Risk Responsibility for Supply in Deregulated Electricity Markets- The Chilean Case

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Abstract-- The presentation will review the supply problems faced in the Chilean electricity market over recent years, and how market and regulations have worked in relation to allocating the responsibility for supply. The risks associated with that responsibility will be discussed and how Chile has taken actions in this regard, and the consequences of those actions. The Chilean regulation transfers full responsibility to suppliers. In theory, different types of penalties and compensations are applied when load is not supplied, in practice they have been difficult to apply. The presentation will analyze the performance of this approach, the crisis faced in 1998-1999 and the changes introduced to the regulation due to that crisis. Conclusions on the effectiveness of the regulations and the changes will be developed as well as an assessment of unexpected impacts in the market.

Index Terms--Power sector deregulation, electric market, supply reliability, risk allocation.

I. INTRODUCTION

Throughout the world, the power industry is in the midst of important changes in the structure of its markets and their regulation. The primary trend of this restructuring is to promote competition, mainly in the generation sector, liberalizing those markets and allowing access to private agents. In this manner, the traditional large state owned vertically integrated companies are being segmented and different legal organizations are created to try to regulate the operation of these new competitive generation markets. Chile was a pioneer country in Latin America and the world to make these regulatory changes in 1982. Several other Latin American countries followed close after.

With no paradigm to rely on, the regulatory changes had to innovate to cope with unforeseen problems, often choosing solutions that did not prove to work well in major system crisis. This was painfully true when supply crisis were faced, either because of impacts of nature (major droughts for example) or failures of equipment. This was the case of Chile, where the restructuring process worked well, minor problems faced, until; a severe centennial drought hit the country in 1998-1999. A severe supply disruption took place with rolling blackouts, conflicts among electricity companies and with the regulator, and a significant social and economic impact on society, which led the country to hurried emergency changes to the electricity law.

II. THE CHILEAN MARKET

There are two interconnected power systems in Chile, one of which, the Central Interconnected System (SIC), which supplies over 93% of the country population, is the source of this analysis. The system corresponds to a longitudinal network with 500 and 220 kV lines, and an installed capacity of 6,737 MW in 2002, 60.2% of which is hydro. Annual energy consumption in that system was around 26,000 GWh in 2002.

A condition that may makes Latin American markets, and the Chilean one, very volatile is the predominance of hydroelectricity generation. In a rainy year such as 1972-1973 or 1992-1993 nearly all the energy requirements in the SIC can be supplied with hydro generation. However, during an extreme drought such as those of 1968-69 or 1998-99, hydro generation cannot supply more than 40% of annual consumption [6]. In an average year, about 80% of annual consumption can be supplied with hydro generation.

In those conditions, the impact of an adequate reservoir usage on system security cannot be over emphasized. A system with a large fraction of hydropower is subject to constant changes in supply and costs and to periods of very tight capacity (i.e. during droughts), so that the regulatory design needs to deal explicitly with this issue.

III. THE REGULATION

The Chilean regulation aims at providing price signals to agents, so that they not only are interested in continuously invest to supply an increasing demand, but also, take provisions to face equipment failures (that may affect thermal plants) or droughts (that may leave a hydro plant with enough capacity, but without energy to supply).

A) Energy and Capacity prices

First, there are energy and capacity price signals. Consumers pay the two components. Regulated consumers; those under 2 MW, pay projected energy generation spot prices (nodal prices), calculated every six months by the regulator, and pay regulated capacity payments (based on the annual cost of installing a new diesel fuel gas turbine generation facility). Consumers over 2 MW directly negotiate energy and capacity prices with the suppliers, but the regulated prices are a strong reference.

One element of the regulation that aims at providing economic signals for new installed capacity, fundamental in markets with significant growth and highly subject to supply

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shocks (e.g. droughts), is the capacity payment. While in theory energy spot prices provide the right incentives for new investments, several market analysts argue that in electricity markets such energy price signals are insufficient and can lead to under investment [12]. In that regard, most of the actual Latin American regulations, including the Chilean one, contain a provision to prevent that from happening: the so-called capacity payments. It often remunerates investment in generation by its contribution to peak capacity, independent of its energy contribution. It must be pointed out that besides the regulated prices, there exists the energy spot price, for exchanges among generators, and the non-regulated prices, freely negotiated between suppliers and consumers over 2 MW.

B) Compensation payments

Second, the regulation contemplates the payment of compensations to consumers, when the contracted supply is not available. Deficit generators (those that do not have enough energy available to supply their contracts) have to pay compensations at much higher prices than typical production costs (the non supply or outage cost, determined by the regulator) [2,3]. The aim of the regulation is that, in supply crisis, those deficit generators will look for supply alternatives, so that they do not have to pay those compensations.

However, the regulation also defined exceptional conditions where those compensations were exempted. A prolonged drought, that was not in the 40-year statistics used by the regulator to calculate regulated prices, would be such a “force majeure” condition. This was defined in article “99 bis” of the regulation.

Compensations have to be paid through the distribution companies to the regulated consumers. The calculation of the nodal prices, in theory, incorporates an insurance payment for the 40-year hydrology scenario used by the regulator.

C) Contracts

Financial bilateral contracts are an important element in the Chilean market, and also contribute to share the responsibility in the supply. Given the high price volatility that may take place in the hydro system, generators have tended to extensively contract to face the income variability, hydro generators in particular. In the short term the volatility of the income is small, since water can be stored transferring energy from off peak hours to peak hours, but that is not the case in the long term. Thus, contracts become a valuable tool to stabilize revenues. The more capacity contracted the less the impact of spot prices on generator revenues.

Through contracts, at least in theory, supply is ensured and generators will take actions to comply with them.

IV. THE CRISIS

A severe centennial drought started to hit the country in 1998, caused by the La Niña phenomenon. The April 1998- March 1999 hydrological year was worse than the previous recorded worse draught (1968-1969). Flows to the main reservoir, Lake Laja, were 65% of those of a normal year and 35% less than those of 1968-69 [7, 10].

This extreme condition worsened because a new natural gas combined cycle, Nehuenco, with 370 MW, that was supposed to start operation in April 1998, was repeatedly postponed until December 1998. It then had in March a major failure that left it out throughout the entire crisis.

Although there was enough installed capacity in the country, there was no hydro energy to make the plants work. Figure 1 illustrates the dramatic reduction of energy storage in the main system reservoir, Lake Laja.

![Figure 1: Evolution of the Laja reservoir level](image)

Figure 2: Evolution of the Laja reservoir level

A severe supply disruption took place with rolling blackouts. Electricity supply in Santiago was curtailed three hours a day, when over 450 GWh were not available for supply, with a significant social and economic impact on society.

Severe conflicts developed among electricity companies and with the regulator, accusations crossed all parties, including the government.

There has been much discussion on the causes of the crisis [4-12], and different arguments have been used, depending on who is expressing them, either thermal generators or hydro ones.

There was a total failure of the price system. It was not sufficient to neither cope with the crisis nor provide the right economic signals for agents to contribute to solve it. Prices to final consumers were totally immune to the crisis; nodal prices continued to reduce, as the effect of the arrival of natural gas to the country from Argentina implied the building of several combined cycle plants, which projected price reductions in normal conditions into the future. Nodal prices reduced almost 40% from 1993 to 1998, and continued its decline (see figure 1). While short-term marginal costs increased up to the cost on non-served energy, regulated consumers—which account for more than 60% of electricity consumption in the SIC—were making consumption decisions based on a long-term marginal cost of production, completely isolated from the true marginal production cost at the moment. This uncoupling between supply shortage and forced demand inelasticity in practice meant a failure of the price system.
When there are energy shortages, the spot price of energy becomes the cost on non-served energy (non-supply or outage cost), a value several times that of normal generation costs. As an example, in October 2002 the non-supply cost, as determined by the regulator, was 12.4 times that of the regular energy cost. The non-supply value, according to the regulation, was to be used for exchanges among generators, giving deficit generators (essentially hydro ones) an incentive to reduce their deficit. Nevertheless, the deficit generators questioned that interpretation of the regulation since the first failure to supply in November 1998. The regulator had the power to intervene, by speedily interpreting the regulation, one way or another, but it took long months to finally take a decision, which was to use the non-supply cost for the spot price.

The contract scheme and the compensation scheme did not work either. Generators failing to supply regulated consumers, through distribution companies, argued that because the drought was not in the statistics, it became a “force majeure”. The “insurance premium” paid did not cover that risk. Thus, without compensations, deficit generators did not have any incentives in looking for supply alternatives.

Although generating companies had potential alternatives to cope with the crisis if the right prices had been in place [10], the lack of correct price signals, including compensation fees, slowed action, worsening impact on the companies themselves and the country as a whole.

V. SOLUTIONS TO THE CRISIS

The crisis demonstrated, dramatically, the difficulties of the political class to face emergency conditions in energy supply. Although the regulator had legal tools to manage the crisis by bringing spot prices closer to marginal costs, ill thought solutions were taken to ensure supply and protect quality and security.

Instead of revising the price system with the intention to make it more flexible [9], a change of the law was hastened through the congress in June 1999, dramatically changing the 99 bis article. It eliminated droughts from the “force majeure” conditions. Any generator, contracting at nodal prices with a distribution company that supplies final consumers, has to supply them, irrespective of the severity of an eventual drought. That puts total risk responsibility on the generators, if they contract with distribution companies.

The Superintendence of Electricity and Gas was given stronger powers to deal with crisis, and to impose higher penalty fees to agents that did not comply.

The hasty solution of changing the 99 bis article created new problems that later weakened the contract system, leaving distribution companies with no support to ensure future electricity provision. Contracts with distribution companies at the nodal price, transferred all risk to the generators, which started having second thoughts about contracting with them. Several years later, problems to sign contracts continue. There is one distribution company whose contracts finished and it has not been able to sign new ones. As distributors cannot buy in the spot market, they are left with limited alternatives. In theory, non-contracted distribution companies had to be disconnected from the system. The regulator intervened, and decreed that they must be supplied, irrespective if they had no contracts or not. While this was a short-term solution that kept the lights on, it is out of the regulatory framework and at the end did not solve the problem. Investment came to a halt in the system, only contracts with large consumers, out of the nodal price and full compensation scheme, were attractive to investors. Contracts with distribution companies were thought to be too risky, because of the full compensation scheme.

Four years after the crisis, the country is still looking for new regulations that will reduce the risk of non supply, and bring investment back into the country.

VI. CONCLUSIONS

The crisis faced in the main Chilean power market in 1998-1999, and the changes introduced to the regulation due to that crisis, illustrate the difficulties faced when trying to assign supply responsibility through economic signals and regulator intervention in a complex market. The effectiveness of the Chilean regulation, that in many ways was a reference regionally, was questionable, and new alternatives are still been searched, as of this writing, to ensure system expansion and quality and security of supply.

VII. REFERENCES


VIII. BIOGRAPHY

Hugh Rudnick, (F'00) received the B.Sc. degree from the University of Chile, Santiago, and received the M.Sc. and Ph.D. degrees from Victoria University, Manchester, U.K. Currently, is Professor of Electrical Engineering at Catholic University of Chile, Santiago. His research and teaching activities focus on the economic operation, planning, and regulation of electric power systems. He has been a consultant with utilities and regulators in Argentina, Bolivia, Central America, Chile, Colombia, Peru, Venezuela, the United Nations, and the World Bank, mainly on the design of deregulation schemes and transmission and distribution open-access tariffs.