An SD Model to Support Strategic Bidding in the Colombian Electricity Market

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Abstract

This paper discusses some important elements that need to be taken into account when a major electricity producer prepares its offers to the market (electricity pool) within a system dominated by a large hydroelectric component. In this case two important sets of variables need to be considered. On the one hand, those related to medium-term issues such as whether forecasts as well as company's yield, goals and budgets; and, on the other hand, short term issues such as demand, plant availability, the competitors position and whether forecasts. Here variables differ significantly from those consider in a thermoelectric-based set up, where demand forecasts are of utmost importance as fuels maybe almost always ready available at a price (medium-term contracts tend to supply cheaper fuels than those obtained at spot market prices).

In a hydroelectricity system, when plants are located in cascade, as it is often the case in Colombia, the bidding process turns to be even more complex. In this particular case the electricity generator may benefit from a combination of decision science tools, human insight and experience to assess both the likely system evolution and the appropriate bidding into the market. For these purposes, procedures need to be design and tools need to be developed. Specifically, SD modelling is proposed here to support the strategic-bidding process, whereas other tools maybe considered for more operational issues such as day-ahead bidding, which include hourly quantities and prices for each plant. In this paper we provide a general causal-loop diagram and initial simulation results.

1 The Colombian Electricity Market

The Colombia power market has been very dynamic since it was re-structured in 1994. There are now over 20 generation utilities, seven of which account for about 90% of the system net capacity. Although the supply industry is heavily hydroelectric-based (about 75%), it is rapidly moving towards a more important thermo and micro-hydroelectric component. More than 30% of the total capacity is privately owned today yet new gas-fuelled private plants are being built in the Caribbean and the Central and Southwest regions of the country. Dyner and Garcia (1995) and Dyner and Bunn (1997) provide a more thorough description of the Colombian energy system.

The Colombian "pool" (a one day ahead electricity market) is up to now delivering relatively low prices. However, it has not been under stress because of the large margin between

capacity and demand, due to well above average wet conditions in the country during the last two years. Competition is now under way and the incumbent companies do not feel as comfortable as in the past (although revenues are now much higher due to constant increases in the electricity tariffs being charged to the regulated customers). In this new environment, strategic issues are becoming a common place and the need for tools to evaluate these seem to be in greater demand. In other context Bunn et al (1997) explored some of the alternatives available to improve the revenues of generators and used SD to evaluate their viability. In this paper we examine the role of SD tools to support strategic bidding in the Colombian electricity market.

2 Towards an SD model (platform) to support strategic bidding

In this new heavily competitive set up, strategic players seem to have a better chance of success. It is apparent that analysis and strategic tools maybe required and that SD may provide support to this end.

Strategic bidding in the Colombian electricity market ought to consider a large number of variables. On the one hand, those related to medium-term issues such as whether forecasts (hydrology) as well as company's yield, goals and budgets; and, on the other hand, short term issues such as demand, plant availability (both hydro and thermo), the competitors position and whether forecasts. Strategies will lead to bidding and contracting schemes, as well as maintenance practices. These and other relationships can be appreciated in Figure 1.
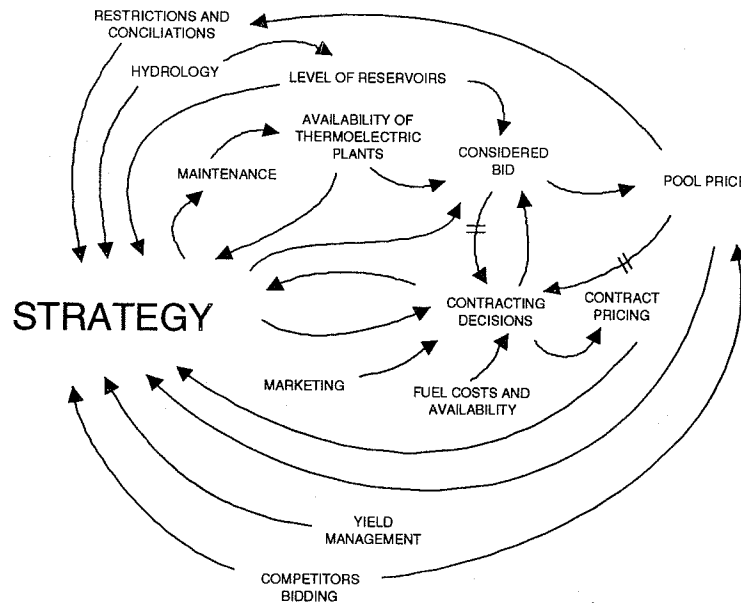

Figure 1 Dynamics of Strategic bidding.

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Statistical analysis of historical data may indicate which strategies may have been used by generators in the past, but this analysis is of little help to investigate alternatives which they may want to execute in the near future. In this case, simulation exercises are useful since feedback effects take place in some of the most important processes involved in the Colombian electricity system.

For example, a bidding strategy needs to consider the amount of water available for generation everyday, including the incoming water and that which is dispatched, otherwise it may not be feasible for implementation or alternatively it may lead to inconclusive and misleading results.

For these reasons, an SD model which contains some of the elements of Figure 1 was developed to support strategic bidding in the Colombian electricity market. A number of strategies have been explored and some interesting results have emerged.

3 Typical results

Figures 2 and 3 show typical simulation results of the effect of bidding strategies on the water level of some of the reservoirs in Colombia. The reader can observed that the strategy in Figure 3 is not sustainable since the water level decreases steadily.
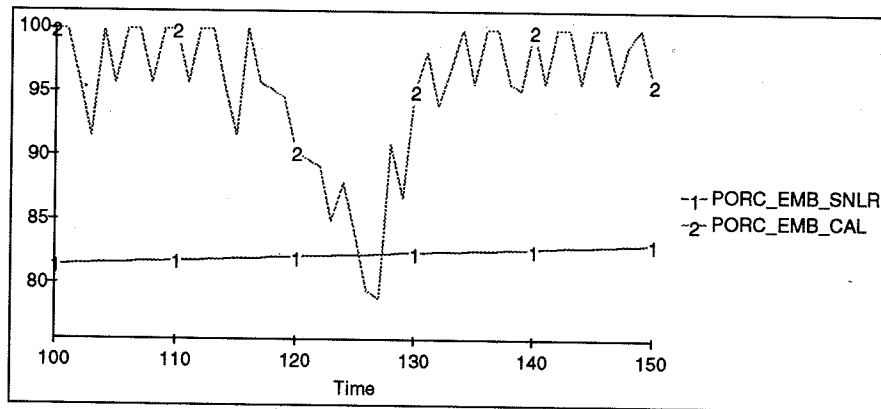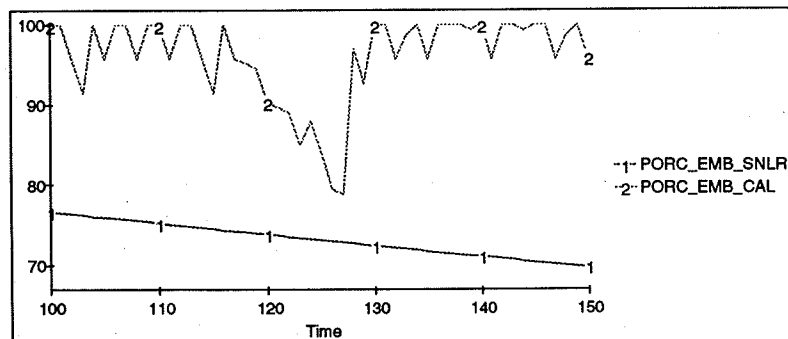

Figure 2. Evolution of reservoirs as consequence of strategy (scenario 1)

Figure 3. Evolution of reservoirs as consequence of strategy (scenario 2)

The model also allows to evaluate the likely rewards to generators under the scenarios being considered by strategist.

4 Conclusion

This paper shows how the use of SD models (platforms) may support strategic bidding (formulation and evaluation of strategies) in the Colombian electricity market. Some of the ideas can be applied to similar systems elsewhere.

It is important to note that in this case statistical analysis, based on historical data, is almost irrelevant for the purpose of strategy evaluation since feedback effects with respect to reservoir management will mislead the decision makers. Simulation is a requirement in these circumstances.

This paper reports work in progress which seem promising to provide useful insight to support the strategic bidding process in the Colombian electricity market.

Acknowledgements

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