EXECUTIVE SUMMARY AND KEY RECOMMENDATIONS

Chile's energy sector has four distinctive characteristics. First, unlike many of its South American neighbours, Chile has limited indigenous fossil energy resources. Yet, fossil fuels account for almost 80% of the country's total primary energy supply (TPES). As a result, Chile imports close to 75% of its TPES in the form of oil, gas and coal. In the case of natural gas, this external dependence was concentrated almost exclusively on one supplier – Argentina – until the arrival of liquefied natural gas (LNG) in July 2009.

Second, Chile's unique geography – 4 300 km long and 175 km wide – has given it a varied climate, ranging from the world's driest desert (the Atacama desert) in the north, through a Mediterranean climate in the centre to a snow-prone Alpine climate in the south. Chile's geography has also shaped its electricity systems. The northern system (SING) comprises one-third of total installed capacity and covers an area equivalent to 25% of Chile's continental territory, in which only 6% of the population lives. Large industrial customers, mainly mining companies, account for around 90% of electricity consumption in the SING. The central system (SIC) is the country's main electrical system and provides electricity supply to more than 90% of the country's population of 17 million, including the country's largest consumption centre, the Santiago Metropolitan Region.

A third characteristic of Chile's energy matrix is the distinctive role played by combustible renewables and waste, accounting for 16% of Chile's TPES. Biomass – in the form of firewood mostly used for heating and cooking – accounts for 57% of energy consumption in Chile's residential sector, with potentially adverse health impacts. The market for firewood is largely informal, thus posing particular regulatory and policy challenges. Native forests are now protected by law and the government is planning to enact laws to certify wood production.

Last but not least, Chile's geography has also endowed it with significant renewable energy potential. This potential includes a wide spectrum of renewable energy sources, ranging from mature technologies such as small and large-scale hydropower and biomass, to emerging technologies, such as solar, ocean and wave energy. The Chilean government recognises the significant long-term potential of renewable energy in Chile and has recently adopted a wide-ranging approach, which includes assessment studies, a law

for the development of non-conventional renewable energy (NCRE), specific financial support measures, and research and development activities.

Given these distinctive characteristics, this Review takes a comprehensive look at Chile's energy sector, with a special focus on the institutional framework, energy security, environmental sustainability and energy efficiency, as well as recent developments in sub-sectors such as: fossil fuels, electricity, renewables, biomass, access to energy in rural areas, transport, and energy research and development. Six main themes emerge from the Review.

Successful liberalisation of power sector

The first theme relates to the underlying principles of Chile's energy policy: private initiative, competitive markets and the subsidiary role of the state. For the past 30 years, energy policy in Chile has been founded on the premise that the best way to meet the demand for energy at prices that consumers can afford is: to rely on competition between privately owned entities wherever possible; to regulate where it is not (*i.e.* in the natural monopolies); and to limit the role of the state in entrepreneurial activities. Consistent with this approach was the assumption that competitive markets would deliver an appropriate level of security of supply.

Chile was the first country to institute a comprehensive reform of its electricity sector. It has rightly been hailed as a successful example of electricity market liberalisation, and has been emulated by other countries in the region and elsewhere. In common with many other countries in the early 1980s, the electricity supply industry in Chile was vertically integrated and state-owned. The enactment of the 1982 *General Law of Electric Services* created an unbundled and privately owned sector. The law recognised generation, transmission and distribution as separable activities; introduced a pool-type market in generation and third-party access to the transmission network; and set up a system operator to co-ordinate the operations of competitive generators. The privatisation process began in 1980 and was completed in 1998 when the last state-owned utility, Edelaysen, was sold.

Successes achieved in the electricity sector have been impressive. Growing demand over the past 20 years has been accommodated by a rapid increase in installed capacity, almost entirely financed and built by the private sector. Between 1982 and 2008, the share of households with access to electricity increased from 62% to 98.5% nationwide. Substantial improvements in labour and capital productivity in the sector since 1988 have reduced costs and prices. Distribution margins have fallen in real terms, and technical

energy losses in the country's distribution system fell from 17% in 1988 to 8% in 2007. Aware of these achievements, other countries, beginning with the United Kingdom in the early 1990s, have followed Chile's example.

State plays essential role in energy security

The second theme to emerge is the essential role of the state in guiding the evolution of the energy sector, and in ensuring energy security and emergency response. The electricity sector has faced three periods of significant stress over the past decade. First in 1998/99, as a result of the worst drought in 40 years, which affected the SIC. From 2004 onwards, when natural gas supplies from Argentina, the sole supplier, were increasingly restricted. In 2007/08, the loss of natural gas imports from Argentina was further exacerbated by a drought in the SIC, where hydroelectric production normally accounts for over half of generation.

During the 2007/08 crisis, outages were successfully avoided through a combination of short-term measures. On the supply side, these included: the installation of fast-response emergency diesel-fired generation; the switching from natural gas to diesel oil in electricity generation; the more flexible use of water in reservoirs with inter-annual capacity; and reductions in transmission voltage. On the demand side, a government information campaign urged consumers to save energy; generators provided incentives to their customers to reduce consumption; and consumers reacted distinctly to higher prices. For example, industrial customers switched to back-up diesel generation to avoid having to pay as much as USD 350/MWh for grid-based electricity on the spot market.

In the medium term, the focus is on achieving greater fuel diversity as a means of increasing energy security through: the building of two LNG terminals to substitute for imported Argentine gas; the installation of additional coal-fired capacity; the promotion of NCRE sources; and a greater emphasis on energy efficiency.

Despite the short-term success in avoiding outages, from which other countries can learn valuable lessons, the experience of 2007/08 has shown that security of supply is a basic requirement of a well-functioning energy market. While investment decisions should continue to be made by the private sector, the government needs to take a more proactive position with regard to monitoring energy developments and systematic risk assessment. This could be done by strengthening prospective analysis and long-term scenarios. To this end, it is fundamental that the government continues

to improve the quality of its energy statistics and develops modelling capabilities in the institutions in charge of energy policy.

The Chilean government has recently scaled-up its efforts to reduce and contain energy demand, not just in times of crisis, but as an essential feature of energy policy. The ability of the demand side to participate in the electricity and gas markets; the active promotion of energy efficiency measures; and the development of NCRE sources are all means of doing so without imposing significant costs on the consumer. The Chilean government should be commended for developing an energy efficiency policy portfolio with determination and vision in such a short time. Looking to the future, however, several areas warrant further attention when considered in relation to the broad suite of potential cost-effective energy efficiency policies recommended by the IEA.

Long-term energy policy re-formulation should be completed

The release of the National Energy Commission's *Energy Policy: New Guidelines* in 2008 is an important first step in policy re-formulation. The IEA recommends that the government finalises its new long-term energy policy as soon as possible. In recent years, the National Energy Commission (CNE) has greatly contributed to defining a more comprehensive energy policy, including the sustainable use of biomass, research and development priorities, stronger modelling capabilities, and the creation of a multi-dimensional rural energisation programme, among others. The proposed Ministry of Energy should maintain and expand its focus on these important energy issues, in close collaboration with relevant public agencies and other stakeholders.

Chile's long-term energy policy document should also set clear objectives and indicative targets to facilitate the monitoring of on-going policies and their *ex-post* evaluation. This will inform policy design and implementation in the future, and enhance public accountability. Finally, given the strategic importance of some of the energy projects currently under consideration in the country, including large coal-fired plants, large hydropower projects and the nuclear energy option, the government of Chile should address all the issues at stake in a national public debate with the aim of fostering support for such decisions across the political spectrum.

Reorganisation of institutional framework important step forward

The fourth theme to emerge from the Review is the need to assess the sector's institutional framework. A recent study of the existing structure reveals a number of shortcomings: the difficulty of co-ordinating policies where interests are shared across a number of ministries, commissions and agencies, which is a particular problem in the case of environment and energy policy; a legalistic approach to the regulation of the sector to the detriment of long-term public policies; and the institutional weakness of the CNE in relation to other entities in the sector. Draft legislation is currently before the Chilean Congress seeking to establish a clear separation of functions between policy formulation, technical-economic regulation, and enforcement and oversight in the energy sector. If it is enacted in its current form, it will create a Ministry of Energy and an Energy Efficiency Agency.

The creation of a Ministry of Energy will be a significant step forward and one which the IEA supports. As contemplated in the proposed legislation, the IEA recommends that the proposed Ministry of Energy be given the necessary human and financial resources to enable it to work effectively, with clear lines of authority and co-ordination mechanisms with other ministries and government agencies. At the same time, the CNE should be provided with the necessary resources to ensure the effective and efficient operation of its regulatory functions. It should be able to recruit suitably skilled labour and to take decisions independent of government. The hiring process for the Director of the CNE through the independent system of higher public administration is an important element in this reform.

System operators need greater independence

A similar theme arises with the governance of the system operators in the SING and SIC, the two main interconnected electricity systems in the country. The two system operators were originally controlled by the largest generators and the transmission companies in each system. Recognising the difficulties this could cause for other participants, the law was changed in 2005 to require the board of both system operators to include a representative of large industrial customers. This requirement was implemented by decree in August 2008.

The IEA recommends that the government take further action and consider transforming the two system operators into wholly independent entities. This could be along the lines of the independent system operator model

found in the United States, Canada, Europe and Australia, where the boards of system operators have no financial interest or ties to any company doing business in the wholesale electricity markets they administer. This would ensure that the decisions of the two system operators are impartial and represent the interests of all users, including consumers.

Clearer regulation and incentives for investment must integrate social and environmental costs

A sixth and final theme to come out of the Review is the need for a strong framework of regulation and incentives to ensure that the competitive market internalises environmental and social costs. In common with many countries, Chile faces the difficult challenge of balancing economic growth, energy security and environmental objectives. Increasing concerns about climate change and the possibility of an international post-Kyoto climate agreement make energy and environment policy co-ordination in Chile even more important. Investment in new coal-fired power plants is expanding at a much faster rate than in renewable energy sources. Environmental externalities in Chile are partly internalised in the current environmental regulatory framework. But absolute emission standards for thermoelectric plants do not yet exist.

Chile has recently published a National Action Plan on Climate Change (PANCC). It contains useful analyses and presents a course of action, with accompanying measurable objectives, for the next four years. The government should now consider formulating a national greenhouse gas emissions mitigation strategy with indicative objectives, both nationally and at the sector level, to prepare Chile's economy for a possible post-Kyoto international climate agreement. This would avoid the risk of "locking-in" future CO_2 emissions in the electricity sector. This recommendation also applies to other sectors, such as transport. The application of fully cost-reflective pricing of transport fuels, roads and transport modes will facilitate the transition to a more sustainable energy system.

Key Recommendations

The government of Chile should:

- Continue to pursue diversification in terms of energy sources and suppliers to enhance energy security, in particular the active development of indigenous energy sources such as renewable energy and energy efficiency.
- Finalise Chile's long-term energy policy document by: adopting an integrated approach; setting clear targets and objectives; and building consensus around those objectives through broad public consultation mechanisms.
- Complete the reorganisation of the energy sector, especially the creation of the Ministry of Energy, with clear lines of authority and policy co-ordination.
- Create independent system operators in both the SIC and the SING to ensure that system operation decisions are impartial and take into account the interests of all users and consumers.
- Send clear investment signals to the private sector and create a framework to ensure that long-term investment decisions will be based on long-term cost/benefit analysis, including environmental externalities and the downward cost curve of certain technologies.