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Expert survey on capacity markets in the US: Lessons for the EU

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ABSTRACT

We present a survey of US capacity market experts with the purpose of drawing lessons for the EU. Of the respondents, 41% advised EU member states against implementing capacity markets, while the remaining were neutral or provided suggestions for improving capacity markets. Cross-border effects are currently not a concern but may become so in the future. Imports may dampen prices in a capacity market, but neighbouring markets may also experience pressure to implement a capacity market. The capacity markets in the USA were believed to have achieved their goals with respect to reliability, but in an economically inefficient manner.

1. Introduction[1]

The arguments for implementing a capacity market have been described extensively in the literature (Chao and Lawrence, 2009; Cramton et al., 2013; De Vries, 2007; Hobbs et al., 2001; Joskow, 2008a, 2008b, 2006a, 2006b; Nicolosi and Fürsch, 2009; Stoft, 2002). As member states of the European Union are starting to implement capacity markets, learning from other regions with more experience could not only reduce the risk of policy failure but could also help improve the design and implementation of new market mechanisms. While capacity markets have been the subject of debate for more than a decade, there is little consensus on the need for them or their optimal design (Cramton and Stoft, 2006; De Vries and Hakvoort, 2003; Joskow and Tirole, 2007; Joskow, 2008a, 2008b, 2006a, 2006b; Neuhoff et al., 2011; Pérez-Arriaga, 2001). Perhaps as a consequence, the market designs for France and the UK are widely different (DECC, 2014; RTE, 2014). The UK's capacity market recently held its first auction, clearing at a lower price than expected and indicating once again the difficulty of design (OFGEM, 2015). Germany, on the other hand, decided not to implement a capacity markets (BMWi, 2015).

Capacity market design in the US has faced a number of issues, such as the role of demand response, whether locational constraints should be imposed, how far forward such markets should be run, and whether separate markets should be created for flexible capacity to back up intermittent renewables. An issue of particular interest to the EU concerns inefficiencies that might arise when wholesale electricity markets with different capacity markets are interconnected or when regions with capacity markets are interconnected with energy-only markets. This could lead to sub-optimal performance of the capacity markets and spillover of benefits or costs to neighbouring markets. There is also a risk that capacity markets might distort cross-border trade and reduce market transparency (Cepeda and Finon, 2011; Elberg, 2014; Gore, 2015; Meyer and Gore, 2015; Tennbakk, 2014; Viljainen et al., 2013). The above-mentioned effects are termed as "seams issues" (US) or "cross-border effects" (EU). Seams issues that may arise with the implementation of capacity markets are currently of much concern in the European Union (ACER, 2013; Finon, 2015; Mastropietro et al., 2015; Newbery and Grubb, 2014; Regulatory Assistance Project, 2013; SWECO, 2014). The objective of this paper is to draw lessons for Europe from the American experience.

Over the past decade, three wholesale electricity market regions in northeast United States implemented capacity markets (NYISO, ISO-NE, and PJM).[2] These markets have differing designs and have

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[1] A preliminary version of this paper was presented at the 38th IAEE International Conference, Antalya 2015.

[2] NYISO: New York – ISO, ISO-NE: ISO New England, PJM: Pennsylvania-New Jersey–Maryland.

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Table 1
Status of capacity mechanism implementation in the EU (Based on (ACER, 2013)).

Capacity mechanism	EU member states
Capacity Market	France, UK
Capacity Payment	Greece, Ireland, Italy (Capacity market planned), Portugal, Spain
Capacity Reserve	Germany (Under consideration)
Strategic Reserve	Belgium, Finland, Sweden (Phase-out 2020)

evolved over their periods of existence. This evolution includes the creation of separate markets for flexible capacity, geographical definition of market sub-regions, and modifications to market clearing mechanisms (such as use of demand curves). MISO has recently implemented a capacity market. Capacity markets have not been implemented in the southwest region (Southwest Power Pool or SPP). The state of California has imposed a resource adequacy requirement on load serving entities, but has not created a centrally coordinated market to facilitate efficient trading of resources to meet that requirement. California's resource adequacy framework is described in literature by Pfeifenberger et al. (2012), CPUC (2015), CAISO, (2015).

The main objective for capacity markets is to improve the resource adequacy of the system by maintaining sufficient reserve margins. These margins are calculated from the loss of load probability (LOLE) requirement of the independent system operator (ISO). An underlying assumption is that spot markets by themselves are characterized by market failures for which capacity markets must compensate. The first market failure was the 'missing money problem' (Cramton and Stoft, 2006; Joskow, 2008a; , 2008b, 2006a, 2006b; Pfeifenberger et al., 2009; Shanker, 2003). Due to price caps, the absence of shortage ("scarcity") pricing, long averaging periods, or other reasons, energy and ancillary service prices may fail to reflect the full value of power, which in theory would result in inadequate remuneration for investors and underinvestment in capacity. Revenues from capacity markets enable resources with high variable costs that under normal circumstances would be either mothballed or dismantled to remain available. The second market failure is the absence of a long-run contract market that some argue is necessary to induce risk-averse investors to build new, long-lived generation capacity. The additional revenues from the capacity market provide a stronger investment signal for new capacity additions.

In the EU, design and implementation of capacity markets are left to the discretion of member states, which means that each member state may have different capacity market designs or mechanisms. Table 1 indicates to what extent capacity mechanisms have been implemented in the member states of the EU. While France and the UK have implemented capacity markets, the German Federal Ministry for Economic Affairs recently released a 'white paper' that rejected implementation of capacity markets in response to discussions with various stakeholders and recommendations from experts (BMWi, 2015). At the same time, however, the white paper states that there exists broad support for introducing capacity reserves and improving the electricity market design.

After a desk review of the four capacity markets in the US, this paper presents a survey of experts with knowledge of the United States electricity sector. The goal of this survey was to provide insight and advice to the EU with respect to selecting, designing, implementing and administering capacity markets in a highly interconnected electricity network, based on the experience with capacity markets in the United States. Emphasis was given to cross-border effects that may arise from implementing capacity mechanisms in interconnected regions. The survey respondents were questioned about such occurrences and their impact as well as how they were dealt with in the US experience. The respondents invited to participate in the survey represented various stakeholders (Details in Section 3).

This paper is structured as follows. Section 2 provides a description of the four capacity markets in the United States followed in Section 3 by a description of the knowledgeable expert survey. The survey results and conclusions are presented in Section 4 and 5 respectively.

2. Capacity markets in the United States

The development of competitive wholesale electricity markets has been described in Borenstein and Bushnell (2000); Brennan et al. (2002); Joskow, (2008b, 2008a, 2006a, 2006b, 1997); Navigant Consulting (2013); Sioshansi (2013). Currently, the United States has seven regional wholesale electricity markets that are administered by independent system operators (ISOs),[3] namely SPP, ERCOT, MISO, 2013, CAISO, 2015, ISO-NE, NYISO, 2013b, 2013a, PJM, 2013 (IRC, 2015). Capacity markets have been implemented in the four northeast-Midwest markets of NYISO, 2013b, 2013a, PJM, 2013, NE-ISO, and MISO.[4] Their performance has been discussed by, among others, Harvey (2005), Harvey et al. (2013), and Spees et al. (2013).

Each region has its own unique capacity market design (see Table 2) and modes of interconnection with neighbouring regions. This makes the study of US capacity markets relevant for Europe. As the heterogeneity in US capacity markets provides the context for our survey findings, we provide a brief overview of the different capacity market designs presently implemented in the United States.

2.1. NYISO: installed capacity market

The New York Independent System Operator (NYISO) organizes an installed capacity (ICAP) market. Unforced capacity (UCAP) (NYISO, 2013a, 2013b) is offered in a series of auctions by generators. Load-serving entities are obligated to purchase the minimum volume of unforced capacity that has been assigned to them (Harvey, 2005; NYISO, 2013a, 2013b). UCAP is defined as the installed capacity adjusted for availability, as provided by the Generating Availability Data System (GADS) (NYISO, 2013b). Harvey (2005) describes how the UCAP is calculated. The unforced capacity requirement is calculated from the Installed Reserve Margin (IRM) and forecasted peak load (NYISO, 2013b). The IRM, defined as the required excess capacity (presented as percentage of expected peak demand), is established such that the loss-of-load expectation (LOLE) is once in every ten years, or 0.1 day/year. The LOLE represents the probability that the supply would be lower than demand, expressed in time units. In NYISO, 'days/year' are used (Čepin, 2011)).

[3] An illustration of the areas of the ISOs is available at www.ferc.gov/industries/electric/indus-act/rto.asp.

[4] MISO: Midcontinent ISO.