Toward Energy Security in Chile

A Working Paper of the Americas Society/Council of the Americas Energy Action Group

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INTRODUCTION

Chile is on the cusp of becoming the first developed country in South America, but it cannot fully achieve that status without a secure, affordable energy supply. Chile's GDP is expected to grow 5.1 percent per year until 2015, and the government estimates energy demand will double by 2022 and triple by 2032.[1] Low domestic energy production presents a potential bottleneck for continued growth, but public opposition to coal and hydropower projects is strong, and Chile is struggling to take advantage of its renewable energy resources. Against this backdrop, the government faces the challenge of building broad-based support for a long-term energy policy.

Chile is on the cusp of becoming the first developed country in South America, but it cannot fully achieve that status without a secure, affordable energy supply.

This working paper explores Chile's efforts to achieve energy security, reduce energy costs, and respect the environment. It begins with background on the liberalization of the energy sector in the 1980s and an overview of Chile's energy matrix today. The paper then focuses on government initiatives to increase renewable energy, reduce greenhouse gas (GHG) emissions, and implement energy efficiency measures. This is followed by a discussion of some of the opportunities and challenges in the energy sector, including infrastructure needs, the investment climate, public and environmental concerns, and cross-border cooperation. Finally, the paper makes several recommendations based on Chile's experience but intended for broader hemispheric consideration. These recommendations are drawn in part from a high-level meeting the Americas Society and Council of the Americas Energy Action Group held in Santiago, Chile, on November 2, 2011. The meeting brought together senior representatives from the public and private sectors for a discussion of energy issues in Chile.

[1] Economist Intelligence Unit, "Chile's Energy: Energy Security Still Elusive," April 2011.

Briefly, the recommendations are as follows:

1. Chile should streamline its energy project approval process to maximize investment in the sector.

2. Chile should prioritize public engagement in the energy sector.

3. Chile should upgrade and expand its energy infrastructure, particularly its transmission system.

4. Chile should prioritize efficiency measures to help meet demand, decrease costs, and lower emissions.

5. Chile should seek to strengthen energy interconnection with its neighbors so it can take advantage of regional energy sources and economies of scale.

BACKGROUND

Chile's energy sector underwent a dramatic overhaul in the 1980s focused on a private-sector-led growth strategy and market competition. The 1982 Electricity Law, for example, privatized electricity generation, transmission, and distribution. Following implementation of the law, overall access to electricity rose dramatically, from 62 percent of the population in 1982 to 98 percent in 2008.[2]

By the mid-1980s, Chile's economy was growing, and it required new sources of energy. Neighboring Argentina, with abundant natural gas assets, seemed like a logical partner. In 1995, the two countries signed the "Gas Integration Protocol," and five pipelines connecting Argentina and Chile were constructed over the next several years. From 1995 to 2001, natural gas consumption in Chile increased fourfold as coal and oil were replaced by Argentine natural gas, accounting for nearly 80 percent of Chile's natural gas consumption.[3] The heavy reliance on a single source of energy would eventually have consequences for Chile. Following Argentina's 2001 economic crisis, price controls that kept electricity prices artificially low and a devalued peso resulted in elevated domestic consumption of natural gas in Argentina and little new investment in the industry. Argentina could not satisfy its domestic needs and continue to meet its commitment to Chile at the same time. In 2004, Argentina restricted natural gas exports, and Chile was forced to take immediate steps to secure its energy supply and begin to reassess its long-term energy strategy.

CHILE'S ENERGY MATRIX

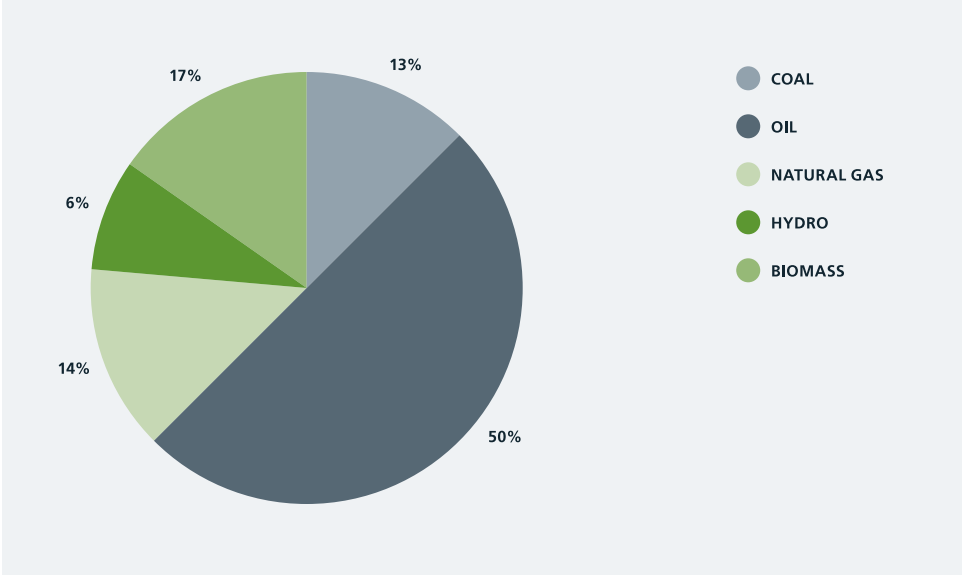
Today, Chile remains heavily reliant on foreign sources of energy. After the natural gas crisis, Chile replaced Argentine natural gas with other imports, largely oil and coal; nearly 75 percent of Chile's total supply is imported fossil fuels.[4] While Chile has few indigenous sources of fossil fuels, it does have significant renewable energy resources. Large-scale hydropower concentrated in the central and southern regions makes up 35 percent of the country's electricity generation.[5] The potential for nonconventional renewable energy (NCRE)—wind, geothermal, solar, and

2 International Energy Agency, "Chile Energy Policy Review 2009," 37.
3 Paulina Beato and Juan Benavides, eds., *Gas Market Integration in the Southern Cone* (Washington, DC: Inter-American Development Bank, 2004), 122; and International Energy Agency, "Chile Energy Policy Review 2009," 111.
4 Economist Intelligence Unit, "Chile's Energy."
5 Rodrigo Álvarez Z., "La Encrucijada Energética de Chile: Los Desafíos del Desarrollo," Presentation, October 2011.

While Chile has few indigenous sources of fossil fuels, it does have significant renewable energy resources.

minihydro—is great, and the government has begun promoting the development of these alternative sources. Because of the prevalence of earthquakes, nuclear energy is controversial. Chile currently does not have any nuclear power plants, but it continues to study the possibility of introducing nuclear energy into its matrix.

Chile has two major electricity grids, and both have been vulnerable to disruptions because of weaknesses. The Northern Interconnected System (SING) covers 25 percent of Chile's territory in the northern region. Home to most of the country's mining activities, electricity in this region is primarily used for industrial purposes. The Central Interconnected System (SIC) supplies 90 percent of the country's population, including the Santiago area.



Chile's Energy Matrix

Source: Ministry of Energy of Chile

Fossil Fuels

Oil accounts for 50 percent of Chile's energy supply and natural gas for 14 percent.[6] At its peak, natural gas from Argentina was 33 percent of electricity generation in Chile.[7] Today, natural gas makes up 17 percent of electricity generation.[8] Domestic production of oil and natural gas is minimal, but Chile continues exploration activities. In 2007 the Ministry of Mines issued tenders to international and domestic firms for the exploration of hydrocarbons in the southern Magallanes and Tierra del Fuego regions.

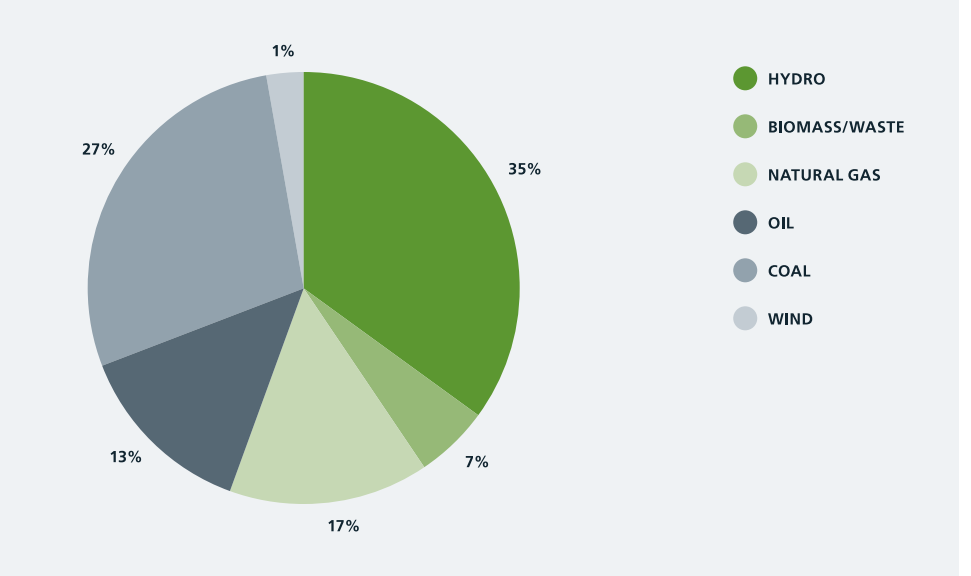
Chile has begun importing liquefied natural gas (LNG) to help offset the loss of natural gas from Argentina. Two LNG terminals were recently constructed: Quintero, which supplies Santiago, and Mejillones, which is located in the north of the country. Both terminals supply vulnerable areas, but high LNG prices have curbed demand for the fuel. Compared to pricey LNG and sporadic natural gas from Argentina, coal has become an attractive energy source because of cost and availability. Coal constitutes 13 percent of Chile's energy supply and 27 percent of electricity generation, and since the natural gas crisis, has become the source of most electricity generation in the north. Domestic production contributes less than 5 percent of Chile's coal consumption.[9]

Conventional and Nonconventional Renewable Energy

Renewable energy contributes 23 percent of Chile's energy. Large-scale hydroelectric power is 6 percent of energy supply and generates 40 percent of electricity. In comparison with other countries in the region, Chile's hydropower supply is less geographically diverse, which makes it vulnerable to periodic droughts. At 17 percent of energy supply, biomass is a significant energy source in Chile.[10] Much of the biomass used is firewood for heating and cooking though this traditional energy source will likely be reduced over time as access to modern energy sources grows. Other NCRE sources are negligible but increasing.

6 Álvarez Z., "La Encrucijada Energética de Chile."
7 International Energy Agency, "Chile Energy Policy Review 2009," 51.
8 Álvarez Z., "La Encrucijada Energética de Chile."
9 Álvarez Z., "La Encrucijada Energética de Chile"; and Economist Intelligence Unit, "Chile: Energy Report," February 25, 2011.
10 Álvarez Z., "La Encrucijada Energética de Chile."

Chile has abundant NCRE resources. Home to 10 percent of the world's active volcanoes, Chile's geothermal potential has not yet been exploited.[11] Wind energy can be harnessed in the area just north of Santiago, and the Atacama desert in northern Chile has excellent conditions for solar energy. But these areas are far from population centers and connecting them to the electricity grid is costly. Furthermore, the intermittency of some NCREs (*e.g.*, the sun doesn't shine all the time), combined with limited storage technology, necessitates backup fuels.



Electricity Generation in Chile

Source: Ministry of Energy of Chile

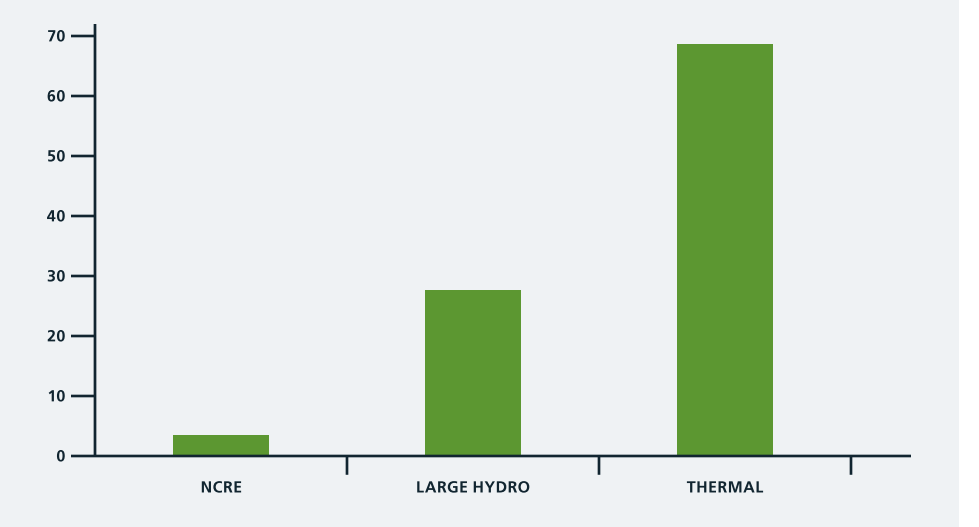
[11] International Energy Agency, "Chile Energy Policy Review 2009," 159.

GOVERNMENT INITIATIVES

Promoting NCREs: Targets and Incentives

Despite Chile's vast endowment of renewable energy sources, NCREs supply only 4 percent of Chile's power generation and amount to less than 4 percent of energy projects under construction.[12] The government has taken measures to promote greater adoption of NCREs. A law passed in 2008 requires 10 percent of electricity to come from NCRE sources by 2024.[13] Under the legislation, NCREs must constitute 5 percent of new energy generation contracts beginning in 2010.[14] The quota will then increase by 0.5 percent each year from 2015 through 2024.[15]

The Chilean government also provides some subsidies for nonconventional renewable energy development. The Chilean Economic Development Agency (CORFO) administers a $400 million fund and offers lines of credit up to $5 million to



Energy Projects Under Construction

Source: Ministry of Energy of Chile

[12] *The Economist,* "Dancing in the Dark: A blackout highlights a pressing problem," October 1, 2011; and Álvarez Z., "La Encrucijada Energética de Chile."
[13] International Energy Agency, "Chile Energy Policy Review," 167.
[14] *Introduce Modificaciones a la Ley General de Servicios Eléctricos Respecto de la Generación de Energía Eléctrica con Fuentes de Energías Renovables no Convencionales,* Ley 20257 (March 20, 2008).
[15] International Energy Agency, "Chile Energy Policy Review," 167.

support solar, wind, and geothermal projects.[16] In 2011, the government announced an additional $85 million fund for geothermal exploration.[17] These efforts still pale in comparison with government support for renewable energy in developed nations, and some industry representatives argue that Chile's programs do not provide sufficient incentives to support investments in renewable energy.

Greenhouse Gas Emissions: Reduction Targets and Regulations

Although the government has raised the profile of renewable energy, Chile remains highly dependent on fossil fuels. While Chile is not one of the world's largest emitters, its emissions have been rising. Chile may see GHG emissions double by 2025 over their 2008 levels.[18]

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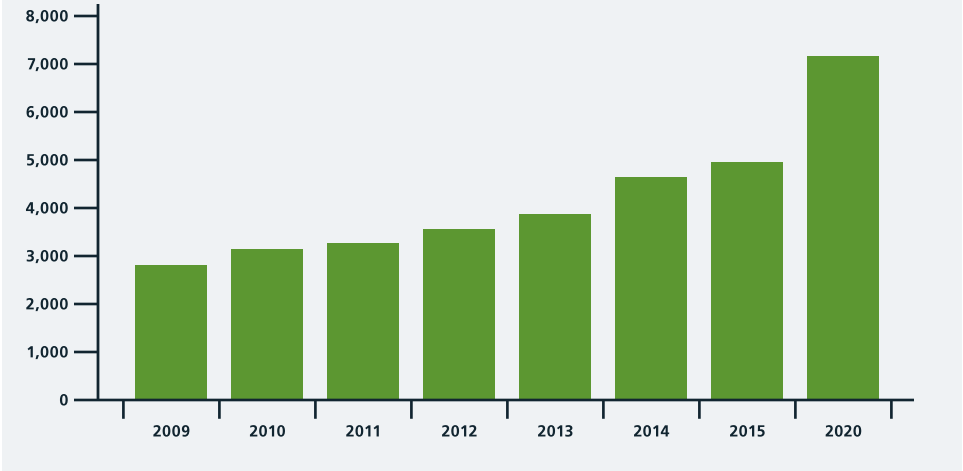

Projected Growth in Coal Consumption (KTOE)

Source: Economist Intelligence Unit

[16] Allan Miller and Patricia Silberman, "Chile: A Renewed Path to Energy Autonomy," *Latin Lawyer* 7, no. 8(2008), 29-32.
[17] *ADP News Latin America,* "Chile govt earmarks USD 85m for geothermal exploration in 2011," May 19, 2011.
[18] International Energy Agency, "Chile Energy Policy Review," 71.

If the government fulfills its commitment to make Chile a developed nation by 2020, it could face global pressure to commit to reduce emissions at a level in line with richer countries. A more immediate concern stems from the fact that OECD member countries are the destination for half of Chile's exports, and consumers in these markets increasingly demand environmentally friendly products. Chile is beginning to implement stricter environmental standards. New emission limits for thermoelectric plants went into force in 2011. So far only one of Chile's 18 coal-fired plants has been approved and the cost of upgrading the remaining 17 is estimated to be $50 million per plant.[19]

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Energy Efficiency

With economic and population growth, energy consumption in Chile has increased significantly in the last several years. Since 1999, electricity consumption has grown at a rate of 6 percent per year.[20] A study by the University of Chile's Energy Research Program found that if energy efficiency policies are implemented in major consumer sectors, energy demand could be reduced 20 percent by 2021 (over 2007).[21]

Argentina's curbs on natural gas and growing pressure from international organizations, namely the OECD, have an upside: they have forced Chile to reassess its approach to energy efficiency. Over the last several years, the government has been taking steps to increase energy efficiency. In 2005, the government created the National Energy Efficiency Program (PPEE) to develop and carry out new policies and initiatives for the efficient management of the country's electricity use. In 2010, the PPEE became the Chilean Energy Efficiency Agency.

[19] UK Trade & Investment, "Power and Renewable Energy Opportunities in Chile," January 11, 2011.
[20] International Energy Agency, "Chile Energy Policy Review," 89.
[21] United Nations Economic Commission for Latin America, "Energy Efficiency in Latin America and the Caribbean: Situation and Outlook" (Santiago, 2010), 71–72.

OPPORTUNITIES AND CHALLENGES

Transmission Infrastructure

Chile's transmission system is perhaps one of the greatest obstacles to Chile's energy security. Limited in range and weak, Chile's transmission system will require large investments to extend and upgrade the network. In addition, complex geographic conditions and protected areas such as those in Patagonia make construction particularly difficult, both technically and politically.

Chile's transmission system is perhaps one of the greatest obstacles to Chile's energy security.

Strains on the system have worsened since the February 2011 earthquake. A power failure at the SIC grid in September 2011 left more than half the population without energy. It was the second such blackout in less than two years. Another limitation of Chile's transmission system is reach. Power lines do not cover many rural areas. Extensions are also needed to dispatch electricity from outlying production sites to more populated and energy-intensive parts of the country. NCRE projects, in particular, require new power lines because they are generally in remote areas, out of reach of existing transmission capability. Without the ability to send energy to paying customers, NCRE projects are not financially viable.

Investment Climate

With impressive economic growth rates since the early 1990s, Chile's investment climate is attractive to investors. Chile has a high level of political stability and a sound institutional and regulatory framework. A member of the OECD since 2010 and an observer since 1996, Chile has also successfully integrated itself into the global economy and won the trust of foreign investors. In addition to strong macroeconomic indicators and institutions, Chile ranks among developed economies in terms of the ease of doing business in the country.

Chile has a high level of political stability and a sound institutional and regulatory framework.

Nevertheless, despite an overall attractive investment climate, the energy sector has suffered from project approval delays because of unnecessary bureaucracy, which has discouraged investors. In a report presented to the Minister of Energy in November 2011, an expert advisory committee recommended reducing the environmental approvals required for project implementation. Former energy minister Marcelo Tokman, a member of the committee, has argued that environmental requirements force project revisions that delay construction and ultimately lead to undersized systems.[22]

Despite an overall attractive investment climate, the energy sector has suffered from project approval delays because of unnecessary bureaucracy.

Public Opinion and Environmental Concerns

Opinion polls show that Chileans are increasingly concerned with environmental well-being. There is strong opposition to new coal plants as well as to HidroAysén, a large hydro project in Patagonia. Even NCRE sources have come under fire, most notably geothermal exploration in El Tatio. A lack of public support for new energy projects could be a considerable obstacle to meeting Chile's rising energy demand.

Environmental lobbies have opposed construction of HidroAysén since it was designed in 2006 because transmission lines must pass through Patagonia, renowned for its untouched nature and the absence of industrial activity. Although initial plans were revised to mitigate environmental impact, a nationwide poll taken in mid-2011 found that 61 percent of the population still opposed HidroAysén.[23] Some experts claim that if HidroAysén is not built, the country will fail to meet energy demand without increasing the use of conventional energy sources, namely coal.

[22] James Fowler, "Advisory Committee Recommends Transmission Corridors, Less Bureaucracy," *Business News America,* November 16, 2011.
[23] Roy Carroll, "Protests after Chile Backs Giant Dams in Patagonia's Valleys," *The Guardian,* May 10, 2011.

The majority of new energy investments in the coming decade will be in coal-fired thermoelectric plants.[24] Coal projects make up 95 percent of all thermoelectric plants currently in construction.[25] While leading local producers claim that coal production will continue to be cost competitive, the expense of upgrading plants to meet new emissions standards could be passed on to consumers.

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Cross-Border Cooperation

Although Chile will continue to depend on foreign energy supplies for the foreseeable future, it has few energy connections with neighboring countries. The development of a regional power network has been held back by border disputes that date back to the 19th century. In addition, Chile is particularly cautious after relying too heavily on natural gas from Argentina. But leaders are becoming more open to energy interconnections, notably the exportation of natural gas and electricity from Peru to Chile, and the newly formed Pacific Alliance between Chile, Colombia, and Peru (as well as Mexico), which contemplates establishing electrical interconnections between the countries.

[24] Álvarez Z., "La Encrucijada Energética de Chile."
[25] Ministry of Energy, "Antecedentes sobre la matriz energética en Chile y sus desafíos para el futuro," June 1, 2011.

RECOMMENDATIONS

These realities lead to several conclusions and recommendations.

Chile Should Streamline Its Energy Project Approval Process to Maximize Investment in the Sector

Chile is an attractive destination for investment because of its long-standing commitment to market friendly policies. While this is largely true for the energy sector, unnecessary delays in the permitting process for energy projects put Chile at risk of losing investor interest given the relatively small size of the market. Complicated regulations, institutional overlap, and a lack of transparency often result in an extended approval period that costs companies money and keeps Chile from meeting its growing demand. Public officials have acknowledged the need to streamline new-project authorization in the energy sector. As a fundamental element of energy reform, Chile should prioritize the restructuring of review and licensing procedures for new energy investments to simplify and speed up decision making, save money, maintain investor confidence, and, ultimately, ensure its energy needs are met.

Chile Should Prioritize Public Engagement in the Energy Sector

As evidenced by recent overwhelming public opposition to high-profile energy developments such as HidroAysén in Patagonia and lower-profile projects such as a thermoelectric coal plant in Barrancones, Chile's population has strong opinions about the direction of the country's energy sector. To avoid derailing future energy investments, Chile's public and private sectors would do well to engage the public early and often in energy developments. The Chilean government should improve its process for public engagement in energy decision making. Private investors should also incorporate public consultation into their project development plans.

Chile Should Upgrade and Expand Its Energy Infrastructure, Particularly Its Transmission System

Facing limited and weak transmission systems, Chile has experienced two wide-ranging blackouts in its central grid in less than two years. No one denies the need to upgrade the power system and increase its capacity and reach, but costs, environmental challenges, and public opposition are some of the complications that hinder consensus on solutions. While these are not easy problems to solve, Chile must find a way to work through them or face more power outages and limited ability to link to the new generation projects it desperately needs.

Chile Should Prioritize Efficiency Measures to Help Meet Demand, Decrease Costs, and Lower Emissions

The most immediate way to help meet demand, reduce costs, and lower emissions is to use energy more efficiently. Chile has established an Energy Efficiency Agency and developed an Energy Efficiency Action Plan. These are great first steps, and Chile should begin to implement its action plan and continue to work to create support among private companies and the general public, perhaps through a system of incentives, to ensure that its energy efficiency goals are realized over the long term.

Chile Should Seek to Strengthen Energy Interconnection with Its Neighbors so It Can Take Advantage of Regional Energy Sources and Economies of Scale

Chile is still recovering from a disappointing cross-border natural gas connection with Argentina and is, for good reason, cautious about depending on its neighbors for its energy security. Nonetheless, energy cooperation, if done right, can help meet Chile's—and its neighbors'—needs by creating larger, more efficient markets. Interconnections can, in addition, make NCRE generation more attractive to power companies because they can take advantage of savings that come with economies of scale.

A regional energy market could be a means to foster overall political integration. Mercosur would be a useful framework under which to build a regional energy market and engage both full (Argentina, Brazil, Paraguay, Uruguay) and some associate (Bolivia, Chile, and perhaps Peru) member countries. A regional market could give Chile access to Bolivian natural gas by allowing Bolivia to export to the regional market, rather than directly to Chile, which is objectionable to Bolivia.

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