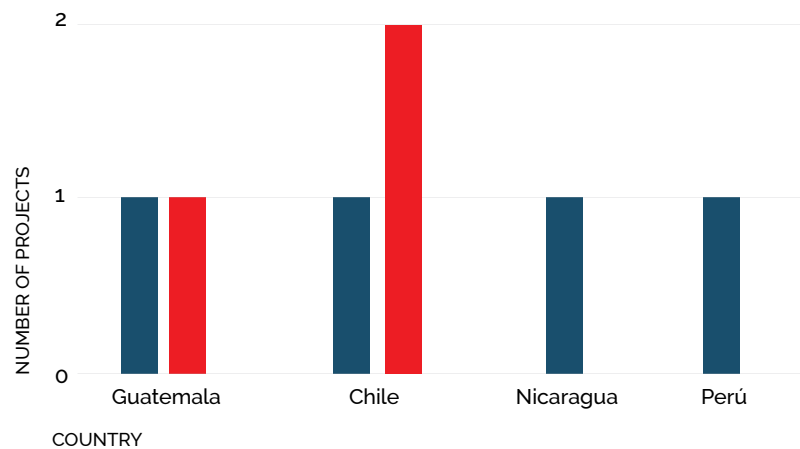
■ Private ■ Public ■ Public - Private

GRANT TYPE



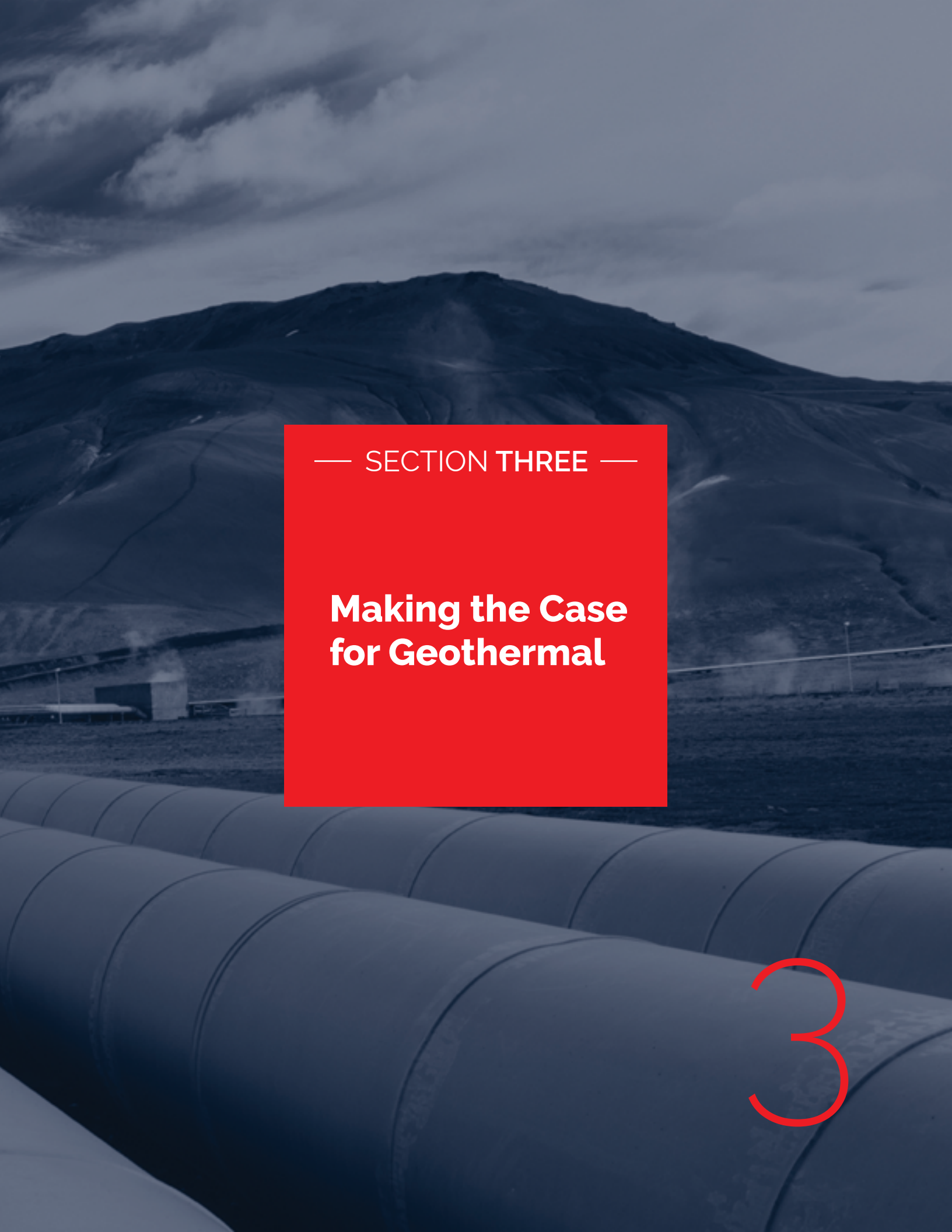
■ Surface Studies ■ Confirmation Drilling

PROJECT COUNTRY SUMMARY



■ Surface Studies ■ Confirmation Drilling





— SECTION THREE —

Making the Case for Geothermal

3

WHY DO DEVELOPMENT FINANCE INSTITUTIONS ADVOCATE FOR GEOTHERMAL?

Development organizations have been committed to geothermal development for more than 30 years. But why are development banks still so committed to geothermal in an era of solar, wind and storage? This question was posed to a panel of senior development bankers. The consensus which emerged was that:

- Geothermal energy is a robust, reliable and renewable source of baseload available at a competitive cost to society and stakeholders.
- Geothermal infrastructure is relatively resilient in an era of climate change and increasingly severe weather events.

Nils Janson, Managing Director, Policy and Regulation, K&M Advisors, and consultant for the IDB, stated, "there is no single technology that best meets all the requirements of the electricity supply system objectives." But geothermal does meet most requirements, according to Janson, and is one of the lowest-cost sources of base load renewable energy. He emphasized, however, that making decisions based solely on cost can ignore risks and disadvantages such as operational inflexibility, vulnerability to external shocks or severe climate events. His view was that geothermal does not have any major disadvantage and is more resistant to natural disasters than other renewable energy options.

“There is no single technology that best meets all the requirements of the electricity supply system.”



Nils Janson
Managing Director,
Policy and Regulation,
K&M Advisors

ENERGY VALUE AND OPERATIONAL FLEXIBILITY

Panelists at GEOLAC 2018 also discussed the role of geothermal in the context of a region that is investing heavily in other renewables. Rahm Orenstein, Vice President of Business Development - Americas at ORMAT, spoke about the competitiveness of geothermal energy in terms of energy value and operational flexibility compared to solar photovoltaic based on the case of California, which operates a combination of renewable energy resources. Orenstein emphasized the need for regulators to recognize the costs associated with integrating renewable resources into the electric system and the attributes these resources provide. Geothermal power for instance, uses existing transmission capacity very efficiently because of its high capacity factors while energy sources with low capacity factors create inefficiencies in the use of transmission infrastructure, thus imposing costs on the system that currently remain unaccounted for when regulators select renewable resource additions. This "hidden fee" is a cost which the ratepayers will have to incur (Matek and Smith, 2013).

One of the most notable advantages is that geothermal not only generates electricity but can be used directly as heat. From an emissions reduction perspective, the heating sector is very relevant; in 2015, it accounted for more than half of total final energy consumption, of which over 70% was generated with fossil fuels (IRENA, IEA and REN21, 2018).

In a panel organized by GIZ during the 2018 Geothermal Congress for Latin America and the Caribbean in Mexico City consisting of IRENA, the UNAM Engineering Institute, LacGEO, CEGA and STORENGY discussed the international trend of direct use of geothermal energy, as well as examples of real uses such as district heating or industry applications (greenhouse, coffee / fruit drying, etc.) that contribute to local economies and that require low operation and maintenance costs. There is enormous potential for the use of direct geothermal heat but there is a mismatch between potential and developed geothermal resources which currently supply only 0.15% of the annual global final energy consumption (Limberger et al. 2018). To the financial barriers imposed by high up-front costs of exploratory stages, direct geothermal heat projects face additional barriers relating to the lack of uniformity among projects, and the decentralized nature of geothermal heat production. Transporting geothermal heat long distances from geothermal wells is much less efficient than transporting electricity and more often than not may not be economically viable (IRENA, 2019).

The panels agreed that while environmental and social considerations are common problems for geothermal development, the promotion of direct use for the local economy could contribute to fostering social acceptance of geothermal.

“ Geothermal energy not only generates electricity, but this can be used directly.”

A CLIMATE RESILIENT SOURCE OF ENERGY

As extreme weather events become more prevalent, grid infrastructure needs to be more robust and resilient. Across the region there are ongoing discussions around what a resilient grid looks like. Several participants made the case for geothermal as a particularly resilient source of energy compared to other sources of energy.

“ The consensus at GEOLAC was that the industry needs to better advocate for the resiliency of geothermal to national stakeholders.”





— SECTION FOUR —

**Markets
in Transition:
Has the needle
moved since
July 2018?**

4



MARKETS IN TRANSITION: WHERE HAS THE NEEDLE MOVED SINCE JULY 2018?

ALEXANDER RICHTER, THINKGEOENERGY

The geothermal market in Latin America and the Caribbean remains one of the key potential regions for growth for the global geothermal energy industry. Today, the installed geothermal power generation capacity in Latin America and the Caribbean totals 1,7 MW or around 11% of the total capacity worldwide. There are approximately 150 geothermal projects at various stages of development region-wide. If all of them were to be completed, they could provide up to 2,500 MW to regional power markets.

Internationally, geothermal energy development continues to be driven by favorable legislation and regulatory frameworks, stable market conditions, support mechanisms and available funding. Through this lens, there have been some interesting developments in the region. Despite challenges in project development and in the political climate, a number of long-awaited projects have been kicked off, contracts for new geothermal power plants have been signed, a number of new geothermal plants are close to completion or construction, new financial support schemes have been announced, and the use of geothermal energy has found its way into broader discussions on the future of energy in the region.

THE COUNTRY-BY-COUNTRY SNAPSHOT

After two successful funding calls, the Geothermal Development Facility for Latin America (GDF) launched in early 2019 its third call for expressions of interest in the region for funding of surface studies or confirmation drilling under the scheme. This followed the announcement, in late 2018, of the recipients of a total of US\$15 million in funding for seven geothermal projects. The GDF supports geothermal development in the Andean Region (Bolivia, Chile, Colombia, Ecuador, and Peru) and Central America (Costa Rica, El Salvador, Guatemala, Honduras, and Nicaragua.)

In 2018, Mexico launched a new program to attract investment into geothermal development that generated great interest. Currently one geothermal project under construction, being built by state-owned CFE. The start of operation of the 25 MW Los Azufres III-2 Phase 2 is planned for 2019. Another addition to the Los Hornos III plant has been postponed to 2023. Private develop-

ment continues.

DFI support will continue to be crucial in driving geothermal overall. Initiatives such as early-stage funding created as part of the GDF are also imperative to push projects forward.

Chile and Bolivia made the news in recent months. Chile issued the first geothermal exploitation license in a long time to an international developer.

In Bolivia, the EPC contract to build a 10 MW pilot plant as part of the longstanding Laguna Colorada project was awarded to an international consortium comprising Ormat and Sacyr.

In Costa Rica, the second unit (55 MW) of the Las Pailas geothermal power plant is set to come online at the end of 2019.

In Nicaragua, power production has continued to increase significantly at the San Jacinto geothermal power plant, owned and operated by Polaris Infrastructure. There are several geothermal projects currently in the exploratory phase which could translate into the development of approximately 430 MW of power generation capacity.

The other major geothermal country in Latin America, El Salvador.

In the Caribbean, the IDB and CDB announced a new \$85 million funding program for geothermal development in five Eastern Caribbean nations with funds from the GCF and the government of Italy, which were approved at the end of 2019. To complement the Sustain-

able Energy Facility for the Eastern Caribbean which already has resources from the Clean Technology Fund (CTF), the Global Environment Facility (GEF), IDB and CDB. The funding is for debt financing for plants and transmission, exploration drilling grants and capacity building efforts.

Dominica secured funding of \$27 million from the World Bank Group for the construction of a 7 MW geothermal power plant.

The geothermal project in Saint Vincent and the Grenadines, began drilling in 2019.

In Guadeloupe, Ormat Technologies plans the extension of the Bouillante geothermal power plant.

The details of projects in Nevis, St. Kitts, Montserrat are still being discussed.

Exploratory drilling for geothermal project
in St. Vincent and the Grenadines

Source: New Energy Events,
<http://newenergyevents.com>





NEW TRENDS AND APPLICATIONS

Globally, a crucial element in the success of geothermal deployment has been the implementation of feed-in-tariffs. As with FITs for solar and wind energy, European countries like Italy, Slovenia and Germany have tried various models to reflect the value of geothermal to a national grid. Some of the strategies include using a system of bonus payments to encourage particular types of geothermal development. Others include higher tariffs for higher limits.

In Latin America, however, the focus has solely been on garnering highly competitive auction systems that guarantee the lowest price possible. When this is the case, geothermal cannot compete with low-cost solar and wind power. We see, however, an emerging recognition among regional policy-makers that geothermal, as a stable and resilient source of baseload, should be evaluated, and procured, independently from intermittents. If the playing field is leveled, a corollary will be increased investor confidence in geothermal project development. Mexico has taken steps to address this and we expect similar approaches elsewhere.

For the smaller-sized projects in the Caribbean, the cost of drilling is the most crucial barrier to the advancement of geothermal. To keep costs to a minimum, elements such as rig mobilization need to be taken into consideration. In addition, procuring vendors for multiple projects simultaneously would serve to reduce the project overhead.

Modular approaches to geothermal development are being tested. There are various examples world-wide which should be examined for potential applications in Latin America. These include a less costly slim-hole based approach to drilling with smaller-scale plants in Indonesia; also interesting are small, modular low-heat binary technology power generating units - down to 70-100 kW - in Japan. Both use low temperature resources and expanded geothermal applications while mitigating high upfront costs.

Modularity also allows for a staggered scaling of power generation and can provide power locally without extensive transmission infrastructure. This provides significant opportunities for Latin America's regional development, while at the same expanding the reach beyond traditional high-temperature resource areas. In the Caribbean context, it could pave the way for smaller-sized pilot projects at lower cost which would have an immediate impact on replacing diesel-fueled power generation. We expect that the market will be receptive to this kind of development approach and anticipate an increasing emphasis from technology suppliers and investors in this space.

Increasingly the topic of the direct uses for heating, cooling and related industrial and residential uses takes center stage. Increasingly, an energy cascade can be connected to a generation plant. While heating might only be of hyper-localized use in certain parts of South America, it would still represent an expansion of the use of geothermal energy in the region. This is certainly the case in Chile where this discussion is already taking place with support from the current government.

Utilizing geothermal energy in food production is also part of the global conversation. The dehydration of food using geothermal could expand export capabilities for the region. By the same token, crop and food production could be increased using geothermal-powered greenhouse operations. There are examples of this type of utilization for dehydration of food in, for example, Guatemala and Mexico, where geothermal is helping to create additional markets and preserve food that would otherwise go to waste.

Last but not least, the topic of deriving rare metals out of geothermal brine has been a dominant discussion item, for things such as mining lithium needed for the production of batteries. This might be limited to geological conditions found in the mining areas of Argentina, Chile and Bolivia.

In the broader Latin American market, we will see increasing interest on direct use applications also in the context of international sustainability goals. Smaller-scale development might revive some development activities and expand it beyond the current "geothermal" countries of the region.

The LAC market continues to show great promise. Our sense is that the increasing alignment between the DFIs and regional policy-makers will result in a new emphasis on geothermal at a national level, and on substantial funding support for geothermal programs and projects region-wide.



Geothermal plant in Amatitlan (GUATEMALA)



Alexander Richter
Founder, ThinkGeoEnergy

Alexander Richter founded ThinkGeoEnergy in 2008. He is a Director on the Board of International Geothermal Association (IGA) and Director-at-Large on the Board of the Canadian Geothermal Energy Association (CanGEA), and has been a spokesperson for geothermal energy at many of the major geothermal and renewable energy events internationally. Before launching ThinkGeoEnergy, he was a founding member of the first and only geothermal energy focused investment-banking team at Icelandic Bank Glitnir (now Íslandsbanki). There he led the team's research efforts and worked on business development with clients globally from 2005 to 2011.



— SECTION FIVE —

**IDB Roundtable
and Site Visit**

● We took a look around the region and examined which markets were making headway, and how. An IDB-sponsored roundtable, "From North to South: Challenges and Lessons Learned from Geothermal Initiatives in Latin America and the Caribbean" where all regional countries were represented, enabled participants to share their experiences, the challenges they have faced and the tools they are employing to tackle barriers to geothermal development.

The roundtable represented an initiative to catalyze the exchange of knowledge and experience among neighboring countries with a view to building consensus on effective policies and initiatives to develop geothermal potential region-wide.

A delegation also participated in a site visit to Campo Los Azufres in Mexico. With the inauguration in 2015 of the Los Azufres III plant in Michoacan, the Los Azufres geothermal plant increased by 17 percent the total installed capacity of Campo Los Azufres, expanding from 192 megawatts to 225 megawatts and enough to supply 800,000 inhabitants

Credits: Pedro Zavarce







A dark blue background featuring a close-up of two hands shaking in a firm grip. The hands are wearing dark suits, and the image is semi-transparent, allowing the text to be clearly visible.

— SECTION SIX —

**Conclusions and
Recommendations**



CONCLUSIONS

- Latin America and the Caribbean continue to show huge promise for the development of geothermal.
- Funding programs that consider regional challenges and tailor country-specific approaches through programs established by the DFIs continue to be essential for the development of geothermal in LAC countries. Collaboration among donors is also key.
- Financing programs that mitigate the risk of upstart costs combined with PPPs are most successful.
- Concrete support for projects e.g. drilling in St. Vincent and the Grenadines, support for a planned power plant in Dominica are very important.
- Projects in South America for the sector, such as in Chile and Bolivia, will hopefully push development across the region. Their success is and will be crucial for further political support.
- The geothermal industry needs to advocate robustly to regional stakeholders for geothermal as a competitive and resilient source of renewable baseload and one which is a useful complement to natural gas and intermittent renewables.

POLICY RECOMMENDATIONS

- Geothermal energy requires a long-term view. Development cycles are long and short-term political will needs to be institutionalized into supporting policies and concrete support for development.
- Innovative financial mechanisms can improve the competitiveness of geothermal projects by mitigating exploratory risks. Competitiveness is affected by the high costs during the evaluation stage amid high uncertainty of whether sufficient resources will be found to make the project economically viable. As this represents a considerable financial risk for the developers, in the absence of risk mitigation mechanisms, this risk is priced into the private investor's expected return on equity. Funding programs can go a long way to mitigate this risk for both governments and developers enhancing the competitiveness of geothermal.
- Beyond critical funding programs, it is crucial to engage and garner the support of local political entities and communities. Development cannot take place in a vacuum; all stakeholders need to be supportive and aligned. Therefore, policies and regulations must clearly establish the procedures that geothermal developers must follow to ensure transparent and effective public consultation processes.
- It is necessary to tackle the lack of specific on-the-ground knowledge, ranging from geothermal exploration to drilling, reservoir engineering and operation and maintenance of the plant. Governments should promote capacity building in this sector and develop significant scientific knowledge about their geothermal resources.
- The lack of regulatory and legal certainty, and the absence of clear fiscal and environmental policies increases the perception of risk for developers and can also affect the competitiveness of geothermal projects. The development of comprehensive regulatory frameworks is key to enabling geothermal development. As such, governments should aim to have complete legal and policy frameworks not only for non-conventional renewable energies in general but also for geothermal development.
- The relative competitiveness of geothermal projects with respect to other renewable energy sources as currently assessed does not consider all the benefits that geothermal can bring to power systems, neither does it account for the costs that other renewable energy sources may impose on these systems. The focus on low electricity prices alone and on auction systems for renewable energy development continues to be challenging for geothermal energy. It is imperative to value the baseload capacity attribute of geothermal energy, e.g. through a bonus element for the capacity factors and the energy security geothermal energy provides
- Geothermal direct use provides ample opportunities for local economic development and can support power development locally. Although small in scale, it is easier to accumulate local support and ease the permitting process. The industry needs to make a robust case for direct use applications and economics.

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