

CHILE

- *Chile's GDP is projected to continue growing robustly at 4.9 percent annually between 2002 and 2030.*
- *Economic growth is mainly driven by the industrial sector (mining); Chile being the world's largest producer and exporter of copper.*
- *High dependence on imported natural gas for electricity generation and lack of transmission infrastructure across the economy are fast becoming a problem of energy security.*
- *Environmental protection and sustainable development concerns, clean energies such as natural gas, hydropower and renewables are priorities in the government policy.*
- *The investment requirements over the outlook period will amount to between US\$64-83 billion.*

RECENT ENERGY TRENDS AND ENERGY POLICY

Chile's total primary energy consumption grew annually at 1.8 percent from 2001 to 2004. Electricity consumption has increased by 5.1 percent in the same period, primarily through the expansion of the mining sub-sector - particularly for copper - of the industrial sector. Chile is the largest copper producer and the second largest copper refiner in the world. Additionally, rising income has resulted in higher passenger vehicle ownership and robust economic activity has resulted in more freight transportation, which has consequently increased oil consumption accounting for 25 percent of the total incremental energy consumption between 2001 and 2004.

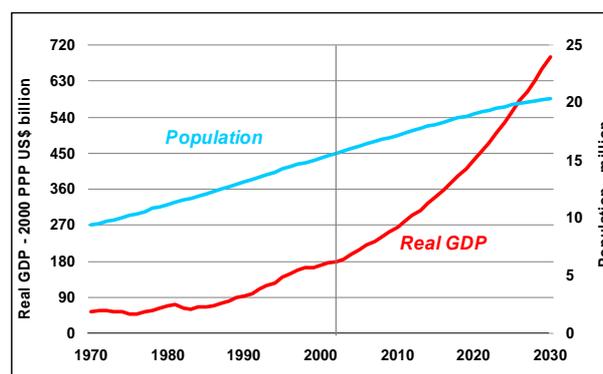
Except for hydro, Chile has very limited indigenous energy resources and therefore must rely on imports to sustain growth. Between 2002 and 2004, imports of natural gas increased at an average annual rate of 15.5 percent, coal at 8.5 percent and oil at 4.8 percent. The economy's net energy import ratio has increased from 41 percent in 1980 to 63 percent in 2002.

The instability of natural gas supply from Argentina as a result of supply cuts in 2004, which reduced by half the contracted volumes on some days, has prompted the economy to reconsider energy policies vis-à-vis the supply of natural gas and reducing high import dependence on Argentina. Chile has formulated a new policy that advocates the construction of a liquefied natural gas (LNG) import facility. In addition the construction of new hydro power plants and a greater focus on the development of new and renewable energy sources has been considered.

ENERGY DEMAND DRIVERS

Chile's growth in energy demand will be led mainly by increased economic activity with GDP projected to grow at 4.9 percent annually over the outlook period. Expansion in industrial sector activities, particularly in the mining sub-sector is expected to contribute to the economy's GDP growth.³⁰

Figure 19 GDP and Population



Source: Global Insights (2005)

Population growth is projected to be restrained at 1.0 percent per year over the outlook period, and by 2030 Chile's total population is expected to reach over 20 million. UN Habitat projects that the share of Chile's urban population will reach 92 percent in 2030 from 87 percent in 2002.

OUTLOOK

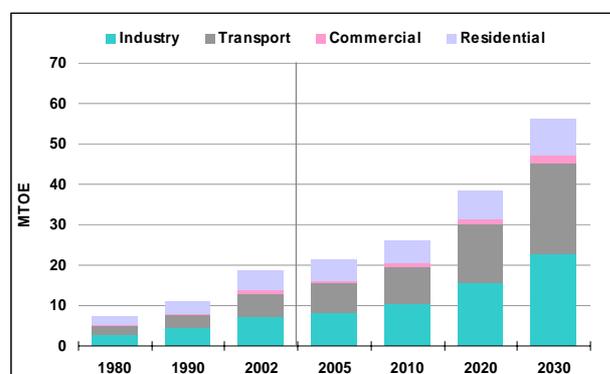
FINAL ENERGY DEMAND

Over the outlook period, final energy demand is projected to grow at 4.0 percent annually, 0.3 percent less than that of the previous two decades. The

³⁰ Between 2002 and 2004, on the back of high commodity prices, export revenues for Chile's ferrous and non-ferrous mineral products have contributed about 29 percent to the economy's GDP.

industrial sector's share will remain the largest at 41 percent, followed by the transport sector at 40 percent, and the residential and commercial sectors at 16 percent and 3 percent respectively in 2030.

Figure 20 Final Energy Demand



Source: APERC Analysis (2006)

Industry

Energy demand in the industrial sector is projected to grow at an average annual rate of 4.2 percent, slightly lower than the average annual growth of 4.4 percent over the past two decades. The shift in industry structure, from manufacturing to service industry, will lead to the lower projected growth in energy demand in this sector. In addition, the decrease in the share of mining and quarrying (especially the copper industry) to the total value-added of the industrial sector will result in this lower growth trend in the latter part of the outlook period. Among the fuels used in the industrial sector, electricity is projected to maintain the largest share throughout the outlook period. Electricity, as a major input for copper production, will grow at an average annual rate of 5.0 percent, with its share increasing to 42 percent in 2030 from 34 percent in 2002. Petroleum products are likely to take the second largest share of 29 percent by 2030. Demand for diesel which is largely used as a fuel in copper production and agricultural activities is expected to lead the growth in industrial oil demand. Natural gas is also projected to grow robustly at 4.2 percent per year as it continues to replace fuel oil and coal for boilers in the mining and manufacturing sectors. The share will remain constant at 12 percent through to 2030.

Transport

For the past two decades, Chile's transport energy demand has grown annually at 4.5 percent. The largest portion of incremental growth came from the road transport sub-sector, accounting for 86 percent. Income growth and development of urban areas has spurred the growth of passenger vehicle

ownership, and led to the 4.6 percent increase in gasoline consumption in the same period. Economic recovery starting from the early 1990s has driven a more than two-fold increase in diesel consumption for the trucking/freight segment. Development of a highway system – through effective utilisation of private financing – has facilitated the flow of inter-city passenger and freight traffic.

Over the outlook period, Chile's transport energy demand is projected to increase at an annual rate of 4.9 percent – a faster pace than the previous three decades at an annual rate of 3.6 percent. By sub-sector, the road transport sub-sector is projected to grow substantially, accounting for 87 percent of the incremental energy demand (2002-2030), with the remainder coming from energy demand for the air transport sub-sector. Increasing utilisation of transportation will result in per capita energy demand reaching 1.1 toe in 2030 from 0.38 toe in 2002.

As economic development continues to be supported by the export of mining, forestry and agricultural products, requirements for freight transport – mainly for the trucking sub-sector – will grow substantially. As a result diesel demand for freight is expected to grow at an annual rate of 5.3 percent. Gasoline demand for passenger transport is projected to grow at 4.6 percent annually. Income growth will boost the level of passenger vehicle ownership from 79 per 1,000 population in 2002 to 185 per 1,000 population in 2030. Towards the end of the outlook period, after 2020, population growth is projected to decline resulting in lower demand for road transport thereby the slower growth in gasoline demand. In addition, the government initiative to restrict overall bus travel along Santiago City streets, as a measure to reduce pollution, is projected to contribute to the lower diesel demand and increase in gasoline demand.³¹

Residential and Commercial

Along with the strong income growth and improvement in living standards, energy demand in the residential sector is projected to grow by 2.3 percent annually throughout the outlook period. In 2030, electricity is projected to take the largest share in total residential energy demand, accounting for 34 percent. Due to the implementation of a rural electrification program, electricity will grow at the fastest rate at 5.9 percent per year between 2002 and 2030. The share of biomass (mostly fuel wood) is projected to decline at 0.2 percent per year, to

³¹ In 2001, the government announced the "Atmospheric Decontamination and Prevention Plan", which restricts overall bus travel on Santiago's city streets in addition to restrictions on the utilisation of leaded gasoline for passenger vehicles.

become the second largest fuel in total residential energy demand by 2030, after reaching a peak in 2009. Biomass is however expected to be continuously used to provide electricity to remote areas where the national electricity grid is inaccessible. Petroleum products are expected to grow by 3.6 percent per year, comprising mostly LPG at 80 percent. LPG will continue to replace biomass for cooking and heating in residential buildings, with the share increasing from 17 percent in 2002 to 27 percent in 2030.

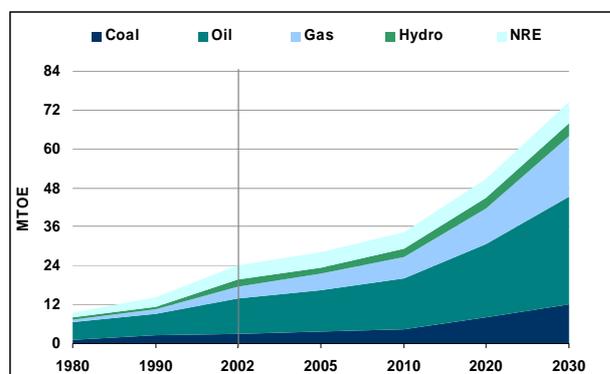
Energy demand of the commercial sector is expected to grow at an annual rate of 3.8 percent, consistent with the growth of value added for the services industry at 5.6 percent annually throughout the outlook period. Driven by the increase in demand for cooling and lighting in commercial buildings, electricity is projected to grow at 3.7 percent annually and maintain the largest share over the outlook period. Following electricity, natural gas is projected to account for the second largest share in total commercial energy demand. As natural gas will continue to replace diesel for electricity and heat production and compete with LPG in the commercial sector, demand for natural gas is expected to grow the fastest at 6.3 percent annually.

PRIMARY ENERGY DEMAND

Chile’s primary energy demand is projected to grow at an annual rate of 4.1 percent, a slight decrease compared to the previous two decades at 4.3 percent per year. Among fossil fuels, natural gas is expected to grow at the fastest pace of 5.9 percent per year, followed by coal at 5.3 percent and oil at 4.0 percent.

Natural gas demand will be largely driven by the electricity sector, with gas-fired electricity generation accounting for more than 45 percent of total electricity generation in 2030.

Figure 21 Primary Energy Demand



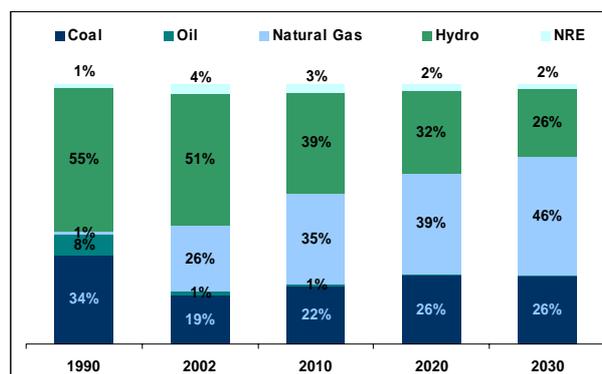
Source: APERC Analysis (2006)

ELECTRICITY

Electricity demand in Chile will increase at 5.0 percent per year, to nearly quadruple that of the 2002 level over the outlook period.

The share of natural gas in the generation mix will increase from 26 percent in 2002 to 46 percent in 2030. The installed capacity of natural gas-fired electricity generation is expected to more than quadruple from 3 GW in 2002 to 14 GW in 2030.³² Coal-fired electricity generation and hydro will each account for about 26 percent of the total electricity generation mix in 2030.

Figure 22 Electricity Generation Mix

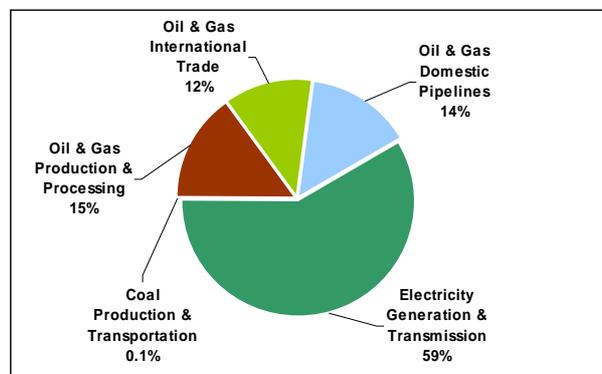


Source: APERC Analysis (2006)

INVESTMENT REQUIREMENTS

The investment requirements over the outlook period are expected to be between US\$64-83 billion. Investment in electricity generation and transmission to meet the increasing demand for electricity in mining and refining of non-ferrous metals will account for the largest share of 58 percent, followed by oil and gas production and processing (15 percent), oil and gas domestic pipeline (14 percent) and oil and gas international trade – including the construction of an LNG import terminal – (12 percent).

Figure 23 Investment Requirements



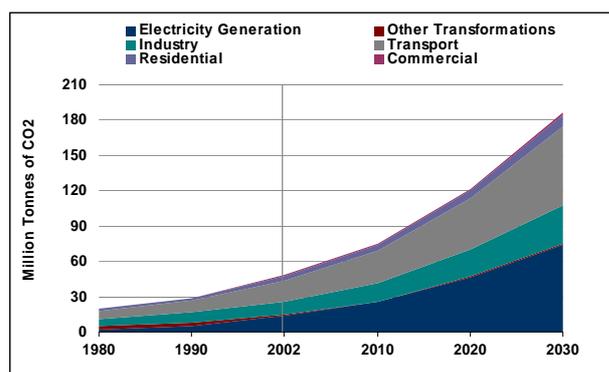
Source: APERC Analysis (2006)

³² This will be achieved over the next decade by the construction of 10 new combined-cycle gas-fired power plants.

CO₂ EMISSIONS

Over the outlook period Chile's total CO₂ emissions from the energy sector are projected to increase from 48 million tonnes of CO₂ in 2002 to 186 million tonnes of CO₂ in 2030. In 2030, emissions from the electricity sector are projected to account for the largest share at 39 percent (74 million tonnes), followed by transportation on 36 percent (67 million tonnes)

Figure 24 CO₂ Emissions by Sector



Source: APERC Analysis (2006)

MAJOR ISSUES

INDEPENDENT OVERSEAS DEVELOPMENT AND DIVERSIFICATION OF SUPPLY

The rate of production for oil and natural gas in Chile has continued to decline over the past decade as existing wells reach economic life and exploration efforts elsewhere within the economy have proven unsuccessful. With rising demand and decline in domestic production, Chile's net oil import dependency is projected to increase from 93 percent in 2002 to 100 percent in 2030.

Recognising the need to augment the depleting reserves and rising energy consumption, the government through the national oil company ENAP (Empresa Nacional del Petroleo) has aggressively undertaken upstream joint exploration and development activities overseas. Sipetrol, ENAP's foreign exploration subsidiary, is responsible for the company's international activities. The company has entered into 15 joint venture agreements over the last 15 years. Operations have extended in various economies around the world such as Argentina, Colombia, Ecuador, Iran and Egypt.

The government of Chile has further moved to diversify supply sources of natural gas in 2004 as a result of supply cuts from Argentina - Chile's predominant supplier of natural gas. This culminated into a plan to construct a 2.7 million tonnes per year capacity LNG receiving terminal. The LNG terminal

is currently under construction and expected to be operational in 2008.

Chile is not only putting investment in overseas upstream projects, but also trying to forge long-term relationships for securing oil supply by strengthening political ties with neighbour economies such as Peru and Bolivia. A plan to build a cross border oil pipeline project between Chile and Peru was earlier proposed, but stopped due to disagreement in the sea demarcation in the borders between Peru and Chile.

FRAGMENTED AND MONOPOLISTIC NATURE OF THE ELECTRICITY SECTOR

Chile's electricity sector consists of four separate power grids, the most important of which is the Central Interconnected System (SIC) which serves 90 percent of Chile's population and more than 40 percent of the economy's land area. SIC installed generation capacity is mostly hydro at around 61 percent while the other areas are mostly thermal. The unbalanced distribution of electricity generation capacity across the economy has become a growing concern, particularly during times of draught, threatening electricity supply from hydro generating plants.

In addition, Endesa (a multinational electricity company based in Spain) is the single largest generator and market power, having almost 50 percent of the generation capacity in the SIC region. The exclusion of smaller generators as members of the Centre for Economic Load and Dispatch Committee (that is, in the SIC region only 7 of the largest generators are represented) raises issues of fair competition, pricing, and rulemaking.

IMPLICATIONS

Although it could be argued that the fragmented nature of Chile's electricity distribution network is based on specific regional needs, geographical distribution of population, and cost limitations of interconnecting the systems, past events have shown the system's vulnerability to changes in weather and fuel supply sources. To stabilise the system and possibly to prevent future electricity supply disruptions, the government may have to look into the possibility of linking the grids. Grid linkages could optimise supply across the network and possibly promote competition within the sub-networks, and subsequently bring down the cost of electricity to the consumers.

On a broader scale, as Chile becomes more dependent on natural gas in the electricity sector, regional integration will become a more pressing point for consideration and gas pipeline and

electricity interconnection networks between the surrounding economies, such as Peru, Bolivia, and Argentina, will greatly enhance the security of energy supply within the region.

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