RETHINKING CAPACITY MECHANISMS IN EUROPEAN ELECTRICITY MARKETS

Reinhard HAAS, Energy Economics Group, Vienna University of Technology, 1040 Wien,
Phone: 0043158801370352, E-mail: haas@eeg.tuwien.ac.at,

Overview

Around ten years ago the discussion on capacity markets or more general on capacity mechanisms or system adequacy started in European electricity markets. In the meantime, the idea of politically motivated capacity payments (CP) for power generators in addition to revenues from the energy-only market, has gained attention in the energy economic discussion in different countries, e.g in Germany, see Keles et al 2016. The reason for this is that a number of market payers claim that the long-term reliability of the electricity system is at risk as long as there is no politically organized mechanism for capacity payments in place, see e.g. Crampton (2012). Indeed, in many countries such CPs have already been introduced. Yet, neither in the scientific world nor in practice clear solutions have been identified.

The core intention of this paper is to serve as a primer on how to introduce truly competitive electricity markets and the possible role of CP. It is triggered by the current discussion on how to integrate large shares of variable RES but the basic intention goes beyond that. It is to show how to head towards real competition in electricity systems, including all dimensions such as generation storage, but especially the customer side.

The major objective of this paper is to analyze and provide insights on the conditions that will bring about a sustainable and competitive electricity system with higher shares of RES without escalating political interventions. How can the original idea of competition be reestablished so that "Markets should do their work"?

The objectives in detail are: (i) to explain how in the future a really competitive market-based electricity system without continuing governmental interferences can be brought about; (ii) to argue why CP will not contribute to such a system but rather retain the conventional system.

Methods

Our method of approach is based on the following principles: (i) Crucial is coverage of residual load (= difference between final electricity demand and generation provided by non-flexible electricity generation). This is modeled on an hourly base over a year based on modeled RES-E generation (ii) Deduction of available conventional and backup capacities including must-run (iii) demand-side flexibility based on consumer behavior incl. flexibility instrument such as batteries etc.; (iv) hourly electricity prices equal to short-term marginal costs and scarcity rents.

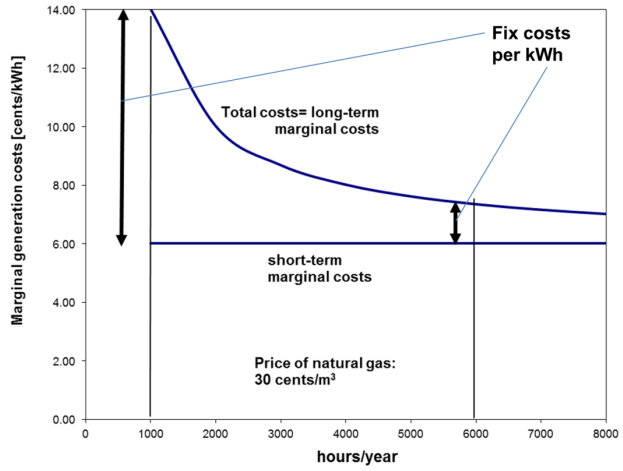

Figure 1. Short term and long term marginal costs of electricity generation in a CCGT plant depending on yearly full-load hours

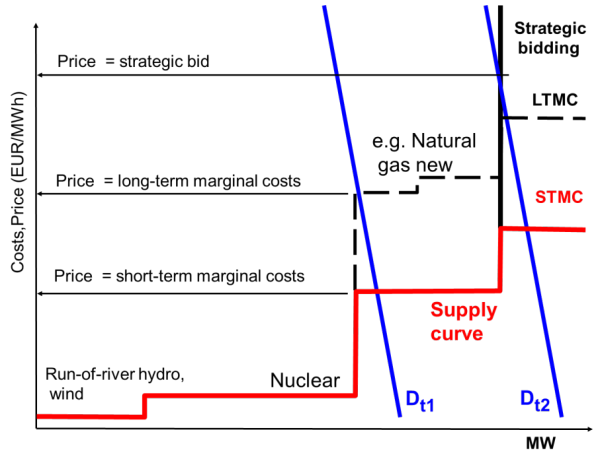

Figure 2. Merit order supply curve for STMC vs LTMC of CCGT plants or strategic bidding at times with low variable renewables

Results

The major results are: (i) The variable renewables will also influence the costs at which fossil generation – especially natural gas – are offered. The illustration in Fig. 1 is based on the right hand-side at 6,000 full-load hours

per year[1]. The revenues derived from these hours must cover both the fixed and variable costs, as illustrated in Fig. 1. The graph schematically shows the total and thevariable (short term) electricity generation costs of a new combined-cycled gas turbine (CCGT) based on its annual full-load generation hours. As can be seen, the share of fixed costs is considerably higher when the plant operates at full load for a minimal number of hours, say, 1,000 h/yr[2] as opposed to a high number of hours, say 6,000 h/yr, see Fig. 1; (ii) How the growth of renewables might impact future pricing strategies of fossil or biomass power plants over time is a subject of speculation. As schematically shown in Fig. 2, the merit order supply curve and the high and low demand curves are affected based on the availability of renewables, which tend to be variable and not entirely predictable. The illustration shows three examples for supply curves: merit order supply curves for Short term and long term marginal costs of CCGT plants and a supply curve for strategic bidding, which is shown as a vertical line; (iii) Of core relevance for a complete markets and to enhance competition is a pricing system in an energy-only market where the price signals provide information about scarcity or excess capacities at every point-of-time;

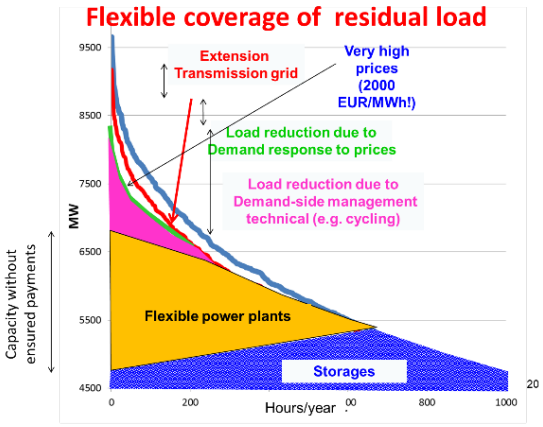

Figure 3. Flexible coverage of residual load power plants with and without regulated capacity payments

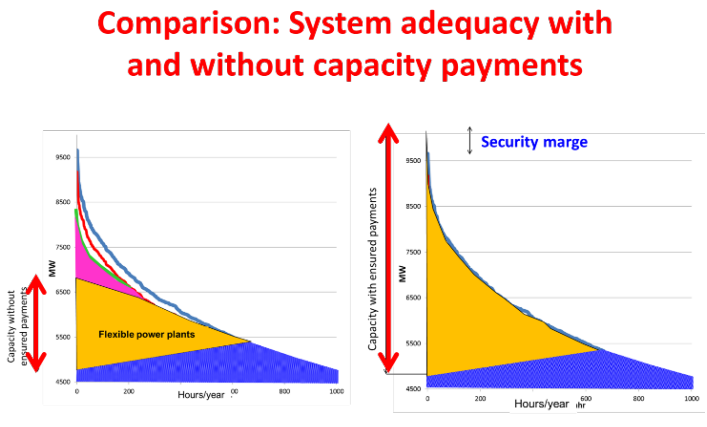

Figure 4. System adequacy and the role of flexible power plants with and without regulated capacity payments

(iv) Most important to balance variations in residual load is a portfolio of flexibility options such as: (a) Battery, pumped hydro and other storage; (b) Technical demand-side management; (c) Demand response due to time-of-use pricing, see Fig. 3; (v) However, flexible power plants for capacity system adequacy will play a role in every system with and without regulated capacity payments, see Fig. 4; (vi) A very important aspect is to provide the right price signals for final customers by implementing a bi-directional tariff for separated components for energy and power.

Conclusions

Our major conclusions are:

- Revised Energy-only-markets have to be introduced which allow temporarily shortage prices higher than short-term marginal costs and in times of excess electricity negative prices;
- All arguments in favour of capacity payments (CP) including aspects of market failure could be managed by a complete, wholly integrated market which would include supply-side as well as demand-side options, without government intervention in electricity generation. This approach would provide the basis for a truly competitive electricity system;
- An important element of such a market will be flexibility options. But these will only be harvested if high price signals from the electricity markets trigger these options, when “the exploration principle in the markets work” (Erdmann 2012). Yet this will only be done if the market is not distorted by centralized capacity payments.
- Finally, it is important to provide the right price signals for final customers, for prosumers and also for energy communities by implementing a bi-directional tariff system for separated components for energy and power.

References:

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[1] That assumes roughly 70% capacity factor.

[2] Of course, full-load hours vary year-by-year depending on demand, hydro power and other factors.