A Regulatory Framework for Cross-Border Electricity Markets

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Overview

A growing concern in South America is the need to regulate the exchange of electricity among countries. The experience of other regions shows that interconnections among neighboring electricity grids have a positive impact as it provides energy security at lower costs and helps diversifying the energy matrix of each country. In the case of Chile, the interconnection with neighbors should allow all market participants to have access to the commercialization of energy with countries in the region, assuming that the treatment of exchanges be non-discriminatory, and that the operation of the Chilean electricity system maintains its current levels of efficiency, economy and security.

An efficient regulation that makes the operation and commercialization of energy more flexible inside and outside the country allows not only to optimize the short-term operation of the generation park but also to increase the total benefit of the electricity sector, thereby contributing to the increase in the well-being of the society.

In this context, this paper proposes a regulatory model for the import and export of energy from the "surplus" available for exchange.

The empirical analysis of the regulatory proposal, based on simulations, shows that the exchange of energy from Chile with its neighboring countries is feasible in a clear and transparent manner, reducing the marginal costs of energy and the total cost of operation, keeping the average cost of generation more stable in the system.

Methods

In this paper, the authors use simulation techniques to evaluate the potential energy exchange between Chile and its neighboring countries, based on actual data from the operation of the electrical system. In particular, the scenario of importing energy from Peru and exporting energy to Argentina is first simulated separately, and finally the joint case of import and export simultaneously.

Each scenario includes simulations and analysis of the treatment of the economic pre-dispatch and the dispatch during the actual operation; remuneration of the transmission systems by the exported and imported energy; management of congestion rents or tariff revenues produced in the interconnection lines; and treatment of energy transit between countries as a result of the existence of large interconnected networks (markets).

Results

Simulations of imports from Peru consider that Chile has a low generation cost during the day due to the high penetration of solar energy, while Peru has a low energy costs at all times, since its energy matrix is based on natural gas and from run-of-river hydroelectric plants. Therefore, the import of energy from Peru would occur in two time slots: from 0:00 a.m. to 8:00 a.m. and from 5:00 p.m. to 11:59 p.m. A first positive effect of energy imports from Peru is that it allows Chile to substitute the participation of power plants or engines based on diesel, thereby improving environmental pollution indicators. Additionally, the results of the simulation show that the

daily operating costs decrease from 1.8 to 1.64 million dollars, corresponding to an operation that is 8.9% less expensive, and the average hourly cost of the system decreases from an average of 34.8 USD/MWh to an average of 31.7 USD/MWh, which implies a decrease of 8.7%. In relation to the average daily marginal cost of the system, the imports under the proposed regulatory framework would allow a 43.8% decrease with respect to the case without importation, basically due to the substitution of high cost generation during the hours when there is no contribution from the generation of non-conventional renewable energies (NCRE). Finally, the simulations show that the import of energy from Peru would generate an Annual Total Benefit of the order of 10.37 million dollars, of which 5.2 million dollars are for Chile and the rest for Peru. This order of magnitude is not negligible, since it is equivalent to 10% of the annual value of transmission toll proceeds of the Great North Interconnected System (SING) to 2016.

The simulations of energy exports to Argentina consider that Chile has low production costs during the day hours due to the high penetration of solar energy, while Argentina has a high energy cost during that same time due to the high local demand and the need to dispatch diesel units to satisfy it. For that reason, the exports of energy to Argentina would have the most significant effect between 8:00 and 17:00. The results of the simulations show that the daily operating cost in Chile would increase 3% from 1.80 to 1.86 million dollars, and the average generation cost would increase 0.7%, from 34.8 USD/MWh to 35 USD/MWh. The average daily marginal cost of the system would increase by 2.6% with respect to the current scenario without export. However, the export of energy to Argentina would generate an Annual Total Benefit of the order of 16.82 million dollars per year, of which 8.4 million correspond to a benefit for Chile. Again, this order of magnitude is relevant, since it is equivalent to 16% of the annual value of transmission toll proceeds of the SING to the year 2016.

Finally, in the case of importing from Peru and exporting to Argentina, under the same conditions and schedules of the two separate scenarios, the results of the simulation show that daily operating costs decrease from 1.80 to 1.68 million dollars, 6.8% lower than the current case without any exchange. The average hourly generation cost would decrease 9% from 34.8 USD/MWh to 31.6 USD/MWh, and the average daily marginal cost of the system would fall by 42%. The results show that in the scenario of export and import of energy with neighboring countries, under the proposed regulatory framework, the Annual Total Benefit is around 40.6 million dollars, of which 20 million dollars correspond to the benefit for Chile.

Conclusions

Currently, sectorial regulation in most countries in South America do not consider the existence of regional electricity markets, nor the possibility of exchanges with neighboring countries, either through mechanisms to optimize available resources in the short term or through long-term supply contracts.

The lack of a regulatory framework for the treatment of imports and exports of electricity prevents the integration of large electricity grids and is a growing concern in South America. In particular, in the absence of regulation, it is impossible to estimate the economic benefits for the countries that operate interconnected, since there is regulatory uncertainty regarding the revenues and costs associated with the joint operation of the electricity systems. This results in a lack of regulatory stability that would provide the framework for the construction of tie transmission lines.

In this context, this paper presents a proposal for the treatment of short-term electricity exchanges between countries. The results of simulations show that this regulatory proposal is not only feasible but also that it would reduce the marginal costs of energy and the total cost of operating the system without reducing the average cost of electricity generation.