

MaRS Market Insights



Market Information Report: Chile

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Executive summary

The *Going Global* series provides a 360-degree view of the energy system in international priority markets for export-ready Canadian energy companies. Each report examines not only the energy and electricity landscape of a particular market but also the business environment, the social, political and legal frameworks, and the country's macroeconomic drivers.

In short, the analysis is meant to help companies answer the following questions:

- 1 Are your capabilities a good fit for the market?
- 2 What are the opportunities and barriers to doing business, and do the former outweigh the latter?

The current report is an update on the previous Chile report published by the AEC in 2015, and provides a revision of the key statistics along with latest drivers and trends. Chile is an exciting market, open to foreign innovation, and a strong relationship with Canada. It is one of the most exciting markets for renewable energy generation, with abundant untapped capacity, low prices for power purchasing agreements along with an easy business environment. The indicators analysed in this report measure key considerations for understanding the challenges and opportunities for energy innovation in Chile: energy security and independence; quality and resilience of electricity supply; electricity costs; support for demand growth; environmental sustainability; and the business environment.

In preparing this report, a set of quantitative indicators were adapted from third-party sources such as: the World Bank, Bloomberg New Energy Finance, the U.S. Energy Information Administration among others. There are limitations to the insights this type of report can provide. The information presented is from secondary sources and interviews with actors in the market. However, the research is not exhaustive and companies are encouraged to conduct further research if they are interested in the market.



CHILE ELECTRICITY SNAPSHOT

Table 1 Chile Power Statistics	
Total electricity generation capacity	20.9 GW (September, 2016) ¹
Electricity coverage	99.6% (2012) ²
Total losses	Approx. 7%(2013) overall ²
Percentage of renewables in electricity mix	Approx. 40% generation from renewables including hydro, wind, solar and biofuels ¹
Target	70% of national electricity generation from renewable sources by 2050 ³

¹ <http://www.revistaei.cl/wp-content/uploads/sites/5/2016/11/Boletín-Generación-Noviembre-2016-1.pdf>

² <http://data.worldbank.org/indicator/EG.ELC.ACCS.ZS?locations=CL>

³ <http://www.energia2050.cl/wp-content/uploads/2016/08/Energy-2050-Chile-s-Energy-Policy.pdf>

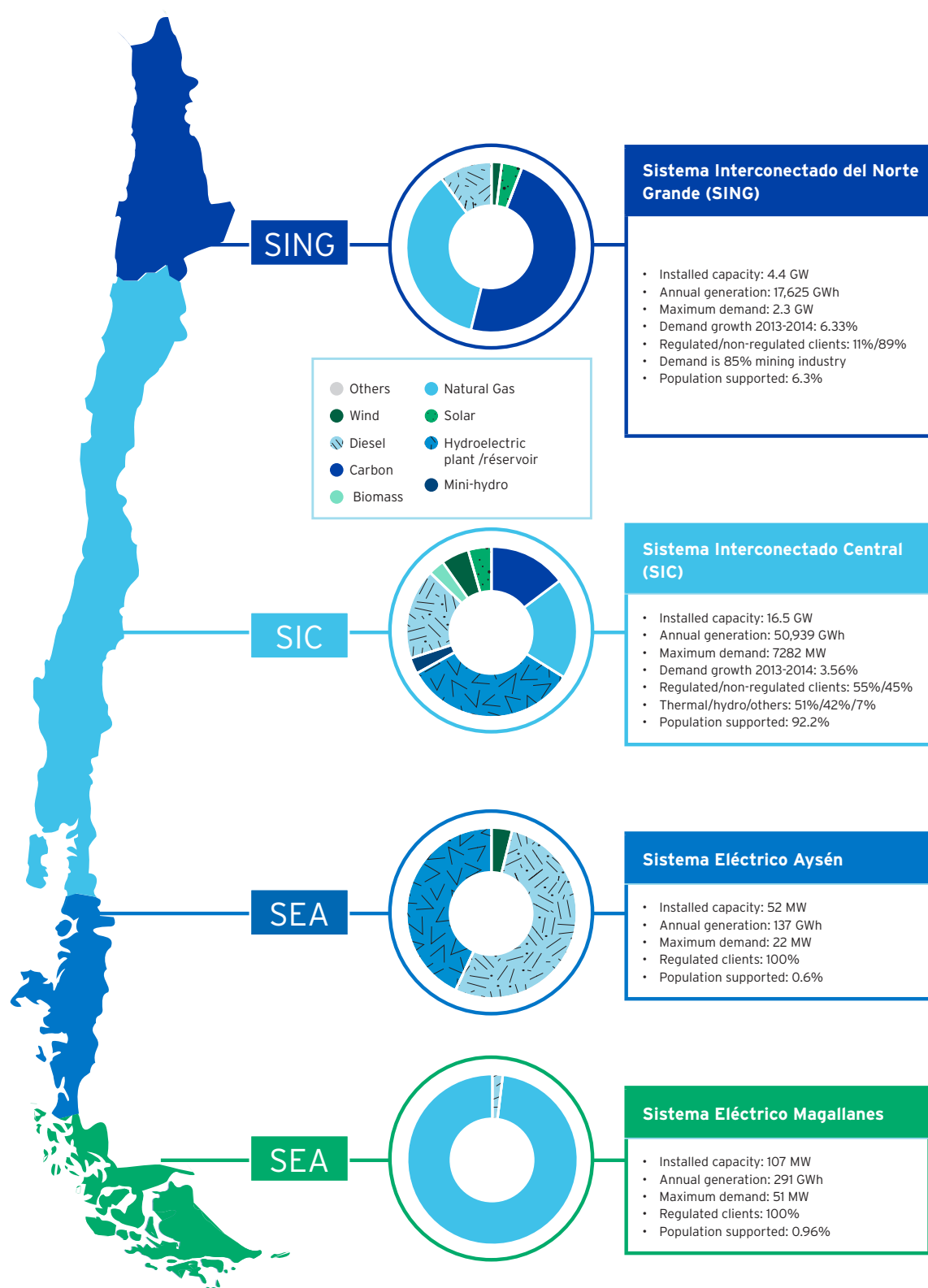


Figure 1 Chile electricity sector overview ^{4, 5, 6}

⁴ <http://www.energia.gob.cl/perfil/energia-20>

⁵ <http://aperc.ieej.or.jp/file/2015/10/19/Chile.pdf>

⁶ <http://www.revistaei.cl/wp-content/uploads/sites/5/2016/11/Boletín-Generación-Noviembre-2016-1.pdf>



Key findings

Table 2 Opportunities and Barriers in the Chilean Market ^{7, 8, 9, 10}

OPPORTUNITIES IN CLEANTECH	BARRIERS TO CLEANTECH
<ul style="list-style-type: none"> • Ambitious clean energy targets: <ul style="list-style-type: none"> • In 2050, 70 % of the electric matrix must come from renewable sources • Goal of 20% energy efficiency by 2025 • 45% of the electric generation capacity to be installed in the country from 2014 through 2025 to come from non-conventional renewable energy sources • High renewable energy generation potential • Little or no land use regulation, leading to ease in development of projects • Transmission Law transforms the way transmission is paid for, consumers not generators to pay 100% of the cost 	<ul style="list-style-type: none"> • The structure of the electricity market is highly concentrated: 90% of electricity generation and commercialization is controlled by 4 companies, Endesa (Spain), AES Gener (US), E-CL (France) and Colbún (Chile) • High levels of curtailment due to lack of grid transmission capacity • Transmission access is challenging, with resources often located in isolated areas (increasing connection costs) or in regions with weak lines • Obtaining permits can be a lengthy process (environmental licence is required for all technologies)
BUSINESS OPPORTUNITIES	BARRIERS TO BUSINESS
<ul style="list-style-type: none"> • Highest credit rating in Latin America, due to macroeconomic stability and integration with global capital markets • Attractive destination for foreign direct investment, due to simple foreign investing process and low taxes • No minimum local participation requirement for companies incorporating in Chile • There is no R&D in energy in Chile, which creates opportunities for cost-competitive innovative foreign players • Auction mechanism in a regulated market provides a stable signal for long term prices, enabling generation investments • Direct power purchasing agreements with the consumer increase bankability of projects 	<ul style="list-style-type: none"> • Chile had world's lowest solar cost during last power tender at \$29.10/MWh, though a good signal for the renewable industry, it also signifies a competitive market. A high degree of competition among foreign firms results in the necessity for companies to have an in-country partners to gain further business advantage • Fast falling prices for renewable energy projects leading to hesitation on part of consumer to enter long terms contracts • A physical presence as well as relationships with local companies and actors are key to business success • Lowest share of skilled labour force relative to OECD countries

⁷ http://www.systep.cl/documents/Energy_Auctions_Chilean_Experience_Mocarquer.pdf

⁸ <http://exportbritain.org.uk/market-snapshots/chile.html>

⁹ https://books.google.ca/books?id=9A4x5-YnWfOC&pg=PA46&lpg=PA46&dq=skilled+labour+force+chile&source=bl&ots=7_J8tqepN-&sig=OCor_JziZkJA01qB3QRD8xbr-wU&hl=en&sa=X&ei=j3kuVebsM8PBYS7mIGgDA&ved=OCGQQ6AEwCQ#v=onepage&q=skilled%20labour%20force%20chile&f=false

¹⁰ http://www.keepeek.com/Digital-Asset-Management/oecd/economics/oecd-economic-surveys-chile-2013_eco_surveys-chl-2013-en#page33



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1 Introduction

Chile is one of the most developed countries in Latin America and a member of the OECD. It is the 44th largest export economy in the world. Table 3 provides a quick look at some key metrics for Chile.

Table 3 Chile Statistics	
Population ¹¹	18.2 million
GDP ¹²	\$240 billion
Official language	Spanish
Currency	Chilean Peso (CLP)
Major exports (worldwide) ¹³	Refined copper (\$18B), Copper ore(\$16.6B), Sulfate chemical woodpulp
Biggest trade partners	China, US, Japan
Major imports	Crude petroleum, Refined Petroleum, Cars

Electricity sector overview

Chile was one of the first countries in the world to deregulate and privatize its electricity sector, with the enactment of the Electricity Law of 1982. According to the law, the generation segment is demarcated as a competitive market with private entities having the freedom to follow market forces while making investment decisions and setting prices, whereas transmission and distribution are recognized as monopolistic activities and therefore companies operating in these segments have regulated tariffs with set measures for investment requirements. The concepts of regulated and unregulated customers were also introduced.¹⁴ The sector is further divided into four distinct (non-connected) power systems, as shown in Figure 1.

¹¹ <http://countrysmeters.info/en/Chile>

¹² <http://www.tradingeconomics.com/chile/gdp>

¹³ <http://atlas.media.mit.edu/en/profile/country/chl/>

¹⁴ <http://hrudnick.sitios.ing.uc.cl/southamerica/ChileanLaw.htm>

Figure 2 illustrates the structure of the electricity market.

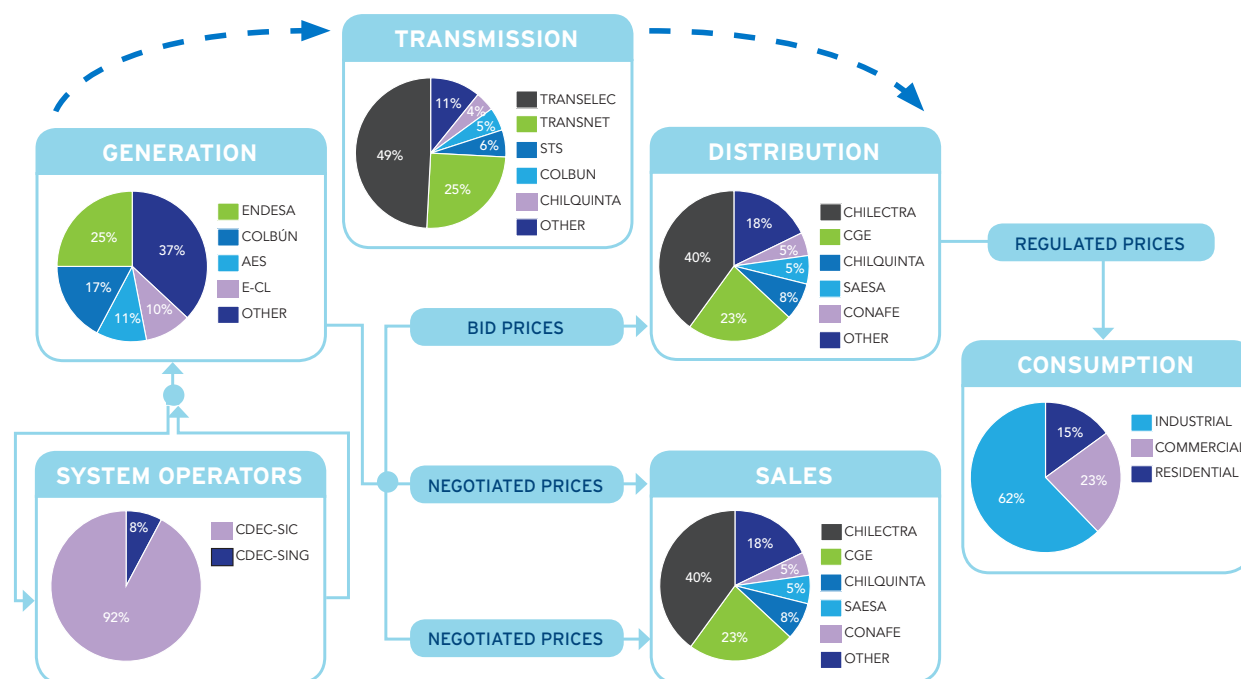


Figure 2 Chile's electricity sector^{15, 16}

¹⁵ Bloomberg New Energy Finance

¹⁶ <https://www.sec.gov/Archives/edgar/data/926864/000119312514126335/d699376d20f.htm>

The National Energy Commission (CNE)—the regulator in charge of setting distribution and transmission tariffs—was created through Law 2.224 in 1978. Following this, Chile's power sector underwent liberalization beginning with the 1982 Electricity Law, which separated the provision of electricity into three distinct activities: generation, transmission and distribution. The Electricity and Fuels Superintendence (SEC) sets technical standards and oversees its compliance.

The concepts of regulated and unregulated customers were also introduced. The Electricity Law also introduced a spot market with marginal pricing that offers exclusive access to generators, and opened the power sector to private investment. Hence, between 1983 and 1989, a wave of privatization of state-owned electricity utilities occurred.¹⁷

Currently Endesa group; AES Gener; Colbún and Engie (E-CI) control the largest portion of the generation sector. The distribution sector is also dominated by four main groups: CGE Distribución S.A., Chilectra S.A., Chilquinta Energía S.A., and Inversiones Eléctricas del Sur S.A. (Grupo SAESA). Transelec is the largest owner of the transmission grid, followed by CGE Transmisión. More information on organisations and companies in figure 2 can be found in the appendix.

Chile's electricity system is divided into a four grid system, outlined in Figure 1. These systems are not integrated, due to the long distances between them. While electricity companies are unregulated, they are obliged to organize their operations through the CDEC (grid operator), an independent entity made up of members from each utility to ensure that the grid is efficient and supply is secure.¹⁸

Generators operating in each regional power market declare their availability and marginal operating costs every hour to set the spot price. Regulated prices for generated electricity are determined based on expected spot prices over a four-year period and this price is calculated and remains fixed for six months in April and November.¹⁹

The competitive market in Chile was successful in creating a robust electricity system with relatively stable and low prices. However, that changed with severe droughts impacting hydroelectricity generation, leading to high prices and electricity rationing in the late 1990s. This was followed by a natural gas crisis, when Argentina (the primary supplier then) cut off gas supply due to geopolitical reasons, followed by earth quakes and volcanic eruptions which impacted infrastructure and another 5-year period of droughts. These events led to high prices which haven't come down in the past 8 years.

Chile's regulatory framework has weaknesses that were highlighted by drought events and unexpected supply restrictions. As a result of these events, Chile had to transition to predominantly coal and diesel-based generation. Fragilities in the regulatory framework combined with delays in important electricity infrastructure projects led to increasing public concern about the security of Chile's energy matrix.²⁰ As a result, the Electricity Law has been amended three times—in 1999, 2004 and 2005—after the country witnessed electricity shortages. These laws and amendments along with more recent laws are detailed in Table 4 below.

¹⁷ <http://ceep.mit.edu/files/papers/2004-016.pdf>

¹⁸ <http://www.centralenergia.cl/en/electric-market-regulation-chile/>

¹⁹ <http://www.centralenergia.cl/2011/09/20/costos-marginales-estrategias-comerciales-y-regulacion/>

²⁰ <http://www.centralenergia.cl/uploads/2012/06/National-Energy-Strategy-Chile.pdf>

Table 4 Development of Chile's Electricity Sector

LAW 18.410 1985	Creates the Superintendency of Electricity and Fuels, which is responsible for compliance
GAS IMPORT PROTOCOL 1995	Gas import protocol begins with Argentina (100% dependency)
1999	In response to electricity rationing, a law was enacted forcing distributors to compensate customers for energy losses during electricity rationing. This created incentives to assure supply
LAW 19.940 "LEY CORTA" 2004	Changes calculation of transmission tariffs to address expansion issues, and creates a panel of experts for dispute resolution of technical issues
LAW 20.018 "LEY CORTA II" 2005	Improves competition conditions in generation activities, distribution agents are required to buy energy through public auctions
LAW 20.257. "LEY DE ENERGÍAS RENOVABLES" 2008	Sets renewable energy targets for: 2010-14: 5% and 2015-24: increase of 0.5% per annum, up to 10%
LAW 20.571. "LEY DE GENERACIÓN DISTRIBUIDA" 2012	Introduces net-metering/billing for tariff-regulated customers whose connection power is below 2 MW
LAW 20.805. "LEY LICITACIONES DE SUMINISTRO" 2015	Offers 12,430 GWh / year of energy to meet the electricity needs of customers of regulated Interconnected systems SIC and SING for 20 years from 2021
LAW 20.936. "LEY DE TRANSMISIÓN Y DEL COORDINADOR" 2016	Sets new electricity transmission system and created an independent coordinator of the National Electricity System Agency

Through its National Energy Strategy, the government of Chile has committed to the long-term diversification of the country's energy matrix and to creating the conditions to make energy cleaner and safer. The strategy prioritizes the incorporation of non-conventional renewable electricity (NCRE) sources and the development of electricity. NCRE sources defined by Chilean law include biomass, geothermal, small hydro plants (< 20 MW), solar, tidal and wind.

In 2016, the Chilean government released the Energy 2050 Roadmap, which lays out the plans for the electricity and energy sector, till 2050. Figure 3 illustrates the main pillars of the plan. The roadmap sets out goals for each pillar ensuring long terms reliability, inclusiveness, competitiveness and sustainability.



Figure 3 Structure for Chile's Energy Roadmap 2050²¹

21 <http://www.energia2050.cl/wp-content/uploads/2016/08/Energy-2050-Chile-s-Energy-Policy.pdf>

2 Security of energy supply

Relative to Canada, Chile's energy supply is insecure. Major challenges include:

- Reliance on imported fossil fuel reserves (60% of its energy)
- No domestic production of fossil fuels
- Demand in Chile is projected to increase 3%-4%

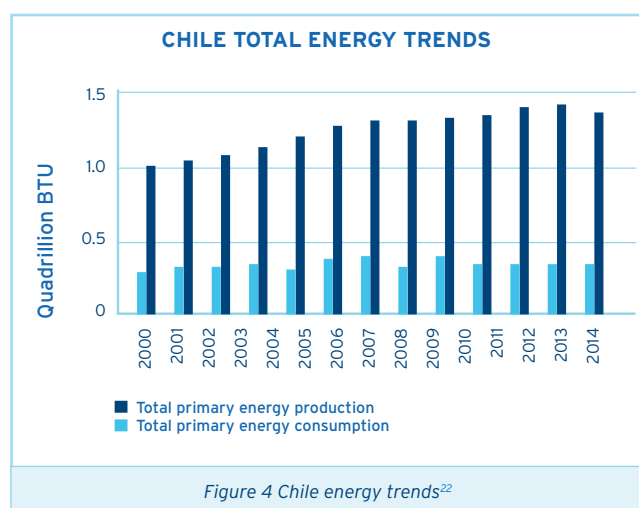


Figure 4 Chile energy trends²²

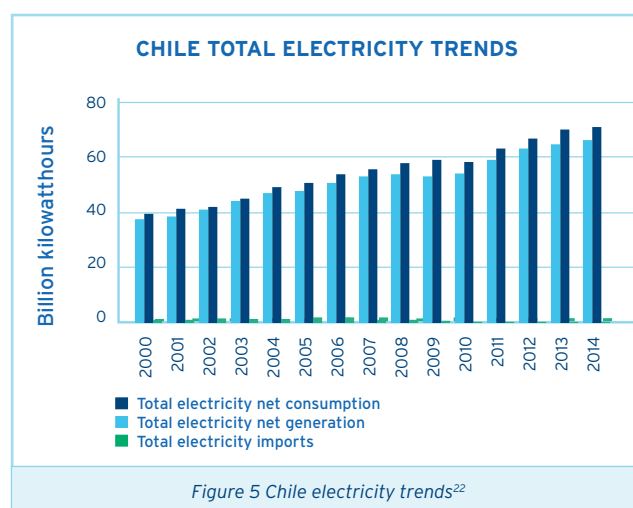


Figure 5 Chile electricity trends²²

22 http://www.eia.gov/beta/international/data/browser/#/?pa=0000002000002000020007vo70400fvc&c=00000004&ct=0&ug=8&tl_id=2-A&vs=INTL.2-2-CHL-BKWH.A&vo=0&v=H&start=1980&end=2014

Chile's primary energy and electricity generation are heavily dependent on fossil fuels as can be seen in Figures 6 and 7. This fuel is mostly imported as Chile doesn't have substantial natural fossil fuel resources. While oil is mainly imported from Brazil and Ecuador, coal is imported from Colombia and the US. Currently, the majority of the natural gas imported to Chile is liquefied natural gas (LNG), from Trinidad and Tobago, Qatar and Yemen. As Chile is heavily reliant on foreign sources of energy, one of the main drivers for the sector is energy independence.

Though Chile's generation market is open, it is dominated by long standing players. According to CNE's June 2016 installed capacity statistics, Engie, Aes Gener and Endesa represent respectively 37.49 per cent 32.90 per cent and 17.9 per cent of SING's installed capacity, whereas Endesa, Colbún and Aes Gener represent respectively 31.37 per cent 22.40 per cent and 13.62 per cent of the SIC's installed capacity.²³

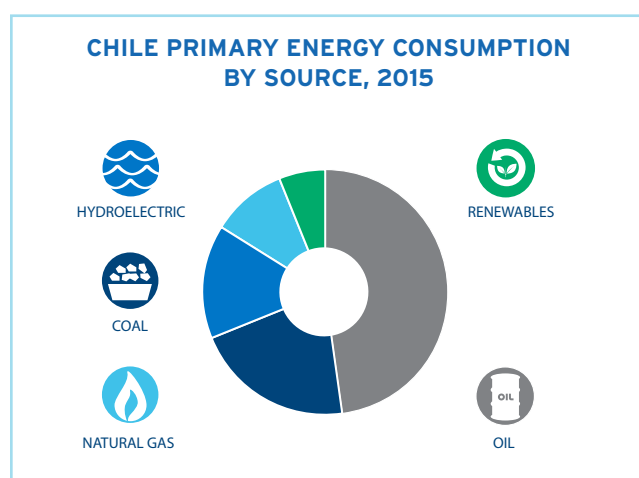


Figure 6 Chile primary energy consumption, by source²⁴

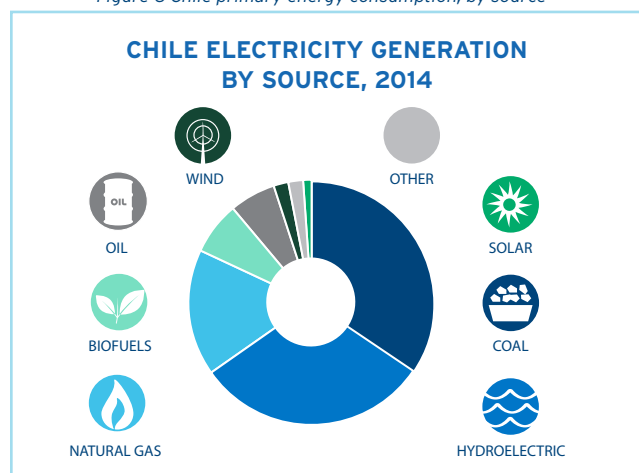


Figure 7 Chile electricity generation by source²⁴

RENEWABLE GENERATION

Bio based fuels along with solar and wind power are playing an increasingly large role in producing power in Chile as prices for renewables decline. Energy experts say Chile's northern desert, where many of the country's copper mines are located, is ideal for producing solar power thanks to the high solar radiation levels, as can be seen in Figure 8. Similarly, wind capacity has nearly quadrupled since 2010, as can be seen in Figure 9.

GLOBAL HORIZONTAL IRRADIATION (GHI) CHILE MAINLANDS



Figure 8 Chile solar irradiance²⁵

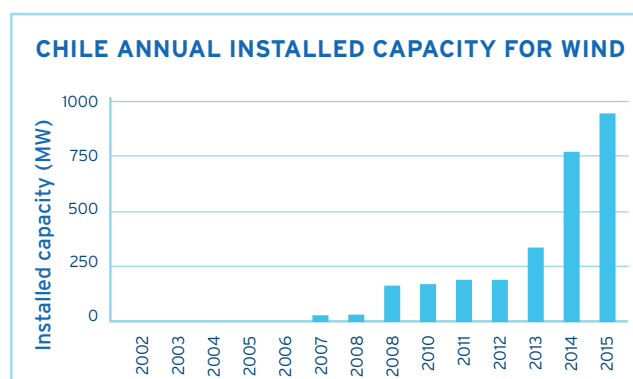


Figure 9 Wind generation capacity in Chile²⁶

²³ <http://latinlawyer.com/reference/topics/85/jurisdictions/3/chile/>

²⁴ <http://www.bp.com/en/global/corporate/energy-economics/statistical-review-of-world-energy/downloads.html>

²⁵ SolarGIS © 2014 GeoModel Solar

²⁶ http://www.thewindpower.net/country_en_57_chile.php

As is evident from the data in Table 5 there is immense potential for renewable generation in Chile. Geothermal energy remains undeveloped mostly due to the fact that exploration and initial costs are high when compared to low price of energy, especially as the resources are in remote areas in the Andes and not connected by transmission.

TABLE 5 - RENEWABLE ENERGY GENERATION POTENTIAL IN CHILE²⁷

Technology	Installed capacity [MW]	Under construction [MW]	Approved [MW]	Potential* [MW]
Small hydro	368	57	337	7,951
Wind	832	165	5,513	37,477
Large hydro	6,017	1,021	1,352	4,521
Solar-PV	452	748	8,173	1,263,407
Solar-CSP	0	110	760	548,478
Geothermal	0	0	120	16,000
Total	7,669	2,101	10,478	1,840,394

* TECHNICAL AND PROBABILISTIC POTENTIAL WITHOUT TAKING ACCOUNT TECHNICAL-ECONOMICS KEY VARIABLE

²⁷ <http://aperc.iese.or.jp/file/2015/10/19/Chile.pdf>

²⁸ <http://www.eqmagpro.com/chile-energy-power-tender-results/>

²⁹ <http://info.bnamericas.com/major-players-fallshort>

ENERGY AUCTIONS

Today, on an levelised cost of energy (LCOE) basis, a wide range of NCRE technologies in Chile are cost competitive with mainstay energy sources such as large hydro and natural gas. These include biomass, onshore wind, solar.

In August 2016, the Chilean government unveiled the results of its latest power tender to supply 12,430 GWh to regulated customers starting in 2021. The average winning price was USD 47.6/MWh. It is the lowest price since tenders started nearly a decade ago. The recent Chile energy auctions, saw the lowest cost of solar in the world, at USD 29.1/MWh. Following this tender, the government estimated energy bills will go down by 20% from 2021 onwards. Major winners in the recent energy auction includes Endesa Chile (only conventional source of power generation awarded in this tender), Acciona (Spain) and WPD (Germany).²⁸ Chile's NEC is expected to launch another tender for the supply of 3,800GWh/y at the end of 2016, 7,200GWh/y tender in 2017 and 8,900GWh/y in 2018.²⁹ It is expected that the government will keep the system of hourly blocks bid and also a seasonal block will be introduced, where a generation company could bid based on its monthly generation profiles.

Major findings

Chile is excessively dependent on foreign sources for its energy supply. However, it has huge untapped potential for renewable energy, which are increasingly becoming cost competitive, especially solar, wind and biomass. Growth in electricity consumption in Chile is projected at 3-4% between now and 2020. To satisfy the 2020 demand the sector will require around 8,000 MW of new generation capacity. Chile's power auctions are facilitating development of cheap renewable energy resources to increase energy security and also decrease costs.

The recent power tender saw the world's lowest cost for solar. These low prices, though good for renewable energy in general can slow down further project development, as rapidly falling prices make it hard to sign long term contracts and result in smaller profits. There is also heavy competition in the sector, with major incumbents along with increasing foreign participation.

3 Quality and efficiency of electricity supply

While the vast majority of Chilean residents have access to electricity (99.6%), with high levels of reliability, affordability remains a considerable issue, particularly in rural and remote areas.

Data for electricity supply interruptions in Chile, last collected in 2005, indicates that the average duration of electricity interruptions per connection is nearly three times as high as the rates in Canada. The IEA has reported that in Chile, electricity generation is fairly resilient, but transmission and distribution networks are more fragile. Despite being highly exposed to severe weather, ranking 22nd on the World Risk Index Rankings (2016), Chile has developed coping and adaptation mechanisms to protect the electricity supply. Average duration of interruptions per connection in Chile rose slightly between 2000 and 2005, with interruptions per connection totalling 13 hours in 2005.³⁰ This is similar to the duration of interruptions per connection experienced in Brazil over the same period, but it's significantly longer than in Argentina and Mexico. Technical and non-technical (theft) losses have fallen sharply in Chile since 1982, with Chile having one of the lowest electricity losses in LatAm at present. Value lost to electrical outages (in terms of percentage of total sales) was 1.6% in 2006, which fell to 1.3% by 2010.³¹

PRICES

Chile has some of the highest electricity prices in Latin America (as seen in Figure 10), as well as OECD countries and reducing prices is one of the main drivers of the electricity sector. The lack of its own oil and gas resources has forced the country to rely on expensive energy imports. Chile's mining sector, mostly based in the north of the country is the world's biggest producer of copper. Due to high prices this sector has paid about twice as much for energy as companies in neighboring Peru, another top miner. A major cause of this problem is inadequate transmission. The congestion faced in the transmission sector has contributed to high electricity prices in Chile, as well.

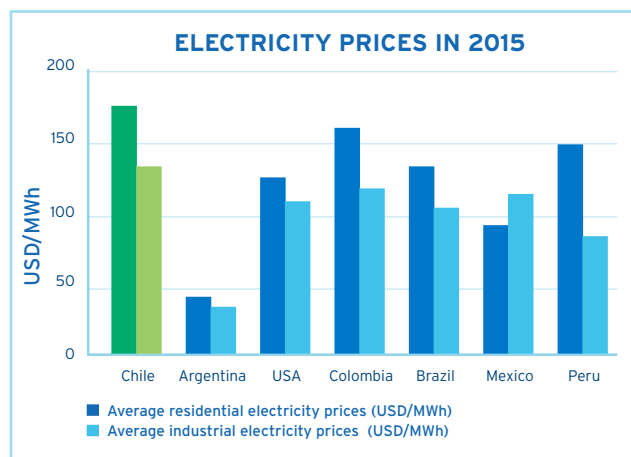


Figure 10 Electricity prices in Chile compared with other countries³²

TRANSMISSION NETWORKS

Chile's electricity system features two major regional grids, the Northern Interconnected System (SING) in the north, and the Central Interconnected System (SIC) in the centre of the country. An additional 11 isolated medium-sized systems (located in the south, known as the Aysén and Magallanes systems) account for less than 1% of the country's electricity production.³³ Because of Chile's geography, it is impractical and expensive to connect these four distinct networks to one another.

Transelec, the main electricity transmission company in Chile, owns 50% of SIC transmission capacity. The SING power system is owned by several companies that each own around 10% to 20% of the transmission capacity. The lack of connection between the grids causes major problems, such as one region can have too much power, driving down prices because the surplus can't be delivered to other parts of the country. In 2016, spot prices for solar dropped to zero in some areas in Chile on multiple days during the year.³⁴ Furthermore, connecting renewable energy generation projects to Chile's electrical grids remains challenging.

Hence, in 2016, the government passed the Transmission Law, which introduced effective measures to impact the challenges of high prices of electricity and lack of proper transmission infrastructure to meet demand. The major changes include, SIC & SING transmission line merger along with transferring the cost of transmission service to consumers.

³⁰ <http://documents.worldbank.org/curated/en/2008/01/16465388/benchmarking-analysis-electricity-distribution-sector-latin-american-caribbean-region>

³¹ <http://data.worldbank.org/indicator/IC.FRM.OUTG.ZS?page=3>

³² Bloomberg New Energy Finance

³³ http://www-pub.iaea.org/MTCD/publications/PDF/CNPP2013_CD/countryprofiles/Chile/Chile.htm

³⁴ <https://www.bloomberg.com/news/articles/2016-06-01/chile-has-so-much-solar-energy-it-s-giving-it-away-for-free>

The merger is expected to reduce generator system costs by about USD 1.1 bn and as a result, electricity prices are expected to fall by USD 13/MWh for households and USD 17/MWh for industries in the SING region, as well as USD 3/MWh for households and USD 9/MWh for industries in the SIC region. The interconnection of the two systems is also expected to boost the development of renewable energies and to reduce uncertainty for operators while increasing competition in the transmission sector.³⁵

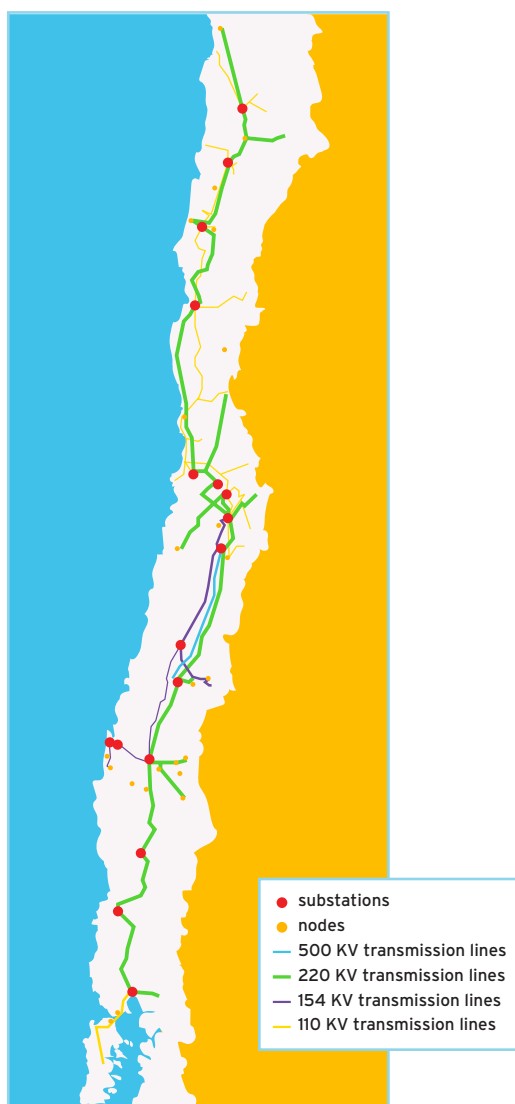


Figure 11 Chile transmission network³⁶

LOSSES

Chile's energy losses stand around 7% (2013) according to the world bank, lower than that for Canada (9% as of 2013) and is close to the average for OECD countries (6.4 % as of 2013) and is not considered a major issue for the electricity sector in Chile. Transmission and distribution losses as a percentage of total output have decreased between 2000 and 2010 in Chile (see Figure 12). In 2011, transmission losses in Chile were 7%, which is lower than the Latin American countries average of 16%, and lower than losses in Colombia, Brazil and Argentina.³⁷

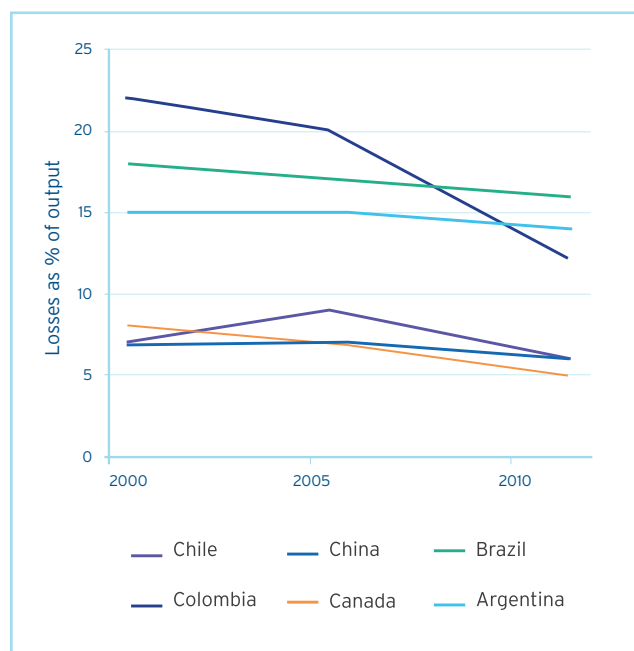


Figure 12 Comparative transmission and distribution losses for select countries³⁶

EXPOSURE TO SEVERE WEATHER

A major issue for the Chilean electricity grid, is exposure to extreme weather. According to the World Risk Report (2012), relative to other countries, Chile has a very high level of exposure to natural hazards, including earthquakes, storms, floods, droughts and rising sea level. Chile is exposed to relatively frequent droughts, which increases the likelihoods of rationing in the country. As a result of the rationing, blackouts such as the one in September 2011 have a major impact on the country, especially on the mining operations.³⁸ Also frequent droughts in the recent years have forced the country to move away from hydroelectric energy to imported fossil fuels, which has been expensive.

³⁵ http://www.enerdata.net/enerdatauk/press-and-publication/energy-news-001/chile-will-interconnect-sic-and-sing-electricity-grids_32392.html

³⁶ http://geni.org/globalenergy/library/national_energy_grid/chile/

³⁷ <http://data.worldbank.org/indicator/EG.ELC.LOSS.ZS>

³⁸ <http://www.reuters.com/article/us-chile-blackout-idUSTRE78000120110925>

Although the country is exposed to natural hazards, the World Risk Report suggests that it has generally effective coping and adaptive capacities. These are largely due to effective governance and a low level of susceptibility, given the country's significant experience in responding to severe weather and natural hazards. The 2010 earthquake in Chile was one of the largest in history, measuring at a magnitude of 8.8 on the Richter scale. The earthquake caused widespread destruction in Chile and wiped out roughly 18% of the country's GDP. Yet the country demonstrated a speedy recovery. The demonstration of resiliency helped Chile become the first Latin American country to be invited to join the Organization for Economic Cooperation and Development in 2010. Listed below are Chile's scores per the 2016 World Risk Report.³⁹

³⁹ <http://weltrisikobericht.de/english/>

- **Exposure** = 30.95% (very high): Related to exposure of population to natural hazards, earthquakes, storms, floods, droughts and sea level rise
- **Susceptibility** = 19.67% (low): Measures public infrastructure, nutrition, income and economic framework
- **Lack of coping capacity** = 58.61% (low): Measures governance, medical care and material sector
- **Lack of adaptive capacity** = 34.70% (low): Related to future natural events and climate change
- **Vulnerability** = 37.6% (low): Sum of susceptibility, lack of coping capacities and lack of adaptive capacity

3.1 Smart grid overview

Energy efficiency is of increasing importance in Chile, especially as developments in generation and transmission have not kept pace with Chile's economic growth and rising electricity demand, and only energy-saving measures are preventing the grid from collapsing.⁴⁰

Hence, one of the key steps of the Chilean Energy Efficiency Action Plan 2012-2020 is to encourage the mining sector and industrial consumers to adopt energy efficiency measures, including smart energy systems. In addition, the government is also looking to implement a large net-metering regime. This would allow both residential and industrial consumers to install these systems in their own homes and businesses. It is expected that as more and more renewables are added to the grid, market for smartgrid hardware, software and services will be on the rise in Chile.

Deployment of smart meters has already started in Chile. CGE Group is Chile's main distribution company and is responsible for providing electricity services to 40% of the population. In 2012, the company deployed smart meters in certain neighbourhoods of Santiago.⁴¹

Chile has developed a smart city pilot project, "Smart City Santiago." As the first intelligent city prototype in Chile, it aims to bring innovative solutions to urban challenges through new technologies, including smart grids.⁴² The effectiveness of the program is yet to be evaluated.

⁴⁰ <http://www.powermag.com/chiles-power-challenge-reliable-energy-supplies/>

⁴¹ <https://www.kamstrup.com/en-uk/case-stories/electricity-casestories/case-tecnec-smart-metering-chile>

⁴² <http://www.smartcitysantiago.cl/reference-in-english>

Major findings

Chile has good electricity coverage, with more than 99% of the population having access to electricity. Electricity losses are not a major issue in the country as well. However, Chile's residential and industrial energy prices are some of the highest in Latin America, and much higher than other member countries of the Organization for Economic Co-operation and Development (OECD) such as Canada. Prices are impacted by lack of grid connection between the two main regional grids, as well as the varying prices of imports and availability of hydropower resources. Chile's transmission and distribution losses have improved significantly in the past few years. At 7%, Chile's losses are less than half of the Latin American average (16%). While relatively low transmission and distribution losses help control electricity costs, high prices driven by other factors may motivate consumers to seek alternative energy sources, creating opportunities for cleantech companies and innovative energy technologies.

4 Environmental sustainability

Chile is a signatory of the Paris agreement, one of the last countries to sign off on the accord. Its environmental targets include:

- Reducing greenhouse gas emissions by 30% of 2007 levels by 2035
- Clean energy target of 45% generation capacity from non conventional renewable sources to be installed by 2025
- At least 60% generation from clean sources by 2030 and 70% by 2050.⁴³
- Energy efficiency goal of 20% savings by year 2025.⁴⁴

In its submission to the United Nations Framework Convention on Climate Change (UNFCCC), Chile also proposes the sustainable management and recovery of 100,000 hectares of forest by 2030 and the reforestation of 100,000 hectares (Government of Chile, 2015). Chile is one of the few countries that separates the Land Use, Land Use Change and Forestry sector target from other emissions, which increases the transparency of its proposed actions.

Under the Copenhagen accord, Chile proposed to undertake Nationally Appropriate Mitigation Actions (NAMAs) to reach an emissions level 20% below business-as-usual (BAU) by 2020 (as projected from 2007). Chile is making progress towards decarbonisation with the Non-Conventional Renewable Energy Law (NCRE) and the carbon tax for fixed sources (turbines or boilers above 50 MWth) of USD 5/ tCO₂ which will come into effect in January 2017.⁴⁵

Chile is also a party to the Kyoto Protocol and the UNFCCC. However, as an Annex II country, it had no CO₂ reduction commitments. Nevertheless, Chile voluntarily committed to reducing its greenhouse gas emissions by 20% by 2020. Chile also pledged to recover 100,000 hectares of degraded soil in the next 20 years, in order to make up for significant deforestation.

NATIONAL STRATEGY FOR RENEWABLES

The Chilean government plans to expand its renewable energy capacity in the coming decades in order to keep up with expected rising energy demand and to reduce its reliance on imported sources of energy. Chile's Ministry of Energy and the National Energy Commission (CNE) has created a policy document, "National Energy Strategy: 2012-2030," that outlines its commitment to "accelerate the incorporation of NCRE sources and to strengthen the development of hydroelectricity."⁴⁶ While a significant portion of Chile's current electricity is already powered by large hydroelectric sources (34%), the government aims to increase hydroelectricity generation to 45% and to increase the share of NCRE to 10% by 2024 (as outlined in Law 20.257). The National Energy Strategy seeks a firm commitment to energy efficiency through renewable sources. Overall, the country has set itself the goal of achieving 20% of its electricity from renewable sources by 2025 (which excludes large hydropower plants).

⁴³ <http://www.energia2050.cl/wp-content/uploads/2016/08/Energy-2050-Chile-s-Energy-Policy.pdf>

⁴⁴ <http://www.energia.gob.cl/sites/default/files/energyagendaweb.pdf>

⁴⁵ <http://uk.reuters.com/article/carbon-chile-tax-idUKL6NORR4V720140927>

⁴⁶ <http://www.centralenergia.cl/uploads/2012/06/National-Energy-Strategy-Chile.pdf>

Major findings

Chile has ambitious renewable energy and climate change targets for the next ten years, exceeding those of many of its Latin American neighbors as well as Canada. By 2025, the government seeks to nearly triple the share of non-hydroelectric renewable generation in the mix, from 9.15 to 25 per cent. They are also striving for a 20% reduction in carbon emissions by 2020 (from 2007 levels). These objectives are outlined in the National Energy Commission's "National Energy Strategy: 2012-2030." There are many initiatives underway in the energy sector to achieve these goals, including the deployment of smart meters and financial incentives for renewable energy technologies. Significant investment and increased deployment of cleantech will be required to achieve these goals.

5 Quality of business environment

According to data from World Bank and Transparency International, Chile is one of the easiest countries in Latin America to do business, with the best infrastructure network and highest credit quality in the LatAm region. It is also the only Latin American country in the Organisation for Economic Co-operation and Development (OECD), with countries such as Canada, the United States, and Germany. Chile's membership offers a platform for collaboration and economic activity with Canada and others within the organisation. Further opportunities for cleantech companies are facilitated by the Canada-Chile free-trade agreement and partnership framework, which include provisions on collaboration on science and technology, sustainable development of mining, and cooperation in the energy sector. Chile has made legislative changes to reduce corruption by enacting a law of criminal liability of legal entities, a whistleblower protection act for public servants and the Transparency Law. Chile is ranked 23 out of 168 countries in the corruption index and corruption does not pose a huge threat to businesses operating in Chile. Chile is ranked 57 out of 190 on the World Bank's ease of doing business index.⁴⁷

Table 6 Ease of doing business indicators⁴⁸

Topics	2016 Rank
Overall	55
Starting a business	56
Dealing with construction permits	22
Getting electricity	59
Registering property	57
Getting credit	78
Protecting minority investors	30
Paying taxes	116
Trading across borders	64
Enforcing contracts	57
Resolving insolvency	56

FOREIGN DIRECT INVESTMENT

Law N° 20.848, in force since 1 January 2016, introduced a new institutional framework for foreign investment. The new Chilean FDI framework continues to prohibit arbitrary discrimination against foreign investors and guarantees access to the formal foreign exchange market, including free remittance of capital and profits. Foreign investors with a minimum investment of USD 5 million may apply to a special FDI regime.⁴⁹

According to Bloomberg New Energy Finance, the main countries investing in Chile are the US, Spain, the Netherlands and Canada. Canadian direct investment in Chile is extensive and diversified, and is a major component of the bilateral commercial relationship. The stock of Canadian direct investment in Chile stood at \$18.3 billion at the end of 2014 and Chilean investment into Canada totalled USD 446 million at the end of 2013.⁵⁰ Canadian companies are mainly present in mining, utilities (water and energy), chemicals, infrastructure and financial services. Clean energy investments in Chile have seen an exponential growth, nearly quadrupling between 2011 and 2014. This has been largely driven by renewable energy investments in wind and solar, one of the largest in Latin America.⁵¹

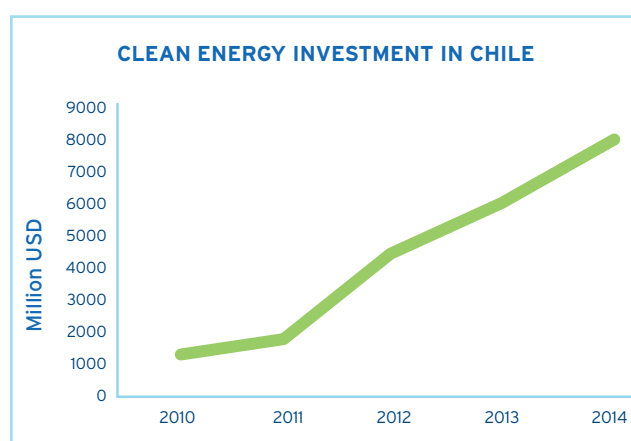


Figure 13 Chile clean energy investments⁵²

CANADA-CHILE RELATIONS

The Canada-Chile Free Trade Agreement (CCFTA) has been in force since 1997 and was the first comprehensive free trade agreement signed by Chile. The agreement covers trade in goods and services, as well as investments, and includes side agreements on environment and labour relations. Canada and Chile also have bilateral agreements on taxation and air transportation.

Major findings

Chile has created a good and welcoming environment for foreign investors in the energy sector. Canada and Chile enjoy good trading relations, especially as they are both OECD members. Canadian companies already have a significant presence in Chile, especially in the mining sector. In other business environment factors, such as ease of doing business, Chile ranks high in Latin America.

⁴⁷ <http://www.doingbusiness.org/rankings>

⁴⁸ www.doingbusiness.org/data/exploreconomies/chile/

⁴⁹ <https://en.portal.santandertrade.com/establish-overseas/chile/foreign-investment>

⁵⁰ http://www.canadainternational.gc.ca/chile-chili/bilateral_relations_bilaterales/index.aspx?lang=eng&_ga=1.51760170.2000039989.1479066662

⁵¹ <http://cleantechies.com/2011/02/24/top-ten-highlights-of-cleantech-chile/>

⁵² <http://global-climatescope.org/en/country/chile/#/details>

6 Conclusion

Chile is a well established energy market, open to private investment, having deregulated this sector in the 1980s. However, over the past few years due to natural disasters and dependence on foreign sources of fuel, Chile's energy security has been jeopardized. Thus, insecurity of supply along with high prices have led to a renewed push for renewables in Chile.

Major findings for the electricity system are as follows:

- High prices for electricity
- Generation dominated by hydroelectric and fossil fuel sources
- High dependence on foreign primary energy sources
- Generation market is competitive, but dominated by incumbents
- Growing rates of demand
- Transmission networks aren't connected between the north and the south and are also constrained by congestion. Plans to connect the north and the south transmission grids are in the works.

In the longer term, experts forecast that Chile's power-generating capacity will expand at an average annual rate of 4.3% between 2016 and 2025, reaching approximately 31,966MW in the next 10 years.⁵³ Meanwhile, total power generation will increase by an annual average of 3.8% over the next 10 years, expanding from 76.96TWh in 2016 to 104.48TWh in 2025. It is expected that a big part of this new capacity to be installed over the next 10 years is renewable

in nature, thus meeting Chile's energy and climate goals for the future. Renewables (Especially solar, wind and biomass) are increasingly cost competitive in Chile, in comparison to other conventional resources.

The Chilean government is increasingly supportive of cleantech and renewable energy, developing policy and structural incentives to facilitate adoption of renewables to meet the country's increasing energy demand. Also, the country's electricity sector is welcoming of foreign investment. This has led to Canadian companies being present in the country. Some Canadian companies with a presence in Chile include Mainstream Renewable Power, Finning, Methanex, Brookefield, SNC Lavalin among others.

Favorable policies include low-interest loans for renewable energy investment, capital guarantees and risk capital funds, a cleantech fund, and a carbon tax. The carbon tax charges generators operating thermal plants with installed capacity equal or larger than 50 MW, \$5/tonne of CO₂ released.⁵⁴

The AEC considers the Chilean electricity sector to be an attractive market for Canadian innovation. The policies and trends discussed in the report foster an environment that is supportive of cleantech deployment and the entry and success of foreign companies into the market.

⁵³ http://www.energia.gob.cl/sites/default/files/annual_progress_report_-_eng.pdf
⁵⁴ <http://uk.reuters.com/article/carbon-chile-tax-idUKL6NORR4V720140927>

Appendix

Key government actors⁵⁵

Ministry of Energy	The Ministry of Energy is the highest governmental institution in charge of governing and administrating the energy sector.
National Energy Commission (CNE)	The National Energy Commission (CNE) is the main state organization in charge of regulating the electricity sector.
Superintendency of Electricity and Fuel (Superintendencia de Electricidad y Combustibles, SEC)	The SEC is a public agency in charge of supervising the energy market. It monitors the compliance of legal regulatory requirements and technical standards. Although the SEC previously acted through the Ministry of Economics, Growth and Reconstruction, as of February 2010, it operates through the Ministry of Energy.
Economic Load Dispatching Centre (Centro de Despacho de Carga, CDEC)	The CDEC is a private entity composed of generating companies supervised by the SEC. It regulates the coordinated functioning of the power generation stations and interconnected transmission lines. One of its functions is to monitor the safety of the grid system and ensure that all operations run smoothly and cost-efficiently.
National Energy Efficiency Program (Programa País de Eficiencia Energética, PPEE)	The PPEE was set up in 2005 under the Ministry of Economics, Growth and Reconstruction as the first public initiative to promote energy efficiency in the country. In 2008, the PPEE became part of the CNE, and since February 2010 it has acted through the Ministry of Energy.

⁵⁵ https://www.iisd.org/pdf/2010/bali_2_copenhagen_Chile_Jun2010.pdf

Institutions & companies in the electricity sector

Institution	Description
Grupo CGE (CGE Distribución, Emelari, Eliqsa, Elecda, Emelat, Conafe y Transnet)	<ul style="list-style-type: none"> • Grupo CGE is a holding company that groups Chilean energy companies, specifically electricity and gas. • It is engaged in the generation, transmission, distribution, and trading of electric power. (It also distributes natural gas and liquefied gas). • Its subsidiaries include CGE Distribucion, Gasco, Metrogas, and Gasnor. • In 2014, Grupo CGE was acquired by Spain's Gas Natural Fenosa.
Chilean Association of Electric Companies (Asociación de Empresas Electricas, Electricas A.G.)	<ul style="list-style-type: none"> • The Chilean Association of Electric Companies (Electricas A.G.) is the trade association representing electric distribution and transmission companies throughout Chile. • Today, it is composed of Chilectra, Chilquinta, CGE, Saesa and Transelec groups, and other independent firms, totaling 27 companies. • The Association of Electric Companies is a permanent channel of communication and collaboration among companies, authorities and other relevant actors in society. Given its solid technical input, it participates in the discussion and elaboration of public policies for a sector as crucial as energy.
Transelec S.A	<ul style="list-style-type: none"> • Transelec S. A. is the main electricity transmission company in Chile. It transports electricity to 97% of the population through its transmission lines that stretch for 9560 km from North to South. Transelec is thus the leading provider of electrical transmission between the Northern Interconnected System (SING) and the Central Interconnected System (SIC). • Transelec is controlled by Canada's Brookfield through Transelec Holding Rentas.
Endesa Chile	<ul style="list-style-type: none"> • Largest public utility in Chile, privatised in 1989, it is now owned by Spain's Endesa, S.A..
Colbun	<ul style="list-style-type: none"> • Private company in Chile involved in generation and transmission.
E-CI	<ul style="list-style-type: none"> • Chilean subsidiary of the Engie group, involved in power generation and is the main generation company in SING.
AES	<ul style="list-style-type: none"> • AES Gener is a producer and distributor of electricity in Chile.
Chilectra	<ul style="list-style-type: none"> • Private Chilean distribution company.
Transnet	<ul style="list-style-type: none"> • Transmission company owned by CGE.
Chilquinta	<ul style="list-style-type: none"> • Chilean distribution and marketing company owned by US firm Sempra Energy.
Saesa Group	<ul style="list-style-type: none"> • Private company working in generation, transmission and generation of electricity in Chile.
CONAFE	<ul style="list-style-type: none"> • Distribution company owned by CGE focusing on unregulated clients.

Websites for key Chilean & Canadian resources

Organisation	Website
Canadian Trade Commissioner	http://www.tradecommissioner.gc.ca/eng/office.jsp?oid=14
Chile-Canada Chamber of Commerce	http://www.chile-canada-chamber.cl/inicio/
Canada-Chile Free Trade Agreement	http://www.international.gc.ca/trade-agreements-accords-commerciaux/agr-acc/chile-chili/index.aspx?lang=eng
Chile Ministry of Energy	http://www.minenergia.cl/
Doing Business Guide, Chile	http://www.doingbusiness.org/data/exploreeconomies/chile/



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The Advanced Energy Centre's Going Global Series is developed in line with its mission to foster the adoption of innovative energy technologies in Ontario and Canada and to leverage those successes and experiences into international markets.

The information provided in this report is presented in summary form, is general in nature, current only as of the date of publication and is provided for informational purposes only.

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