

# Capacity Adequacy in Interconnected Electricity Markets

Camila Ochoa, HEC Lausanne – University of Lausanne, +41 21 692 3665, MariaCamila.Ochoa@unil.ch

Ann van Ackere, HEC Lausanne – University of Lausanne, +41 21 692 3454, Ann.vanAckere@unil.ch

## Overview

Since their creation, electricity systems have evolved constantly. Given the importance of an affordable and secure electricity supply in modern economies, the governments have always been involved in this process. Where electrical utilities have been privatized, strong regulation has been introduced. Not surprisingly, most electricity systems remained, during decades, within the national boundaries.

The liberalization process has led, among others, to considering the possibility of crossing or eliminating those boundaries in order to increase competition and improve efficiency in electricity markets. However, there are many open questions regarding the actual benefits that may be achieved by a regional integration. Many regions have signed interconnection agreements and have been trading electricity for a while. Nevertheless, the results are ambivalent: while some regions have advanced very quickly and successfully, such as the Nord Pool, many have not been able to achieve the expected benefits, with interconnection capacity remaining at a very limited level.

These contrasting results are due partly to the unique characteristics of the national electricity markets, but they are also influenced by the mechanisms chosen for the international transactions and by the policies implemented in each country. A frequent cause of malfunctioning regional markets is that governments retain an independent mind-set and continue to implement policies aimed at guaranteeing self-sufficiency, without taking into account the impact on the integrated region.

Designing electricity markets is a complex task, as electricity is a non-storable good delivered via a network, in which supply and demand must be balanced at each second (Jamash & Pollitt, 2005). Furthermore, electricity demand is mostly inelastic in the short-run. This implies the necessity of building sufficient generation and transmission capacity to supply the peak demand; otherwise, the result will be a blackout.

From the perspective of international electricity markets, having considerable interconnection capacity between countries is essential in order to achieve the potential benefits of integration (Gilbert, Neuhoff, & Newbery, 2004). Nonetheless, cross-border interconnection capacity is in most cases very restricted; consequently, links are highly congested and real competition among agents in different countries is not an option.

Congestion in transmission increases market power, as generators in an import constrained zone may increase the price. Those in an export constrained zone may also profit from congestion if capacity or availability payments are considered. However, as Lévêque (2006) argues, the economically optimal level of congestion is not zero, since this would make it impossible to recuperate the fixed costs of the grid.

The complexity of designing electricity markets has led to a wide variety of approaches in different countries. Consequently, it is almost impossible to replicate a market design, which has been successful in one region, elsewhere, as the specific market characteristics would lead to different outcomes. Besides, it is difficult to predict the behaviour of a region where the countries implement different policies and produce different investment signals. However, it is important to identify under which circumstances integration is desirable, and what kind of policies should be applied, or not, in order to take advantage of integration without putting reliability at risk.

In this paper we analyse the interactions of different capacity adequacy policies in conjunction with different trading arrangements and integration levels. A simulation model is developed in order to represent the evolution of two interconnected markets, considering investment decisions in interconnection and generation capacities.

## Methods

We use a simulation model to analyse several cases of interconnection between two countries. The model includes a representation of the hourly dispatch, as well as of investment decisions. The former determines the electricity flows

between countries and the resulting prices, which affect investment decisions, both in generation capacity and in the interconnector, and thus the long-term behaviour of the system.

The cases analysed are different in terms of technology mix, complementarity between countries, demand growth, relative size of the countries and hydro-storage capacity. In each case, we analyse the long term behaviour of the system when different capacity adequacy policies are implemented in one or both countries.

## Results

Our results show that the lack of coordination between interconnected countries can undermine the benefits of integration. Furthermore, the outcomes of national capacity adequacy policies depend on the characteristics of neighbouring markets and the interconnection capacity. This can lead to counterintuitive results, significantly complicating policy design.

The interactions between countries are even more complex when they exhibit important complementarities, have large hydro-storage capacity or require large investments in generation, since these characteristics result in unexpected behaviours. Also, when the countries are very different in size, there is a higher risk of import dependency for the smallest.

Given the interactions with neighbouring countries, in certain cases, implementing a capacity remuneration mechanism can even result in lower reliability. Thus, it is extremely important for regulators to take into account the characteristics and policies of interconnected countries when evaluating policies.

## Conclusions

The different cases studied in this paper illustrate the complexity of the interactions between interconnection and generation expansions in neighbouring countries, which complicate policy analysis. We conclude that if the right policies are implemented, integration can bring important benefits to a region, otherwise the outcomes can be highly undesirable. The characteristics of the countries play a fundamental role in determining the benefits that can be achieved and the risks involved in an integration process.

A large interconnection capacity is only desirable when the countries exhibit significant complementarities. In the absence of trust, a well-designed capacity mechanism can limit import dependency; however, designing such a mechanism at the national level is a very complex task given the interactions with interconnected markets.

## References

- Gilbert, R., Neuhoff, K., & Newbery, D. (2004). Allocating transmission to mitigate market power in electricity networks. *RAND Journal of Economics*, 35(4), 691–709.
- Jamasb, T., & Pollitt, M. (2005). *Electricity Market Reform in the European Union : Review of Progress toward Liberalization & Integration* (No. 05-003 WP).
- Lévêque, F. (2006). Investments in competitive electricity markets: an overview. In F. Lévêque (Ed.), *Competitive Electricity Markets and Sustainability*. Edward Elgar Publishing Limited.