

The Chilean Search for Energy Security¹

Nelson Altamirano, Ph.D.²

The explicit objective to maintain the economy growing at high and sustained rates has made Chilean governments to focus on energy supply. However, what seemed to be a technical and economic problem has been transformed into something more general. The uneven distribution of energy domestic resources, the abundance of hydropower energy combined with climate recurrent changes and the lack of hydrocarbon resources had transformed the energy supply problem into an energy security problem. The real dimensions of it have been exposed since Argentina started cutting natural gas exports in 2004, and it is now a governmental priority. President Michelle Bachelet has assumed the challenge of achieving energy security before the end of her term by 2010.

Natural gas is still the best and cheapest alternative and the Chilean government is committed to get the most possible from the declining Argentine production. Argentina has become a non-reliable partner and supplier, but until Chile does not build the necessary LNG infrastructure and hydropower southern plants, Argentina is still a valid partner to sell minimum natural gas quantities. The practical argument, expressed by Chilean government officials, is that some natural gas is better than nothing. The strategic argument to continue negotiating with Argentina is based on Chile's incapacity to get natural gas from Bolivia or Peru due to their historical territorial differences. Argentina is the third party that ensures indirect supply deals with Bolivia and may be the market that justifies any natural gas export from Peru. So, the Chilean government recognizes this strategic game and will try to maintain good relationships with the Argentine government as long as it is a necessary third party.

The natural gas crisis and Argentine's unilateral export cuts were scenarios discussed in 1994 when GasAndes and Transgas were fighting to be the sole natural gas provider to Santiago. Transgas argued at the time that GasAndes did not provide security of supply because it was connected to the Argentine pipeline system (TGN). This system was already showing problems during the winter months in the 1990s, and it was common for Argentine consumers to suffer natural gas shortages during the cold season. In addition, the Argentine natural gas legislation permitted exports but it would only be authorized as long as the domestic supply was not affected. So, the risk that the government of Argentina would cut export levels in the winter was high.³ GasAndes replied at the time that being connected to the Argentine pipeline system reduced rather than increased the

¹ This first draft was prepared for CSIS, March 2007.

² Visiting Scholar at CILAS-UCSD, naltamir@ucsd.edu

³ The Transgas pipeline, in contrast, offered a dedicated pipeline and dedicated reserves: 'with a pipeline destined exclusively for the Chilean market, and long-term supply contracts in place, Argentina would never have the option of diverting supplies away from Chile, even if the gas were needed in Argentina (Natural Gas Across the Andes, Eugenio Figueroa and Birgitta Smith, University of Alberta, 2002, p.103).' It must be said that the production decline of the Neuquen basin is notorious by 2006, so this 'dedicated reserve' would have also collapsed if would be built.

possibility of unilateral export cuts because Chilean gas imports would have access to four natural gas basins instead of just one. Three basins would be in Argentina and one in Bolivia. So, a local pipeline failure or specific basin supply problem would be compensated with the supply of the other basins.⁴ In legal terms, GasAndes argued that decree No. 41/94 of Enargas requires service restrictions to be pro-rated among clients based solely on the use to which the gas is put. Then, in emergency situations, Chilean and Argentinean consumers would be treated equally.⁵ GasAndes thought and sold the idea that the Argentine interconnected pipeline network was reliable and secure.

Ten years later the natural gas crisis underscores the vulnerability of all 7 natural gas pipelines connecting Chile to Argentine gas fields (See Map 1). Argentina started natural gas cuts in April 2004 and since then cuts have fluctuated between 30 % and 50% of contracted volumes with a trend to increase volume and duration of cuts. Last year cuts were complete for two days in August and other two days in November because of technical difficulties and labor strikes. The last major cut lasted eight days last February from the 14th to the 22nd. In the worst two days of this week, the two pipelines in the North, NorAndino and GasAtacama transported 22% and 0% of their transport capacity. GasAndes and Pacifico, the two central pipelines occupied only 7.1% and 1.6% of their respective capacities.⁶ And when exports returned to 'normal' in February 22nd, the northern pipelines got 16% of their combined capacity, GasAndes 52% and Pacifico 7.8%. The three pipelines in the South are entirely dedicated to supply Methanex plants in Tierra del Fuego, El Condor-Posesion and the Patagonia. These pipelines were also working at minimum levels reducing significantly the output level of Methanex.

While residential consumption has not been affected even when Argentine exports were cut entirely, the industrial consumption in the North, Central and South has been continuously disrupted since 2004. Generating firms have been pressing industrial clients to renegotiate their long-term contracts in order to share the increasing costs of using more expensive alternatives, but the process has not been easy. Generators have assumed most of the short term additional costs to satisfy supply contracts with small emergency diesel fueled generators or electricity buys at the spot. However, medium-term solutions

⁴ Ibid, p. 103. By 1994 the export protocol between Argentina and Chile signed in 2001 restricted the export volume up to 5 MMCM/d and only from the Neuquen Basin. GasAndes lobbied successfully in both countries to allow unlimited volume and free basin access. This amendment came in 2005 (Ibid, p.270-275)

⁵ Ibid, p. 104

⁶ NorAndino and GasAtacama in the North have transport capacity of 7.075 MMCM/d and 8.49 MMCM/d respectively. In the worst days of February, GasAtacama received no natural gas at all and its Atacama and Taltal generating units were operating entirely with diesel in February 16, 2007. NorAndino had only received 1.6 MMCM/d or 22% of its full capacity for the same days. The two pipelines in the central region, GasAndes and Pacifico have a transport capacity of 8.773 MMCM/d and 9.622 MMCM/d, respectively, but both could only supply to urban residential and business clients those days. All industrial consumers were shutoff. GasAndes transported only 626 MCM/d and Pacifico 150 MCM/d, or 7.1% and 1.6% of their total transport capacity, respectively.

(http://www.minmineria.cl/pagina.php?seccion_id=190&sub_id=191&cont_id=3482;
http://www.minmineria.cl/pagina.php?seccion_id=190&sub_id=191&cont_id=3477;
www.eoearth.org/article/Energy_profile_of_Chile)

require big investments whose costs generators would like to pass to large consumers through contract re-negotiations. Industrial consumers were reluctant to do it at the beginning, but they have changed after two years of intermittent gas cuts and the fact that diesel prices have increased five times their energy costs⁷. These cost distortions plus the fact that Chilean economic growth is not as robust as two years ago have convinced big clients to renegotiate and find solutions to secure energy supply.

The discussion of the energy problem, the role of natural gas and LNG in the search for energy security needs to be discussed in the context of three big electrical Chilean regions, and how they are connected internally and externally to neighbor countries. In general, the south holds most of the Chilean energy potential, the north has no potential at all, and the center that contains 93% of the population needs to receive energy from somewhere else. Great distances between the South and the North respect to the Center make energy national integration very difficult. Chilean President Aylwin in the early 1990s envisioned that the mining north and the industrial and densely populated center would be supplied by Bolivian and Argentine natural gas fields, respectively.⁸ This 'natural' or 'logical' scenario is still a long-term possibility 20 years later. LNG regasification terminals in the center and the North seem to a key element to solve both energy supply and energy security problems.

This paper is divided in four sections. The first section presents the economic context and the problems of economic growth and energy issues. The second focuses on the regional differences among the three big Chilean regions, the different effects of the natural gas crisis in each one and the possible alternatives, including LNG. The third section discusses the geopolitical aspect of natural gas and LNG terminals in Chile respect to the region. Finally, the last section sketches few preliminary conclusions.

1. General Economic Context: Economic Growth and Energy Implications

The Chilean economy measured by its economic activity index shows a sustained growing trend for the last 10 years. It increased 51% from 1996 to December 2006 (Figure 1: Economic Activity Index). However, there was a mild drop between 1998 and 1999, the exact years of electricity shortages due to the failures in the hydropower-dominated electric system, a period known as the energy crisis. This dive started in April 1998 and lasted until November 1999 when the economy recovered its initial activity index of 110.6. When the bottom was reached in March 1999 it was only two points lower than the starting value (108.1). Since the end of 1999, the Chilean economy has not suffered another drop of two points, not even during the current natural gas crisis.

⁷ The first agreement between generators and industrial clients was signed in August 2006 after a year of arbitration between Colbun and Codelco in the big central region. Codelco will pay \$3.1 million in retroactive power price increase for the period between April 2004 and June 2005. Codelco also agree to pay a new rate of \$55/Mwh instead of the contracted \$40/Mwh until the end of their two contracts in 2011 and 2012 respectively. This new price will certainly affect the price node for industrial clients in the SIC, but it also opens the field for other big clients to renegotiate their own contracts and find long-term solutions ('Chile's Colbun ends arbitration,' Canadian Business and Current Affairs, August 17, 2006).

⁸ 'Natural Gas Pipelines in the Southern Cone,' David Mares in Natural Gas and Geopolitics, ed. David Victor, Amy Jaffe and Mark Hayes, Cambridge University Press, 2006.

Although the Chilean economy is growing steadily since 1999, its pace has its own up-and-down cycles (Figure 2: Economic Index Variation). The short term effects of energy disruptions in 1998-99 and 2004-07 are reflected in the index of monthly economic growth. During the energy crisis the economic growth rates became negative, and the economy entered in a soft recession that lasted 19 months. This adverse effect on economic growth rates is not present during the natural gas crisis of 2004-07, there is only a slow down of economic growth. The first Argentine natural gas cut stopped a very strong upward trend that had started in November 2001. The trend started with growth rates of 1.6% and reached its highest level of 6.7% in July 2004, two months after the first natural gas cut.⁹ After this peak, growth rates went down to the 4%-5% bracket, with the lowest rate in Feb 2006 (4.6%) and a recovery trend since then.

The effects of electricity shortages have medium term effects on the economy too. This effect appears in the accumulated growth rate index (Figure 2: Economic Index Variation). As we can notice in Figure 2, immediate changes in monthly growth rates are transferred to the accumulated growth index with a 12 to 14 month lag. So, the highest or lowest points of these two series are more or less a year apart. Therefore, given that monthly growth rates were going up at the end of 2006, we expect this positive trend to continue through the rest of 2007, and we expect the Chilean economy to grow above 5% per year during 2007.

In summary, we can say that the energy crisis of 1998-99 caused or triggered a mild economic recession, and the natural gas crisis of 2004-07 triggered a mild slowdown of economic growth rates from levels above 6% to 5% per year.

The energy crisis of 1998-99 was expected in the sense that the Chilean government and the private sector were already embarked in natural gas projects since 1996. But, it had a negative economic impact because 'La Niña' produced one of the worst droughts in recent history just months before Argentine natural gas arrived finally to Santiago in mid 1998. It is worthwhile to notice that La Niña started in July 1998 and lasted until February 2001, but the economic crisis ended before in 2000. So, the natural gas flow from Argentina became a key element to reboot economic activity while the drought effects of El Niño were still present in Chile.

The natural gas cuts since April 2004 were unexpected, and although there is no effect on the total economy yet, there is the risk that another 'La Niña' may hit the country again in 2007-08. The US National Weather Service confirmed La Niña was winding up again at the end of 2005 and early 2006, and given previous patterns, it raised alarm for a 2-year drought. So far, La Niña's low water temperatures only lasted the first 2 months of 2006. High temperatures, El Niño, developed since the end of the year and continued until February 2007. Heavy rain will still affect the central tropical Pacific during March 2007,

⁹ Monthly annualized rates. In other words, these numbers reflect what would be the annual growth rate if the variation from the previous month would be repeated 12 months.

but neutral temperatures are predicted from March to May 2007.¹⁰ So, nature seems to be aligned with the Chilean government and private investors this time.

The government and the private sector do not want nature to arrive first again, and would like to see La Niña to happen after the end of 2008 and mid 2009 when LNG, diesel and coal alternatives would be in place. Otherwise, La Niña and its drought effect, if severe, may repeat its negative economic effect again. So far, the perspective looks good until May 2007, but there are no climate predictions beyond this short-term window. If La Niña appears in the second semester of 2007 and continues through 2008, it may create another 2-year drought that could not be counter balanced with LNG, coal or diesel alternatives that should be in place by 2008-09.¹¹

Energy Imports

Energy imports reached a new plateau after Argentine natural gas solved the energy crisis of the 1990s and, it is going up again to a new level with the current natural gas crisis. The first plateau was reached when energy imports doubled from \$1.4 billion in 1998 to \$2.9 billion in 2000, the years of the energy crisis and its aftermath. Then, energy imports remained more or less below \$3 billion for the next three years. This plateau was surpassed when strong economic growth rates triggered a new import surge in 2003. Energy imports broke the \$3.1 billion barrier for the first time that year, and continued its raising trend by the combined effects of economic growth and the natural gas crisis.¹² Both forces have pushed up the value of energy imports from \$3.1 billion in 2003 to \$8.1 in 2006 (Figure 3: Oil and Other Related Imports). A new plateau has not been reached yet because the gas crisis is still unresolved and energy international prices remain unstable.

The energy crisis of the late 1990s and the current gas crisis have forced the Chilean economy to devote relatively more resources to import this key intermediate product. The share of energy imports respect to total imports doubled from 8.1% to 16.8% during the energy crisis at the end of the 1990s, and it reached 23% in 2006 during the current gas crisis (Figure 4: Share of Oil Imports in Total Imports). More significantly, energy imports are higher than total consumption imports and total capital imports since 2004

¹⁰ La Niña is defined as water temperature below –5 degree C, and El Niño as temperature above 5 degree C. La Niña is correlated with drought in Chile and El Niño with rain. La Niña lasted from August 1998 to Feb 2001 producing the energy crisis of 1998-99 in Chile. El Niño appeared from May 2002 to March 2003 and from July 2004 to February 2005. These high ocean temperatures provoked enough rain to fill up water reservoirs at record levels in Chile. During 2006 both climatic events did not last long. La Niña was present from Dec 2005 to Feb 2006 and El Niño from Sep to Feb 2007. There have been heavy rains in the tropical regions of Bolivia, Argentina, Paraguay and Brazil. The forecast are neutral temperatures from March to May 2007 (www.cpc.noaa.gov/products/analysis_monitoring/ensostuff/ensoyears.shtml, and www.cpc.noaa.gov/products/analysis_monitoring/enso_advisory/ensodisc.pdf. Both accessed 3/2/2007)

¹¹ The abundant water reserves accumulated throughout 2004 and 2005 ensured enough hydroelectric power generation during 2006 (Business Latin America, March 20, 2006, The Economist Intelligence Unit). Given current El Niño conditions, these reserves will stay there and secure electric hydropower generation through out 2007. So, the uncertain time would be 2008 and 2009.

¹² The Argentine government unilaterally cut natural gas exports to Chile for the first time in April 2004. Since then, cuts have and will continue for the next years.

and 2006 respectively. Energy has become the single most important item in Chilean imports since the gas crisis started in 2004.

This increasing dependency on foreign energy resources has also consequences on the economic export Chilean model. The most important export industries like copper, fishmeal, and pine and eucalyptus chips are very energy intensive and their expansions depend on energy availability. So it is crucial for them to secure stable external sources of energy at reasonable prices. There are some export industries whose international prices have not followed the spike of oil prices and face strong international competition. This is the case of wine, food and fresh fruits. Increasing Chilean energy costs cannot be transferred to international prices without losing some market share. So, export firms are interested in finding a secure and cheap energy alternative to the Argentine natural gas in the short run. However, in the medium term, export firms have to introduce energy efficient processes to continue increasing output export.

Energy Security and Diversification

Both crises have increased, rather than reduced, the Chilean energy dependency on foreign energy resources in an attempt to reduce the risk of energy shortages. This increased international dependency has economic and political implications for energy security, and have implications beyond the specific energy sector or energy policies themselves. As General Oscar Izurieta, the head of the Chilean army, said “Chile is at a crucial moment and must resolve its political-strategic position [...] with respect to both its internal capacity and the level of dependency on foreign countries that Chile is obliged to sustain.”¹³

One lesson from both the energy and the natural gas crises is that diversification is not simple if the objective is energy security. The costs of the energy crisis in 1998-99 were high as more or less predicted in 1994 when justifying the construction of natural gas pipelines. Given the patterns of El Niño and La Niña, it was rational to reduce the risk of depending only on hydropower by importing Argentine natural gas. It turned out the combination of hydropower and natural gas was certainly more diversified, but it was not enough to provide energy security because the provision of natural gas was not diversified. The risk depending on a single natural gas supplier was also predicted and publicly discussed when two competing pipeline projects were battling to win the construction of the Santiago-Neuquen pipeline in 1994.¹⁴ Then, a useful diversification that provides energy security at reasonable risk levels has to include different energy alternatives as well as different locations.

¹³ He also mentioned that Chile’s lack of energy resources creates a relationship of interdependence on security issues with Argentina, Bolivia and Peru in which the individual actions of these actors affect the others directly. He suggested a solution to Chilean problems would be making suppliers responsible for cuts, so far the costs falls entirely on the consumer country. Latin America News Digest, Nov 21, 2006.

¹⁴ Natural Gas Across the Andes, Eugenio Figueroa and Birgitta Smith, University of Alberta, 2002.

Energy security is one of the three challenges President Michelle Bachelet has identified at the beginning of her presidency.¹⁵ To achieve it, the ministry of mining and energy, Karen Poniachik has developed an initiative with 3 main axes: diversification of the energy matrix, development of renewable energy alternatives, and encouragement of energy efficiency.¹⁶ The plan rules out the development of nuclear energy during the current administration, but the government has formed a study group to evaluate this long-term possibility in February 2007.¹⁷

The policies designed to achieve the challenge of energy security imply to reverse some of the previous policies. In the 1990s the emphasis was not only on incentives for combined cycle plants fueled with Argentine natural gas, but also on disincentives for all other alternatives. The 1999 Electricity Law eliminated *force majeure* limits on contractual obligations for electricity supply without a compensating revision in the electricity tariffs formula to offset the increased contractual risk.¹⁸ This measure secured Lagos' reelection but investors started an investment strike to force the government to change it. The government introduced a revision of Article 99 to limit statutory compensation to final users in October 2003, but it did not make a U-turn until a new Electricity Law was approved in 2004. Clearly the natural gas crisis influenced this outcome. There are new rules on generation and transmission charges and the size of the unregulated market has been increased significantly because large consumers are now above 500 kw rather than 2000 kw. All these changes satisfy generation investors, and they are committed to support the government's energy investment plan.

There is no other better document than the 2005-2012 electricity investment plan to show the radical change in the concept of energy security and diversification. CNE announced this plan in March 2004, just two weeks before the Argentine natural gas cut. It called for an increase of 4500 MW in new generation for the SIC based mainly in Argentine natural gas resources.¹⁹ Seven new gas-fired combined-cycle plants would take 59% of it, two transmission lines connecting the SIC and the Argentine grid would count for 14% of it, and finally a transmission line linking the SING to the SIC would make another 13%. In total, 86% of the expansion was based on Argentina's natural gas. The new plan calls for 5263 MW in new generation avoiding entirely Argentina's natural gas. It includes coal-based generating capacity (38 %), LNG-fired plants (36.2%), hydroelectricity (15.2%), geothermal plants (5.7%) and combined-cycle that would work also on diesel fuel (4.9%).²⁰ The new plan certainly avoids Argentina's natural gas and gives a little more

¹⁵ The other two challenges to sustain economic growth are the improvement of the education system and the reform of the privatized pension system (Source: The Economist, March 2006).

¹⁶ The minister ratified this policy in a meeting with environmentalists on March 6, 2007 (www.minmineria.cl/pagina.php?seccion_id=190&sub_id=191&cont_id=3497, accessed 3/7/07)

¹⁷ President Bachelet asked the Ministry of Mining and Energy for a plan to think about nuclear energy in September 2006. Then, Minister Poniachik suggested the creation of a study group of national scientists in February 2007. The 11-member study group should evaluate technical, economic and environmental aspects to produce electricity with nuclear reactors. They will present a first report in September 2007 (www.minmineria.cl/pagina.php?seccion_id=190&sub_id=191&cont_id=3488)

¹⁸ Country Profile, Chile 2006, The Economist Intelligence Unit.

¹⁹ It is interesting to notice that this investment plan proves CNE and the Chilean government were not expecting natural gas cuts from Argentina. How they could miss Argentina's demand and supply figures?

²⁰ Country Profile, Chile 2006, The Economist Intelligence Unit.

role to domestic energy sources. The former expansion was based on 86% of imported natural gas, and the new on 80% of LNG, coal and diesel fuel. It is more diversified but consolidates the Chilean dependence on energy imports.

Reserves and Energy Security

Domestic energy resources can be the foundations of a secure energy matrix for any country if the country has enough natural reserves and governments apply appropriate policies to develop them. In the case of Chile, energy natural resources are unevenly distributed and explicit governmental policies have to be designed to ensure the development of a secure energy matrix.

Chile is rich in hydropower potential for the south and central regions but poor in coal, oil and natural gas deposits. Chilean coal reserves are estimated in 1300 short tons located in the central region of Lota/Coronel and southern Tierra del Fuego. Consumption was 5.7 million tons in 2004 but domestic production was only 0.4 million tons. Proven crude oil reserves are estimated in 150 million barrels by January 2006, small compared to domestic market and all located in the Southern Magallanes region. In 2006, crude oil consumption reached 238,000 b/d but domestic production was only 15,000 b/d. Crude oil imports come from Argentina, Brazil, Angola and Nigeria. Natural gas proven reserves are also located in the Magallanes region and add up to 3.5 TCF.²¹ ENAP has explored other parts of the country with unsuccessful results. So, even the current efforts to attract foreign investment are focusing on the most southern regions.

Hydropower has been the traditional column of the Chilean electrical sector, and it will be the main element of the ambitious governmental plan to double electricity generation from 12,000 MW to 24,000 MW by 2018 or 2020. Droughts due to climate recurrent events have made previous governments in Brazil and Chile to introduce natural gas in the 1990s. Brazil secured natural gas from Bolivia and Chile from Argentina. But after the recent frustrating experience with Argentina, the Chilean government is looking at hydropower again. It still has the lowest cost per kwh produced, and the government claims rainfall rates in some parts of the southern region are stable.

II. The Natural Gas Crisis and Electricity Systems per Region

The Big Southern Region and Its Multiple Energy Alternatives

The Chilean energy resources are massively located in the Southern region, including hydro, geothermal and wind power, as well as, natural gas and oil resources. It is, however, a remote area of difficult access that it is practically isolated from the rest of the country. It is more than 2000 km south of the great urban and industrial center of Santiago. Because of these characteristics, the southern region is a pristine area of great ecological value. So, the development of energy industries in the region is controversial to say the least.

²¹ www.eoearth.org/article/Energy_profile_of_Chile#Coal, accessed 3/3/07

Hydrocarbon, petrochemical, eucalyptus chips and hydropower generation are the main industries in the south. ENAP, Methanex and Endesa-Chile are the largest firms.

Methanex, a Canadian firm, operates the world's largest methane plant in the world and it has been severely affected by the Argentina natural gas cuts since 2004. The three pipelines from Argentina in the south, all supply Methanex plants.²² During 2005 it has produced at 53% of its daily capacity due to lack of natural gas, and during 2006 the Argentina tax increase at midyear disrupted long-term contracts between the firm and its natural gas suppliers.²³ The suppliers are contractually obligated to pay for any export tax, but given that the tax increase is almost as much as the price that suppliers are receiving from Methanex, suppliers were seeking ways to renegotiate their contracts.²⁴

Last year ENAP discovered natural gas and oil fields in the Magallanes region that are commercially viable. In April president Bachelet announced the discovery, and two months later Enrique Davila, ENAP's president, announced that drilling in Lago Mercedes confirmed the presence of continuous flows of gas and oil.²⁵ Based with this information ENAP will evaluate the field's total reserves. The initial plan is to build a 400 km gas pipeline from Punta Arenas to Puerto Natales, and this might supply gas to the rest of the country.²⁶ It is more likely, however, that the southern region would become natural gas self sufficient to guarantee the supply for the intensive export industries in the region.

As an attempt to further increase the hydrocarbon potential of the Southern region the government along with ENAP have started a campaign to attract foreign investors into the Southern region. The reserves will be divided in 10 blocks and given for open auction by March or April 2007. ENAP will reserve 3 blocks to form joint ventures, and the remainder 7 will be 100 % private ventures.

Even before the government designed its plan to attract foreign investment, the private sector already asked its involvement. Layne Energia Chile SA will explore for unconventional natural gas resources and asked the Chilean ministry of mining and energy for a Special Operation Contract.²⁷ Layne's partners are Layne Christensen Company (US drilling service firm) and Raymapu SA (local firm of mining drilling and water services owned by Geotec Boyles Bros) asked They want to explore for coalbed

²² The three plants are in Tierra del Fuego, El Condor-Poseion and the Patagonia. Nova, the Canadian shareholder of GasAndes, also participates in these ventures. In fact, its involvement here was used to convince the Chilean government in 1995 that Nova was also interested in regional development and not only the Santiago market (Figueroa and Schmidt, 2002).

²³ The total capacity was 10500 tones per day, but during 2005 Methanex produced only 5600 tones per day. The firm thought there was enough natural gas in southern Argentina and Chile to satisfy its gas contracts, but natural gas deliveries did not return to normal since 2004. As a consequence, Methanex shares went down (Canadian News, June 20, 2005).

²⁴ Global Power Report, The McGraw-Hill Companies, July 31, 2006.

²⁵ 'Chile says viable oil, gas fields found in South,' Platts Oilgram News, June 29, 2006.

²⁶ 'Argentina hikes prices on gas imported to Chile, Chile says Argentine actions are frustrating,' Notisur, August 18, 2006.

²⁷ Press not in the Ministry of Mining and Energy, accessed 3/7/07

http://www.minmineria.cl/pagina.php?seccion_id=190&sub_id=191&cont_id=3165

methane gas and further development in 250,000 hectares on the Arauco peninsula, in the BioBio region. Layne's Energy division claims the Arauco basin presents conditions comparable to the Cherokee basin in the US, where they have drilled more than 400 wells.²⁸

So, the hydrocarbon potential is still uncertain in Chile's southern region, but the government does not rule out its objective of becoming self sufficient, and if this does not come from hydrocarbons, it may come from the permanent and stable hydropower potential of the Aysen region.

Endesa-Chile and Colbun, the two largest generators and the government want to develop the hydropower potential of the southern region to serve the Central region where 93% of the Chilean population resides. Both firms want to launch the ambitious Aysen project that includes 4 large hydropower plants in the Patagonia with 2430 MW combined capacity. The estimated cost would be \$3 billion and may be operative by 2012-2018. The government justifies the project because hydroelectricity from Aysen is cheap, clean and reliable, especially if we consider that Aysen has Chile's highest levels of rainfall and does not suffer the effects of La Nina.

The Aysen hydroelectric project, 2000 km south of Santiago, has detractors and supporters. Environmentalists claim the project requires the construction of dams in the Baker and Pascua rivers. Some 10,000 hectares of pristine wilderness would be flooded, wetlands would be destroyed, and endangered species would disappear. Sara Larrain, director of Chile Sustainable, argues the Aysen project is not a sustainable in-depth solution to the country's energy needs because it does not diversify the Chilean energy matrix. On the contrary, it will suppress the development of wind energy that just started few years ago. The first wind park was installed in Aysen with 3 windmills generating a combined 660 KW each. A sustainable path, she continues, would be the construction of 2 or 3 fueled coal plants, with latest technology, in the short run, and the beginning of a long-term energy saving plan.²⁹

Government officials, on the other hand, have expressed its support to the Aysen project. The minister of Energy, Karen Ponichik argued that Chile cannot afford the luxury of not using its own energy resources. She contrasted the environmental cost on local communities in the Aysen region with the environmental, social and political costs of Chile not having energy. Given this support and insecurities of natural gas supplies from neighboring countries, Endesa's chief executive, Rafael Mateo is confident the project will go ahead with proper environmental impact treatment, and that construction would not begin until 2008.³⁰

²⁸ Layne Christensen Company expertise is on drilling. Layne Energy Inc has ample experience in the Cherokee basin drilling for coalbed methane, and Layne Christensen Mineral Division has substantial experience drilling for copper in Chile and other minerals in South America (www.laynechristensen.com).

²⁹ 'Chile, energy options drowned by push for hydropower-activists,' IPS-International Press Service, April 26, 2006.

³⁰ Environmental opposition in the past opposed Endesa's Ralco hydroelectric plant. This is the largest plant in the country and it suffered setbacks. Environmental groups may setback Endesa again and delay

The Big Central Region (SIC) and LNG Demand

The Sistema Integrado del Centro (SIC) serves 93% of the Chilean population. It is the largest Chilean market with 3.9 million clients served by 20 generating firms, 31 distribution firms and 1 transmission firm. Contrary to the SIGN, industrial consumers represent only 40% of total clients, so 60% of the market functions with prices regulated by CEN (Comision Nacional de Energia). The generating capacity is 8288 MW, 69% of national capacity and there is no excess capacity (Table 1: Characteristics of Electricity Generation in Chile, 2006). For these reasons the Big Central region receives the most attention from Chilean governments.

Two natural gas pipelines, GasAndes and Pacifico connect the Argentine Neuquen basin with Santiago-Valparaiso and Concepcion, respectively. Both take natural gas primarily from the Loma La Lata field and cuts had adversely affected industrial consumers. As we mention in the introduction, households did not suffered natural gas restrictions in the large urban areas. The effect on them has been on higher prices.

As we mention in section I, the Chilean government has reluctantly accepted to pass some of the higher Argentine prices to small clients during 1996. Domestic prices went up 12%. This policy change respect to previous administrations complement the new orientation to attract alternative investments into the big central region. The combination of natural gas disruptions and policy investments has originated a positive investment reaction based on diesel, coal, LNG and hydropower alternatives.

The generators short term reaction has been to replace natural gas with diesel, and some projects based originally solely on natural gas has been postponed or modified to accept dual feed. Colbun and Endesa continued with their plans to finish their massive 250 MW and 370 MW natural gas combined cycle plants to be finished by 2007 or 2008. Their secure clients are mining firms in Candelaria and the industries in the big Santiago around San Isidro, respectively. Both generators have secured their natural gas supply through the LNG terminal in Quinteros, as we will discuss later.

Other natural gas projects have been postponed during 2005. This is the case of AES Gener's 740 MW Totihue combined cycle plant that has not only faced future higher natural gas prices but also local opposition. Southern Cross revived the Campanario 120 MW combined cycle plant abandoned by local gas distributor Innergy in 2004. Southern Cross solution has been to adopt natural gas and diesel feed alternatives simultaneously (dual feed system), and already started construction in April 2006.

Short term answers have also included coal options. There are only two coal fueled plants in the SIC, both owned and operated by AES. Ventanas and Guacolda have received environmental approval for capacity expansion in the levels of 250 MW and 200 MW respectively in 2006. These expansions increase in more than half their current capacities

the start of the Aysen project (Source: 'Planet source: Chile energy options drowned by push for hydropower-activists,' IPS-International Press Service, April 26, 2006

and are done in spite of their environmental impact in the big Santiago region. It must be noted that the new coal investments in the Northern region has been massive respect to this increment in the central region. Suez, Endesa, and BHP Billiton are committed to add 400 MW, 350 MW and 300 MW respectively. given the size of the SIC capacity

Industries, like ENAP's refineries can not replace entirely natural gas with other alternative. There is already a high level of investment in distribution, combined-cycle plants and industrial processes related to natural gas. So, LNG is the most direct alternative to the decrease of natural gas from Argentina. Assuming that 200 MMCF/d will be in line since 2009, the unsatisfied demand opens a potential window supply that increases from 400 MMCF/d by 2009 to 1.2 TCF/d by 2018.

Assuming that electricity demand will grow at 7% per year, LNG will enter SIC's energy matrix in 2009 with 15% of total electricity. The next year its share will go up to 20% and it is expected that it will be 22% by 2015. These shares imply 13 MMCM/d of LNG, and if Argentina suspends entirely its natural gas supply, LNG would go up to 20 MMCM/d.³¹

ENAP led the process to build an LNG terminal at the Quinteros Bay. BG won the project and it is expected the first phase to be ready by the end of 2008. The second phase may be ready by the end of 2009. The estimated total cost would be \$400 million, and partners are Enap, BG group, MetroGas, and Endesa. Colbun and Chilectra denied participation because they considered the price would not be competitive.

Natural Gas and the Copper Belt in the Big North

The world copper center lies in Chile's northern desert and Andean Mountains. World largest copper mines like Chuquicamata and Escondida and all big copper mines are energy intensive. Diesel engines move the huge mining trucks and general transportation system, and electricity is the key input in extraction and refining processes. Contrary to the southern part of Chile, the north does not have hydropower potential, coal resources or hydrocarbon fields. So, the energy needs of the copper industry and the rest of the northern economy depend entirely on coal, fuel oil, diesel and natural gas imported to the region.

Two gas pipelines and one transmission line were all built simultaneously at the end of the 1990s with the result of overcapacity and low prices in the North. GasAtacama and NorAndino should transport 5 MMCM/d per contract to serve the SING. The SIGN's 3500 MW total installed capacity exceeds in 40% the peak demand, and 1400 MW depend entirely on Argentine natural gas. This huge overcapacity contrast with the big central region, and opens the possibility that a connecting line between the SIC and SIGN would resolve energy shortages in the center. But the distance that separates both systems

³¹ Mario Del Rio, Coordinador Ejecutivo, Project LNG-ENAP. 'Importaciones de GLN a Chile', Power point presentation Mexico, September 2006.

is too big to make such a line economically viable.³² Furthermore, the Argentine export cuts have practically reduced the overcapacity to zero because 40% of the system depends on it, and exports volumes of 1 MMCM/d have been only 20% of the amount contracted in 1998. Generators have tested plant dual-fuel capabilities for short-term solutions, and are considering coal and LNG alternatives for the medium and longer term alternatives.

In the short term generators and mining firms have replaced natural gas with diesel. The introduction of diesel in gas-fired generators is not free of cost, and generators have been asking mining firms to share costs. Mining firms were reluctant initially, but by the end of 2005 they agreed on sharing the costs of testing diesel instead of natural gas. The largest investment involving diesel will be done by Electroandina in the form of \$10 million for a diesel terminal in the Bay of Mejillones.

Medium term solutions include coal, an alternative that was left aside because of environmental issues. Before natural gas was introduced to the north, many plants were fueled by coal, petcoke and heavy oil. In 2001 two coal fired plants in Mejillones were working at 35% and 47.5% of capacity due to pollution constraints.³³ Coal was left for emergency situations like the natural gas crisis, and since 2004 have recovered some market share. Some firms are even incorporating coal in their medium term plans. Electroandina will invest \$440 million in a 400 MW coal-fired generator to be operative in 2009. BHP Billiton presented a plan to CONAMA to build two 250 MW each coal-fired plants in Mejillones to be operative by 2010.³⁴

Long-term solutions in the North are looking for LNG alternatives, and so far there are two competing projects. Suez and GasAtacama decided to join forces in November 2006, resign to their early independent initiatives and avoid the mistake of building parallel pipelines in the late 1990s. The second LNG terminal would come from Codelco that was encouraged by the Chilean government to develop its own alternative last September.

The Suez-GasAtacama LNG terminal includes two phases. The fast-track phase will be operational by the end of 2008 and will consist of an offloading dock and an onshore regasification plant that will inject natural gas into the northern system. The LNG carrier will act as a storage tank until the project builds an onshore LNG storage tank in the final phase by 2010. Both phases cost more or less the same, and total cost was estimated between \$300 and \$350 million.³⁵

³² Chile Country Report, 2006, Economic Intelligence Unit.

³³ Presentation of Pica project by COGC.

http://www.caloilandgas.com/resources/chile_presentation.pdf. Accessed 2/27/07

³⁴ 'BHP Billiton plans 500 MW coal station to power copper mines,' Latin American Weekly Report, Intelligence Research Ltda., August 1, 2006.

³⁵ Complete information about the agreement can be read at www.suezenergyint.com/content/newsroom/pressreleases/20061106SUEZandGASATACAMA_en.pdf

The government is using Codelco to build an LNG terminal in the North. The objective is to replace the Argentine natural gas and diesel currently used in electricity generation in the SING and secure energy for Regions I and II. The LNG terminal would be similar to ENAP-BG's LNG terminal in Quinteros for the SIC. Codelco's directory has already committed \$5.2 million to create a consortium with other mining firms and to advance the LNG terminal project.³⁶ BHP Billiton, Santa Ines de Collahuasi and Phelps Dodge have joined the consortium.³⁷

It is too early to decide if one or both LNG terminals will be built, but one seems to be a bluff. The Suez-GasAtacama leads the race and has the technical and business experience. Suez owns and operates two LNG terminals in the US and Tractebel, one of its subsidiaries have built 50 LNG terminals. The owners of GasAtacama, Endesa and CMS also have LNG experience. Endesa is participating in the Quintero LNG terminal, and CMS Energy was the owner of the largest LNG regasification terminal in Lake Charles (US). On the other hand, Codelco, BHP Billiton, Phelps Dodge and Santa Ines de Collahuasi are huge mining firms with no LNG know-how. I would say that their interest is to get the lowest price possible and to make sure an LNG terminal will be built in the North. The government itself is interested in creating competition because the minister of mining and energy Karen Poniachik has said that only one terminal will be built in the North. I think, the Codelco consortium is a bluff until they incorporate an experienced LNG partner in the consortium.

The Argentina natural gas shortages have also reopen opportunities for natural gas exploration in the Tamarugal Basin. This basin is located in the Chilean Atacama desert (Region 1) and extends into Bolivia and Peru. During the 1980s ENAP confirmed the geological potential of the region, but major oil firms preferred to evaluate prospects in Argentina and Peru. At that time, due to its location on the west side of the Andes, many companies believed the Tamarugal Basin was a fore-arc basin. During 1996 and 2001 more studies were done at an estimated cost of \$4.1 million. These studies include seismic, gravity, magnetic and satellite data, as well as geochemical, petrological, palynological, and computer-generated basin evaluation studies. All these results are accessible, and show that the Tamarugal Basin geological characteristics are similar to the prolific Neuquen Basin of Argentina. In fact, DeGlover and MacNaughton Canada Limited evaluated this information for March Resources, and are very optimistic about the basin's gas potential. The report estimates unrisks gross prospective gas resource from 86 BCF to 1.5 TCF, and a best estimate of 655 BCF of recoverable gas.³⁸ March Resources Corp and California Oil & Gas Corp are betting to find a rich gas field like Loma La Lata in Argentina's Neuquen basin (4.38 TCF), or Camisea in Peru (13 BCF) or Margarita in Bolivia (23BCF).

³⁶ Santiago, 23 de enero 2007,

www.minmineria.cl/pagina.php?seccion_id=190&sub_id=191&cont_id=3458

³⁷ BNAméricas, August 26, 2006. http://www.rigzone.com/news/article.asp?a_id=35464

³⁸ *ibid*

The alliance between March and COGP is a calculated risk partnership. March received approval from the Ministry of Mining and Energy (supreme decrees) for exclusive oil and gas exploration and development rights in February 7, 2007. The lease is for the next 35 years over 2 blocks, Pica North and Pica South, extended over 2.5 million acres.³⁹ In order to reduce risks and get technological know-how, March signed a letter of understanding with COGP in September 2006. They would jointly start an exploration program on the Pica North block.⁴⁰ COGP committed to develop 2 wells to casing point in exchange of 50% interest in the blocks. However, well costs will be divided among the partners. March will cover \$1 million per well and COGC will fund the remaining well cost to casing point. If they are successful, they could provide the closest and less expensive natural gas to the energy hungry 565 mines and cities north of Antofagasta.

This project does not compete with the markets, more or less, secured by GasAtacama, and NorAndino gas pipelines, or the clients for the InterAndes transmission line. All these three projects connect and serve the areas of Antofagasta and Tocopilla, or Region II. The Pica project, if successful, would serve 3 different markets. The first is the mine market in the Calama region for electric generation through a 210 km-long pipeline oriented south. The expected price would be around \$4.5 and \$7.2 MMBTUD. The second market would be the mines 50 to 70 km northeast at an expected price of \$4.5 to \$5.4 MMBTUD. The third market would be for electric generation in the city of Iquique, 90 Km northwest at a price between \$4.5 and \$5.4 MMBTUD.⁴¹

III. Geopolitics and Potential Imports of Natural Gas from South America

It is clear that energy security has diplomatic and geopolitical implications. The head of the Chilean army, General Oscar Izurieta, understands ‘the impact of Chile’s lack of energy creates a relationship of interdependence on security issues with Argentina, Bolivia and Peru, in which the individual actions of these actors affect the others in a direct fashion.’

Argentina has lost its capacity to continue being the main natural gas supplier of the Chilean economy for economic and political reasons. Argentina governmental domestic policies have conflicted with new investments necessary to keep natural gas production and reserves at the level of its recovered economic activity, and there is no willingness to reverse these policies. The Argentine government is embarked in patchy policies like export taxes, export cuts and short-term import agreements from Bolivia that solve temporarily its own domestic natural gas shortages, but that in no way will solve the long run problem of sustained natural gas exports to Chile. In the 1990s oil and gas reserves

³⁹ March Resources Corp is waiting for the Special Operations Contracts which are valid for 35 years and detail the work commitments for the North and South Pica blocks (California Oil & Gas Corporation’s web site, accessed in Feb 27, 2007)

⁴⁰ Intelligence Research Ltd, Latin News Daily, September 13, 2006.

⁴¹ The original data is \$5 to \$8 /MCFD for the Calama market, and \$5 to \$6 for the other two markets (http://www.caloilandgas.com/resources/chile_presentation.pdf, accessed 2/27/07). I transformed these values using the equivalence 1 MCFD = 1.11 MMBTUD.

were supposed to sustain consumption levels for 13 and 35 years respectively. By the end of 2005, these numbers went down to 8 years for both products, and the Kichner administration continues without changing its policies.⁴² Chile knows that the only discussion is how soon Argentina will become a net hydrocarbon importer, and the only option for Chile is to get independent as soon as 2008.

International policies and attitudes have also contributed for Chile to look for non-Argentina's energy supplies. Argentina is the most sued in the world under the Bilateral Investment Treaty, and its behavior with Chile has not been different.⁴³ It continuously discriminate Chilean from Argentinean consumers against its own distribution laws, and repeatedly fails to follow bilateral protocol agreements. The most recent had been the Bachelet-Kichner agreement reached a week before the Argentine government increased 46% export taxes in July 2006. Chilean President Bachelet thought the agreement for the tax increase would only cover the bill for the increased price of Bolivian gas sent to Argentina and passed to Chile. But, the Argentina government ended up generating additional revenue to subsidize Argentina consumers too.⁴⁴ The reaction of President Bachelet has been diplomatically hard, but never confrontational. In a letter to Kichner she expressed her disappointment and that 'it will be necessary to do a lot of work to regain confidence and strategic relations.'⁴⁵

The previous reasons eliminate Argentina from being a direct energy partner. However, given Chile's historical differences with Bolivia and Peru, Argentina is still a strategic partner. It is the valuable indirect partner to access natural gas resources from Bolivia and/or Peru. Argentina has been importing natural gas from Bolivia in order to export intermittently its own natural gas to Chile, and it has also been thought as the market that would justify a gas pipeline from Peru to Chile.

The 19th century Pacific War that landlocked Bolivia and the last political events since 2003 separates both countries deeply and prevents common sense to be applicable to natural gas commercial deals. Given Chile's lack of natural gas, the Argentine impossibility to continue exporting 23 MMCM/d, the location of Bolivian gas deposits and its need to find new customers, direct natural gas exports to Chile would have been an easy commercial deal with enormous benefits for both countries.⁴⁶ However, Chile needs Argentina to cut the deal and find an indirect route.

The triangulation itself has not been easy and full of declarative animosities among these three governments. There is an agreement signed by the governments of Bolivia and Argentina to avoid re-export Bolivian natural gas to Chile through Argentina. The wording, however, focuses on the physical flow of natural gas to pacify Bolivian popular

⁴² 'Argentina faces problem of dwindling gas, oil reserves,' Financial Times, September 17, 2006.

⁴³ Latin American Economy and Business, June 20, 2006.

⁴⁴ Minister De Vido said that to avoid inflation in Argentina, the government will jack up the price of the 10 MMCM/d of gas exports to Chile by more than the increase in the price of Bolivian gas. He implied the difference will be used to subsidize Argentine users of Bolivian gas.

⁴⁵ Latin America News Digest, November 16, 2006.

⁴⁶ David Mares, in Natural Gas and Geopolitics, Ed. David Victor, Amy Jaffe and Mark Hayes, Cambridge University Press, 2006, pp. 169-201.

movements, and not on the real economic flow. President Kichner explicitly recognized this flow and wanted to include president Bachelet in the price negotiations of the Bolivian gas exports during 1996.⁴⁷ Evo Morales halted negotiations because of Kichner's declarations, opposed to negotiate with Bachelet too, but at the end he continued negotiations and got a favorable 56% price increase up to \$5 per MMBTU. Chile was not included in the bilateral negotiations, but president Bachelet accepted the new high prices. She negotiated with president Kichner to 'pay a higher price only for the natural gas imported by Argentina from Bolivia, and not for natural gas produced in Argentina.'⁴⁸

IV. Preliminary Conclusion

Energy security requires Chile to diversify both energy sources and energy suppliers domestically and abroad.

Hydro, natural gas, LNG, coal, diesel, wind, biofuels and even nuclear are all resources included in the energy security strategy. However, direct electricity imports from Argentina, Bolivia or Peru, as the presidents of the latter countries have proposed recently, are not part of the strategy for energy security.

Hydropower is the best alternative to satisfy the increasing energy demand, and it could also bring stability to the system if the Aysen hydropower potential is incorporated in the current energy matrix. However, system stability comes from all other alternatives.

Natural gas is the best option to provide system stability. It is the best in terms of price and environmental air pollution. The government and private investors have not ruled out the alternative of finding big natural gas deposits in the South and the North.

LNG is the alternative that gives supplier diversification to the natural gas component of the strategy. In this sense, could be even used to transport domestic natural gas found in the extreme South to the Central and Northern regions.

LNG terminals in the Central and North regions will be the price referents for South America. Prices will reflect international costs and the larger the market the better price. LNG will also attract natural gas to the Chilean market from neighbor countries.

Once LNG terminals are in place, Argentina will continue being a strategic partner to access indirectly Bolivian natural gas 'molecules.' Any bilateral agreement and

⁴⁷ The phrasing says that 'not even a molecule' of Bolivian natural gas should be sent to Chile. This wording guaranteed the Bolivian popular movement would not fire against President Carlos Meza and break the export deal. Kichner's declarations about re-exporting Bolivian gas did not make president Morales to cut exports, but Morales opposed to include Bachelet in the gas price negotiations.

⁴⁸ The other two agreements reached by both presidents in Cordova (July 2006) were the price increases would not be passed to home consumers, and that the supply to homes and business is secured. The final Argentine resolution released one week later did not reflected exactly these three conditions, and created more distance between both governments. In terms of the price paid by Argentina to Bolivia, Source: US Fed News, July 28, 2006.

investment between Argentina and Bolivia to increase the volume of current Bolivian natural gas favor Chile. In addition, the current natural gas pipelines that connect Argentina and Chile may be used in the opposite direction to allow Argentina to receive international natural gas.

Tables

Table 1: Characteristics of Electricity Generation in Chile, 2006

	SIC	SING	South System
Regions	9	2	Aysen and Magallanes
Population	93%		
Generating Capacity	8288 MW	3596 MW	
Peak Demand			
Overcapacity	0 %	66%	
Clients (million)	3.9	0.23	
Generating Firms	20	6	
Transmission Firms	1	1	
Distribution Firms	31	3	
Largest Generators	Enersis (Endesa)	Electroandina (Tractebel, Codelco)	
Hydropower	60.5%	0%	
Natural Gas	24%	40%	
Coal, oil and other	12%	60%	

Source: Country Report, EIU, 2006

Maps

Map 1: Chilean Pipelines (Source: Decio Odone, Petrobras, 2006)



Figures

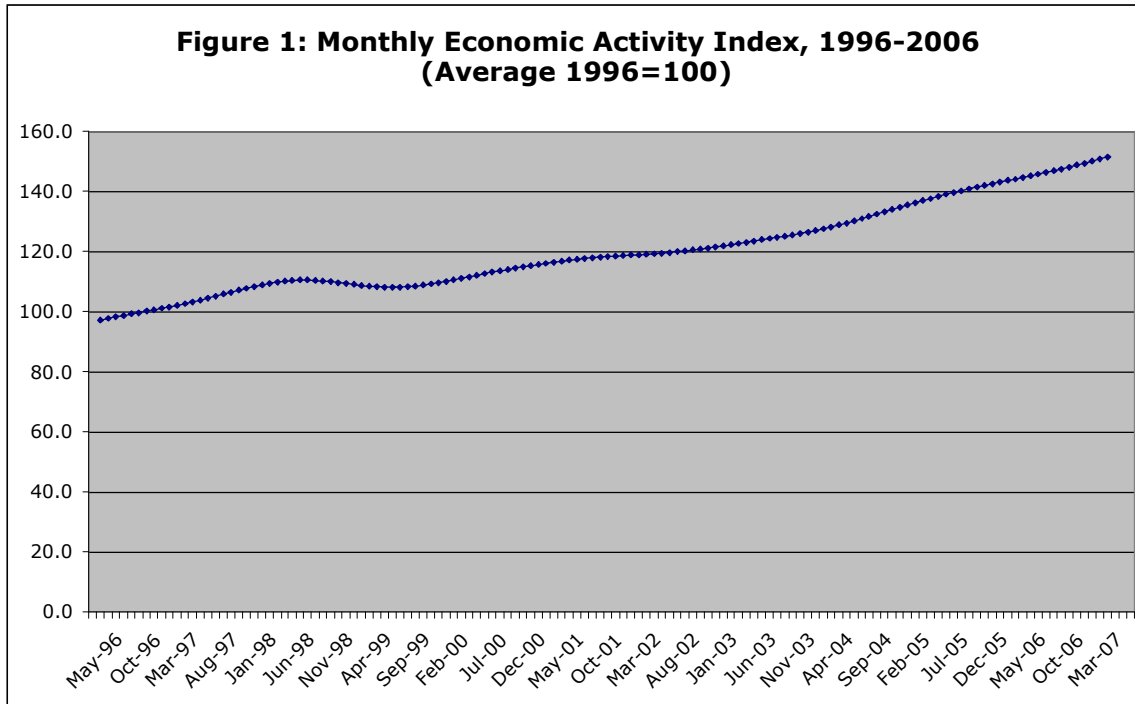
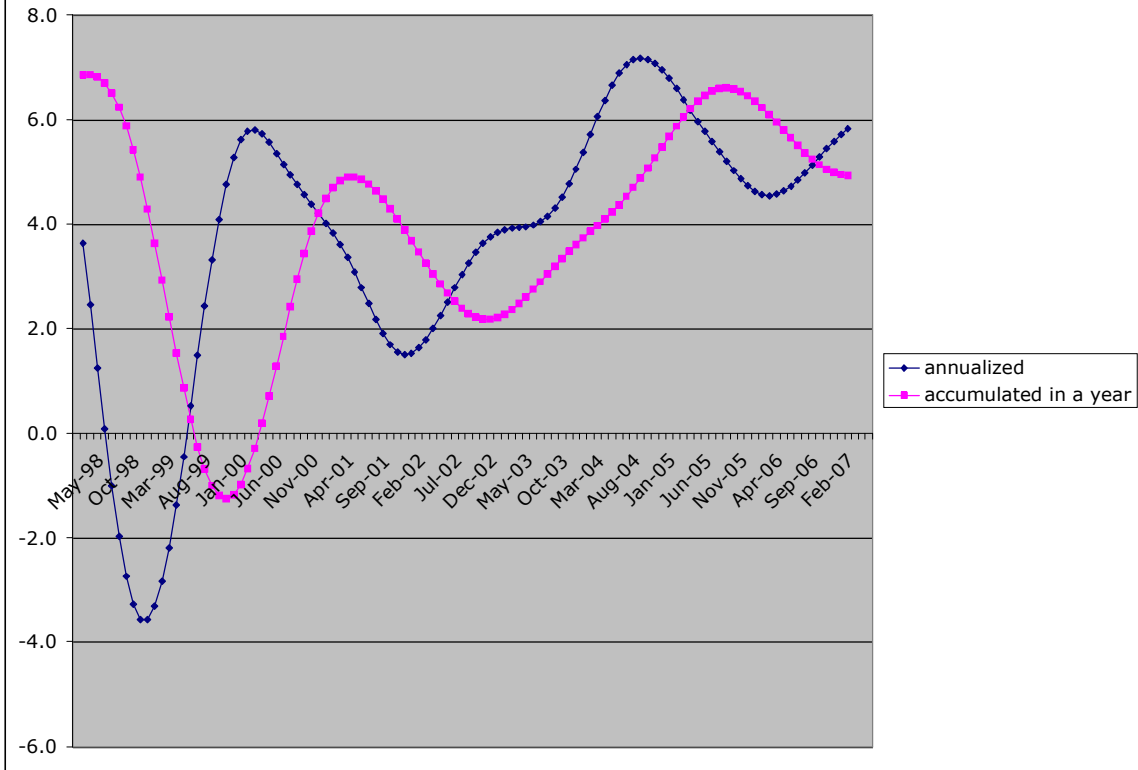


Figure 2: Economic Activity Index Variation, 1998-2007 (%)



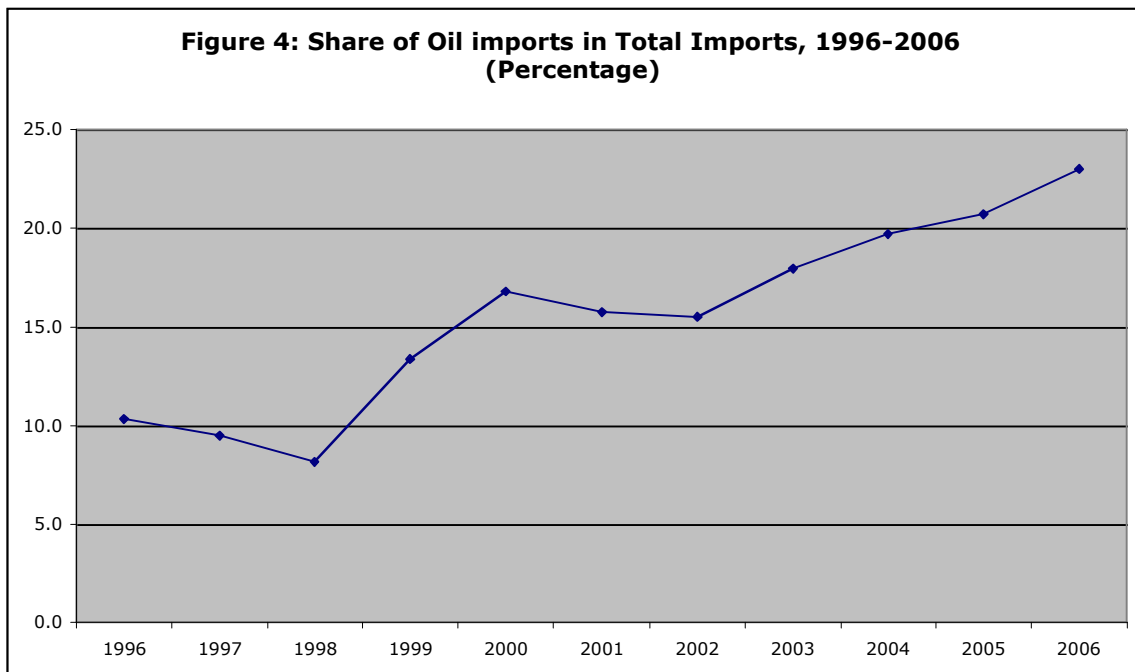
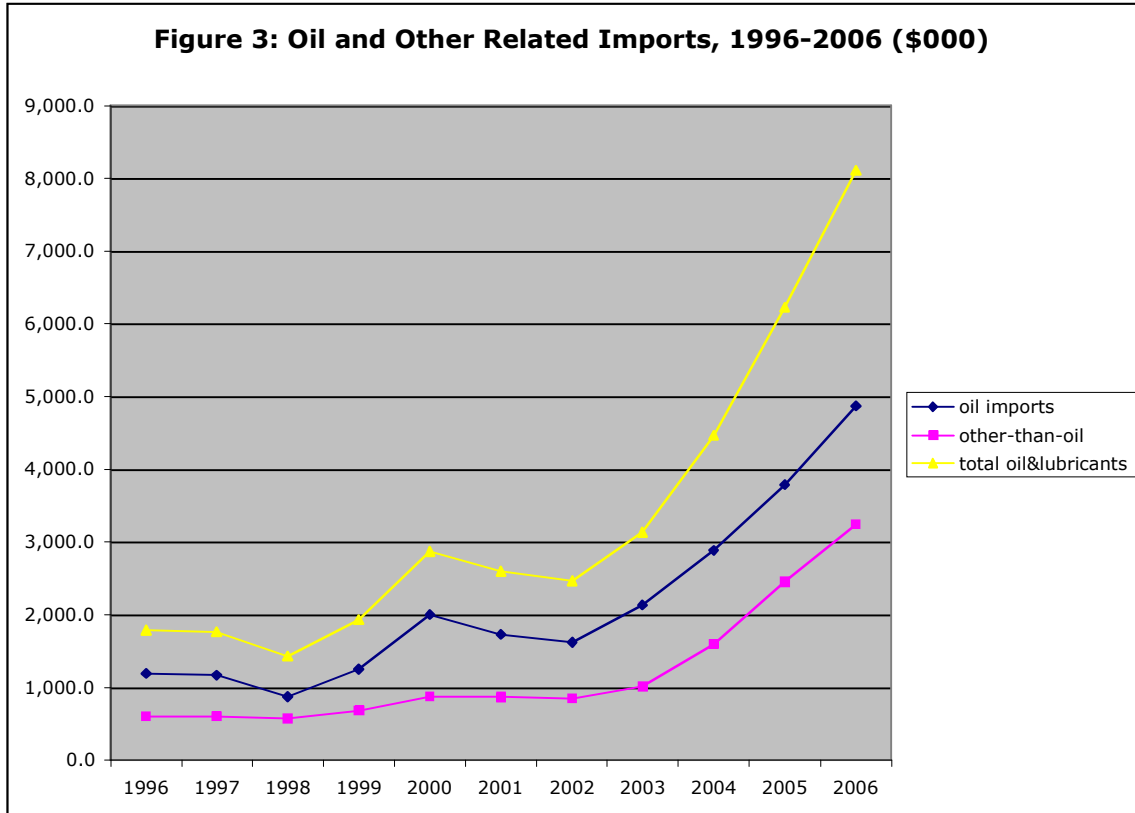


Figure 7: Chilean LNG Potential

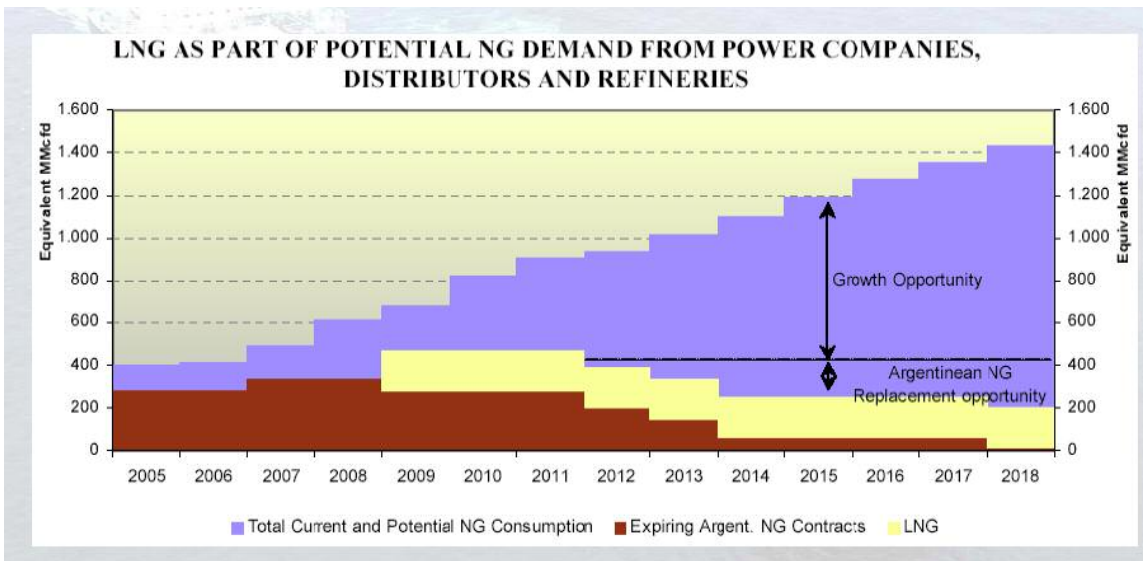


Figure 8: SIC's Energy Matrix

