A study of optimization and balancing problems on an electrical production network

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This presentation is contextualized in an electricity market that has in the first instance three production points which use different technologies with their respective costs and have the possibility of complementing each other since they are connected in order to send and receive electrical energy if it were necessary. The second stage of an auction system is studied, in which an Independent System Operator (ISO) is in charge of planning the choice of resources and the management of energy transfer between the nodes at minimum cost. The structure of this network is introduced in [EJ10]. For this, the corresponding optimization problem is defined and an algorithm is developed capable of finding a configuration that minimizes the total cost of the system in a simplified version that will be the basis of the main algorithm that will lead to the solution of the general problem. Among the assumptions is the existence of losses in shipments, since given the inherent characteristics of electrical energy, this consideration is fundamental for the precision of this work. To develop this algorithm, an idea named *glasses of water* is used, first in a version without losses in shipments and later adding this assumption. Along with this, results related to the optimality of the analyzed problem are provided, within which the accuracy of the algorithm is demonstrated in detail. Later, a derivation of this problem is analyzed in which the existence of a new node, called *satellite*, which is connected only to one of the other three main nodes, is considered. Like the others, this one is capable of producing and receiving electrical energy. In a similar way to the initial problem, this situation is modeled and an algorithm capable of finding a minimum cost schedule is developed. Finally, a more general system is studied with any number of satellites for the three nodes, and like the previous problems, the situation is modeled and an algorithm is developed that finds a schedule at minimum cost.

[EJ10] J.F. Escobar and A. Jofré. *Monopolistic competition in electricity networks with resistance losses.* Economic theory, 2010.

[HJ19] B. Heymann and A. Jofré. *Optimal auctions for networked markets with externalities.* arXiv preprint arXiv:1907.10080, 2019.