

# PROJECT INFORMATION DOCUMENT (PID)

## APPRAISAL STAGE

Report No.: 101165

<b>Project Name</b>	CL Technical Assistance for Geothermal Development in Chile
<b>Region</b>	LATIN AMERICA AND CARIBBEAN
<b>Country</b>	Chile
<b>Sector(s)</b>	Other Renewable Energy
<b>Theme(s)</b>	Infrastructure services for private sector development (50%) Climate change (50%)
<b>Project ID</b>	P152820
<b>Borrower(s)</b>	GOVERNMENT OF CHILE
<b>Implementing Agency</b>	Ministerio de Energía
<b>Environmental Category</b>	B
<b>Date PID Prepared/Updated</b>	November 21, 2014 / August 28, 2015
<b>Estimated Date of Board Approval</b>	October 29, 2015

### I. Introduction and Context

#### Country Context

- Chile is one of the most stable economies in Latin America with steady growth rates mainly driven by commodities export.** With almost 17 million inhabitants, and US\$277 billion gross domestic product (GDP) in 2013<sup>1</sup>, the country recorded an average annual growth rate of 3.5 percent during the past twenty years. Per capita income over the same period has almost doubled in real terms. The effects of steady growth on employment and income have significantly reduced poverty rates, although earnings and labor productivity have been distributed unevenly. Chile's economy is characterized as being open and heavily dependent on natural resources and foreign trade, with the mining sector accounting for 60 percent of the country's total exports. Services and the energy-intensive industrial sector (including value added in the mining sector) account for 60 percent and 37 percent of the GDP, respectively, with agriculture making up the rest. Despite being a mature economy, GDP growth forecasts for Chile for 2014-18 are around four percent per year, almost twice the OECD average (2 to 2.3 percent).<sup>2</sup>

#### Sectorial and Institutional Context

- The energy sector is a key determinant of economic growth in Chile.** The electricity demand in Chile, increasing at around seven percent per annum, has doubled every ten years and has outpaced economic growth. This reflects the relative energy intensity that is driving economic growth, especially in the industrial and service sectors. In order to sustain growth, address poverty, and expand prosperity throughout the country, it will be essential to ensure the availability of reliable and low cost electricity to fuel the productive sectors of the economy. The Government of Chile (GoC) estimates that electricity demand will continue to grow at 6 to 7 percent<sup>3</sup> per year through 2020, which will require an additional

<sup>1</sup> The World Bank.

<sup>2</sup> Economist Intelligence Unit, *Country Report Chile* (London: Economist Intelligence Unit, October 2013).

<sup>3</sup> Government of Chile, *National Energy Strategy (2012-2030)* (Santiago: Government of Chile, February 2012).

eight gigawatts (GW) of power generation capacity and associated infrastructure.

3. **Electricity in Chile is predominantly produced from thermal and hydro resources.** In 2013, thermoelectric installed capacity accounted for 62 percent of the total power generation mix in Chile. Hydropower accounted for 34 percent, biomass made up 2.2 percent, wind was 1.7 percent and solar power was just 0.1 percent of the total installed capacity in the country. With a few small exceptions, all the hydroelectric capacity is located in the *Sistema Interconectado Central* (SIC), representing 43 percent of that network's total installed capacity. The remainder of the installed capacity in the SIC is comprised of coal, natural gas and diesel, each with a share in excess of 15 percent. In the *Sistema Interconectado del Norte Grande* (SING), where most of the energy-intensive mining industry is located, power generation is dominated by fossil fuels. Over half of the generation capacity in the system is based on coal, while natural gas makes up a significant 38 percent. Diesel provides 9 percent of the generation capacity in the SING.
4. **Chile manages the energy sector primarily through a *laissez faire* approach with policies that promote private sector led investments and prices determined primarily through market-based principles.** Given the structure of the sector, electricity prices are mostly determined through market forces. Because of this, electricity prices have fluctuated, reflecting various factors, including volatility in fossil fuel prices, availability of hydro, and shortages created by the disruption of gas supplies from Argentina. This volatility is illustrated by having average spot prices for power ranging from less than US\$ 25/MWh to more than US\$300/MWh. Although electricity prices have moderated somewhat, in 2014 prices still ranged from US\$90/MWh to about US\$200/MWh. Fluctuations in electricity prices in the SIC have been particularly significant, making the cost of electricity less predictable for investors and consumers alike. Since the uncertainty in prices undermines business competitiveness and creates hardship for people, the GoC has made reducing power sector prices and stabilizing price volatility a primary objective for the energy sector.<sup>4</sup>
5. **Chile is also determined to develop the energy sector in a sustainable manner that limits global greenhouse gas (GHG) emissions.** Chile's greenhouse gas emissions, which are expected to double by 2025, are primarily from the energy sector. The CO<sub>2</sub> emissions per capita have increased from 3.6 metric tons in 2000 to 4.6 metric tons in 2011, substantially higher than the average for other Central and South American countries.<sup>5</sup> The SING system has particularly high carbon intensity due to the substantial utilization of coal for power generation. Redirecting the emissions trajectory is an important objective for the GoC since, as an OECD country, Chile may face commitments to reduce emissions as a part of a future global agreement on climate change. Thus, GoC is making efforts to reduce its dependency on fossil-based electricity and to diversify its generation mix. The nation is already a signatory to the Copenhagen Accord, in which Chile agreed to take mitigation measures to reduce by 20 percent its business-as-usual emissions trajectory.
6. **If developed prudently in compliance with safeguards requirements, expanding renewable energy as a part of a better-diversified generation mix will also have considerable local environmental benefits.** Expanding renewable energy will reduce pollutants that are common bi-products of fossil-based power generation, such as sulfur dioxide (SO<sub>2</sub>), nitrogen oxide (NO<sub>x</sub>), and total suspended particulates (TSP). However, as with all power generation technologies, there is a need for incorporating prudent measures that mitigate any negative environmental, social, and safety issues that may arise during construction and operation.
7. **Chile's latest Energy Agenda<sup>6</sup> and long-term strategy seek to boost the utilization of renewable**

---

<sup>4</sup> *National Energy Strategy (2012-2030)*.

<sup>5</sup> United States Energy Information Administration.

<sup>6</sup> Government of Chile, *Agenda de Energía. Un Desafío País, Progreso para Todos*. (Energy Agenda. A National Challenge, Progress for All) (Santiago: Government of Chile, May 2014).

**energy as one key solution for addressing the challenges facing the sector.** In March 2014, the newly elected administration in Chile established an Energy Agenda that aims to address some of the key issues facing the sector. Consistent with its long-term National Energy Strategy 2012-2030, the agenda's strategic objectives include to boost the utilization of non-conventional renewable energy (NCRE), reduce the marginal cost of electricity, and improve energy efficiency to reduce consumption. In 2008, the GoC established a NCRE target of 10 percent by 2024; in 2013, this target was increased to 20 percent by 2025.<sup>7</sup> To meet this goal, it is estimated that between 3,500 and 4,000 MW of NCRE generation capacity will need to be installed in the next 10 years.<sup>8</sup> While Chile has met similar targets previously, some NCRE technologies will face greater hurdles in scaling-up than others.

8. **Chile's abundant geothermal potential provides a good renewable energy option to diversify further the country's power generation mix, reduce price volatility, and improve energy security.** The mountainous eastern backbone of Chile is the Andes Range, comprised of almost 3,000 active and dormant volcanoes. There are good indications that the entire northern and central parts of the Andes have excellent geothermal energy potential. Studies indicate that the geothermal power generation potential could be in excess of 3 GW.<sup>9</sup> The main advantage of geothermal energy among other renewable energy technologies is that it can provide reliable base-load power on a 24/7 basis, as geothermal is a non-intermittent source.<sup>10</sup>
9. **The GoC has made a concerted effort to develop Chile's nascent geothermal industry.** In 2000, the GoC promulgated the Geothermal Concessions Law (Law Number 19.657), with the objective of issuing geothermal development concessions to mobilize investment in the sector. Many developers, including a number that were internationally reputable, hurried to enter the Chilean market and over 100 geothermal concessions were issued, with many developers securing multiple concessions. Despite what appeared to be a promising start, only a few investments were mobilized in a small number of fields for the risky exploration drilling and resource confirmation efforts that are necessary before advancing green field development. A number of issues stymied exploration investment, including the limited time afforded for test drilling under the terms of the concession, uncertainty regarding follow-on development, excessive concessioning given the globally modest number of qualified geothermal developers, lack of exit clauses for those not meeting development objectives, and inadequate capacity within GoC to monitor and oversee the concession regime. Offtake and commercial issues related to the overall power sector integration of geothermal energy as well as environmental concerns have also created uncertainty for developers. The GoC issued a revised regulation in 2013 to ease some of the administrative constraints in applying the law and this has led to a few developers making some progress. However, despite these efforts and the large potential, presently there are no geothermal power plants in operation in Chile. Reforms to the policy and regulatory framework alone have demonstrated insufficient so far to address some of the additional key barriers that are impeding the progressive development of geothermal in Chile. They reflect challenges related to the technology as well as the circumstances specific to the Chilean energy market, like geothermal resource-confirmation risks, integration of geothermal in the power market, long-term competitiveness of geothermal and Environmental and social considerations.
10. **The GoC is intensifying its efforts to address critical challenges in order to advance geothermal and is seeking international assistance to help achieve its goals.** While developing a nascent geothermal industry into a robust one will take time, the GoC recognizes that it is also important to develop geothermal as a viable alternative energy option to meet both the country's NCRE targets and its long-term development needs. Since most renewables are intermittent, supplying stable base load power is key and the GoC's Energy Agenda already includes reforms specific to promoting geothermal development. These include: (a) the preparation of a new geothermal law; (b) design of risk mitigation schemes to mobilize investments in exploration drilling; and (c) launch of a program to promote the utilization of low and medium enthalpy geothermal for direct uses such as heating.

---

<sup>7</sup> Law 20.698, commonly referred to as the 20/25 Law.

<sup>8</sup> Center for Economic Load Dispatch.

<sup>9</sup> With some estimates suggesting the potential may be as much as 16 GW.

<sup>10</sup> The other presently available renewable technology is hydro with storage.

**11. A catalytic effort to kick-start the sector could lead to a more robust outcome over time, exploiting the country's significant geothermal potential.** In order to achieve such an outcome, it will be essential to successfully implement the proposed GoC reform agenda for geothermal as well as to address other key barriers to sector development. To this end, the GoC has sought international assistance from its development partners. The GoC has secured US\$53 million from the Clean Technology Fund (CTF), which is being channeled through the World Bank and the Inter-American Development Bank (IDB) to advance geothermal development in the country. Of the CTF funds, US\$ 50 million is allocated through IDB to facilitate financing for several geothermal projects where field exploration (drilling) is sufficiently advanced.<sup>11</sup> The GoC is seeking to benefit from the World Bank's extensive global experience in supporting geothermal development to help Chile implement a complementary set of market and regulatory reforms in parallel that would progressively address the key barriers to sector development. CTF funds of US\$3 million, along with an additional US\$500,000 from the Energy Sector Management Assistance Program (ESMAP) administered Global Geothermal Development Plan (GGDP) monies, are allocated to technical assistance through the World Bank so that Chile will be in a position to institute such reforms and strengthen its capacity in the geothermal sector in order to implement accepted industry practices and meet international standards. The proposed technical assistance is expected to have an immediate impact by: (i) strengthening the existing architecture for facilitating financing from IDB and other sources for exploratory activities to develop commercializable steam fields; and (ii) reducing or eliminating barriers in order to progressively enhance market conditions to support the sustainable development of geothermal in the longer-term.

## Relationship to CPS

**12. The Technical Assistance for Sustainable Geothermal Development Project in Chile is fully consistent with the World Bank's twin goals and the Country Partnership Strategy (CPS).** The Bank's first twin goal is to end extreme poverty. The CPS (FY11-16), consistent with this goal, aims to support Chile's vision for eradicating extreme poverty and achieving high-income developed status by 2018. A major strategic component of this vision is the promotion of sustainable investments in infrastructure for sectors such as energy. The GoC's strategy calls for improving the business climate to attract private sector investments, including in renewable energy projects. Additionally, the strategy calls for supporting options that make a positive contribution to climate change. The steps taken by the new administration in Chile, including issuance of the Energy Agenda, confirm that geothermal development is a national priority consistent with its long-term development objectives. The reallocation of US\$33 million<sup>12</sup> within its CTF Investment Plan (IP) and the requests for international assistance to support geothermal development are both confirmation of GoC's commitment to reforming the sector. The proposed project and its associated activities will contribute to the promotion of private investments in geothermal and the achievement of Chile's development goals

**13. The proposed project is also consistent with higher-level global development objectives.** It supports the Sustainable Energy for All (SE4ALL) initiative led by the United Nations, which, among other things, aims to double the share of renewable energy in the global mix. In addition, the World Bank through its ESMAP is spearheading the GGDP, which aims to mobilize and channel investments through development partners into high risk drilling activities to advance and unlock the potential of geothermal green fields. Finally, the World Bank is working with KfW Group (KfW) and other development partners to establish the Latin America Geothermal Development Facility (GDF), which is designed to channel funds toward geothermal exploration and development. If Chile can reform the sector and transition to a vibrant and sustainable market for geothermal development, the country is expected to be a key market for the GDF.

---

<sup>11</sup> The IDB project is distinctly separate from this TA project, and the achievement of the TA project's PDO is not dependent on the success of the IDB project. The benefits and achievement of the objectives of the proposed TA project extend beyond the IDB funded geothermal projects and support the development of the sector in order to promote investment in geothermal resources across the country.

<sup>12</sup> Since augmented by another US\$ 20 million, for a total of US\$ 53 million in CTF funds toward geothermal development.

## II. Proposed Development Objective(s)

### Proposed Development Objective(s)

14. The development objective of the Technical Assistance for Sustainable Geothermal Development Project is to assist the Government of Chile in resolving specific barriers to improve the geothermal energy market conditions. By addressing key legal, social and market barriers, this technical assistance will contribute to the development of commercializable geothermal resources.

### Key Results

- Strengthened legal and policy framework through the preparation of revision of law and/or policies;
- Establishment of a framework for mobilizing risk capital toward geothermal exploration
- Greater exploration of geothermal resources through the drilling of wells.

## III. Preliminary Description

### Concept Description

15. The proposed Technical Assistance for Sustainable Geothermal Development project will assist the GoC undertake a number of key reforms to smooth the way for geothermal field development beyond the initial risky stage of resource confirmation by: i) improving the market conditions and ii) facilitating greater immediate, as well as long-term, investments in the sector, so that geothermal can eventually become a key pillar in an optimally diversified power generation mix. It is with these intentions that the GoC has requested the World Bank to bring to bear its global experience to assist the GoC to undertake a number of key reforms.

16. This operation forms a complementary part of a package of initiatives being undertaken by the GoC with development partners through the support of the CTF. This initiative provides funding in designing strategies and identifying specific solutions to address the key barriers that impede geothermal development in Chile, while strengthening GoC's capacity both to oversee and manage geothermal development and to implement the identified reforms. The activities in the proposed project will be carried out under the two components summarized below, with the intention of comprehensively addressing several key barriers:

- **Component 1- Improve policy framework and strengthen management capabilities to help mobilize investments in geothermal** Some of the envisaged activities under this component include:
  - a. Review and reform geothermal concession management framework.
  - b. Enhance legal and regulatory framework.
  - c. Capacity building and institutional strengthening.
  - d. Stakeholder engagement to address social and environmental considerations of geothermal development.
- **Component 2- Enhance market conditions for promoting sustainable development of the sector.** Some of the envisaged activities under this component include:
  - a. Geothermal resource risk mitigation framework to help mobilize investments in exploration and production drilling,
  - b. Integration of geothermal power in the broader power market in Chile,
  - c. Design of a strategy to enhance geothermal competitiveness in the long term by exploring synergies with alternate uses and related domestic sectors.

#### IV. Safeguard Policies that Might Apply

Safeguard Policies Triggered by the Project	Yes	No	TBD
Environmental Assessment OP/BP 4.01	X		
Natural Habitats OP/BP 4.04	X		
Forests OP/BP 4.36	X		
Pest Management OP 4.09		X	
Physical Cultural Resources OP/BP 4.11	X		
Indigenous Peoples OP/BP 4.10	X		
Involuntary Resettlement OP/BP 4.12	X		
Safety of Dams OP/BP 4.37		X	
Projects on International Waterways OP/BP 7.50		X	
Projects in Disputed Areas OP/BP 7.60		X	

#### V. Financing (in USD Million)

Total Project Cost:	4.05	Total Bank Financing:	3.50
Financing Gap:	0.00		
<b>Financing Source</b>			<b>Amount</b>
Borrower recipient			0.55
ESMAP			0.50
Clean Technology Fund			3.00
Total			4.05

#### VI. Contact point

##### World Bank

Contact: Migara Jayawardena  
 Title: Senior Energy Specialist and Task Team Leader  
 Tel: 1(202) 473-7436  
 Email: mjayawardena@worldbank.org

Contact: Mariano Gonzalez Serrano  
 Title: Senior Energy Specialist and Task Team Leader  
 Tel: 1(202) 473-0468  
 Email: mgonzalezserrano@worldbank.org

##### Borrower/Client/Recipient

Name: Agencia de Cooperación Internacional – Ministerio de Relaciones Exteriores (AGCI)  
 Contact: Melissa Sanchez  
 Title: Trilateral Partnerships Manager  
 Tel: 56(2) 2827 5706  
 Email: msanchez@agci.gob.cl

### **Implementing Agencies**

Name: Ministerio de Energía  
Contact: Christian Santana  
Title: Division Chief  
Tel: 56(2) 2365 6686  
Email: csantana@minenergia.cl

### **VII. For more information contact:**