# On the Future of Electricity Supply. Competitive Markets or Planned Economies?

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### Introduction

In recent years increasing shares of electricity generation from intermittent renewable energy sources (RES-E) like wind and photovoltaics (PV) in Germany have started to change the usual pattern of electricity markets in Western Europe fundamentally. The fact that these “must run” capacities are offered at Zero or even negative costs over a large time per year has led to the situation that mainly natural gas power plants became economically less attractive because of lower fullload hours per year and to a call for “capacity” markets (CM) in addition to the “energy-only” markets. Currently, also the EC is looking for a new or revised electricity market design (Koch (2012)). The core objective of this paper is to discuss the relevance and the effects of CM and the alternatives.

Our method of approach is based on the basic principle that prices equal marginal costs. This principle prevails since the start of liberalization. Because at that time considerable excess capacities existed in Europe the expectation was that prices will (always) reflect short-term marginal costs (STMC) see Stoft (2002). Because of lower fulload hours this principle is now questioned.

### How Intermittent Renewables Impact Prices in Electricity Markets

The core issue is, how electricity prices will evolve in future if larger amounts of intermittent RES-E mainly from wind and PV are generated. An example is shown in Figure 1 where a hypothetical scenario with high levels of generation from intermittent RES-E over a week in summer is depicted. The graph shows significant volatilities in electricity market prices with total costs charged for conventional capacities – black solid line – ranging from zero to 14 cents/kWh within very short time intervals. Note, that intermittent renewables will also influence the costs at which fossil generation – especially natural gas – are offered. The reason is that they wcould lead to much lower fullloadhours, e.g. only 1000 instead of 6000 h/yr before. Yet, the revenues earned from these hours must cover both the fixed and variable costs, see also Haas 2013. This leads to the figure of 14 cents/kWh in Figure 1.

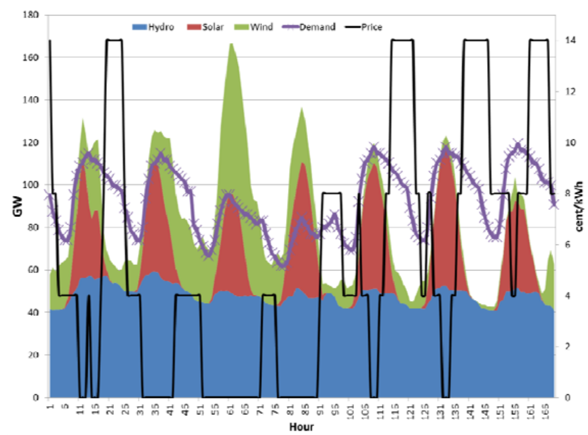


*Figure 1. Development of intermittent RES-E over a week in comparison to demand and resulting electricity market prices with total costs charged for conventional capacities.*

In practice, of course, the prices may not just go to zero but also below. Given the price pattern in Figure 1 we are convinced that it would be attractive for (some but sufficient) power plants operators to stay in the market or even to construct a very efficient new plant! This would lead to a revised energy-only market.

### Capacity Payments and Corresponding Problems

If these temporaily high prices are not accepted CM could be a proper solution. Yet, the first major reason for the call for CM is to retain supply security in the electricity system. The historical (anachronistic) definition of supply security is: At every point-of-time every demand has to be met regardless of the costs! The major reason for this is that in times of regulated monopolies every demand could be met due to significant excess capacities and in the liberalized markets still excess capacities remained. In the context of the discussion of market design this historical view of supply security plus CM would lead to a new market design in the sense of a centrally planned economy.

The major CM models currently discussed are (see e.g. Cramton et al 2012): (i) a Comprehensive CM model which treats existing and new capacities jointly; (ii) a Focused CM approach which differs between existing and new capacities. In both of these market models – as in the classic EOM – the price should equal the STMC. The major open questions regarding CM are: (i) Which quantity of capacity should get payments and where? (ii) How to split in existing and new capacity? (iii) How to tune with grid extention?; (iv) Who plans? On national or international level?

Based on these open questions an important aspect is the international dimen-

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sion. In recent years a remarkable convergence of prices has taken place even in Western continental Europe. That is to say that any measure in one country will affect the market structure in others. The discussion in Europe starts with the request for CM on national level. Yet, because the Western European electricity markets is strongly integrated the national planning activities has at least to some extent to consider the international dimension. Transboundary grid extentions and storage availability are some important aspects. This leads after some time undoubtedly to international planning of CM. The next logical step is to think about an international joint concept for financing. And this would lead very soon to central European planning, Figure 2.

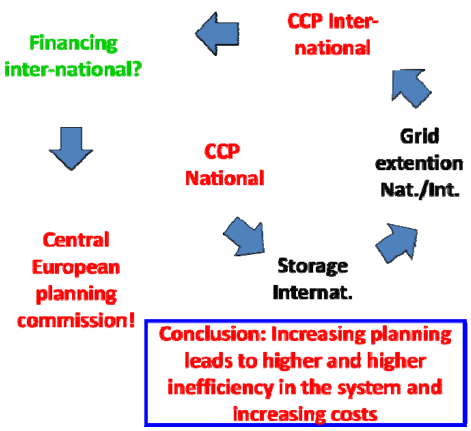


*Figure 2. The international planning spiral in the implementation of capacity markets.*

**A Market-based Approach**

On contrary to this central planning approach a market-based one would take into account customers WTP and the equilibrium between demand and supply would come about at lower capacities. Note, that where WTP is lowest the MC of providing capacity are highest, see Figure 3. A market approach will consider also other options on the supply- and demand-side as there are, see Figure 4 and Praktiknjo 2013:

- DSM (technical): Measures conducted by utilities like cycling, control of demand, e.g. of cooling systems)
- Demand response due to price signals: Response of mainly large customers to price changes
- Transmission grid extention: if the grid is extended there is in principle always more capacity available in the system and the volatility of RES a well as demand evens out;
- Smart grids: They allow variations in frequency (upwards and downwards regulation) and switch of voltage levels and contribute in this context to a load balancing
- Storages: short-term and long-term storages – batteries, hydro storages, or chemical storages like hydrogen or methane – can help to balance significant volatilities of RES generation.

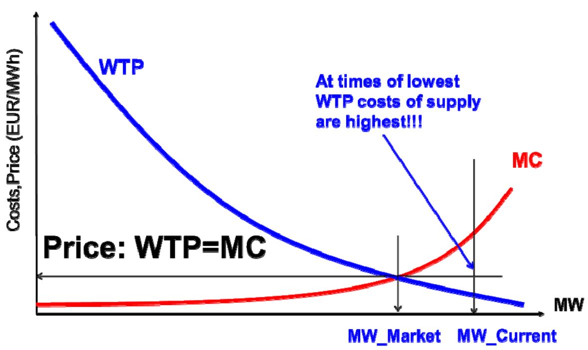


*Figure 3. A market-based approach to supply security*

A core problem is that so far the demand-side has been fully neglected with respect to contributing to an equilibrium of demand and supply in an electricity market. No culture of integration of demand has so far been developed. This aspect – to develop the impact of demand-side and customers willingness-to-pay (WTP) – is essentially for a real electricity market and it is actually regardless of the aspect of an integration of larger shares of RES.

Hence, a major component of the revised EOM-model described above is to include demand-side contracts. In this category fits also the idea of Erdmann (2012) who suggests that the balancing groups should be responsible for providing capacities.

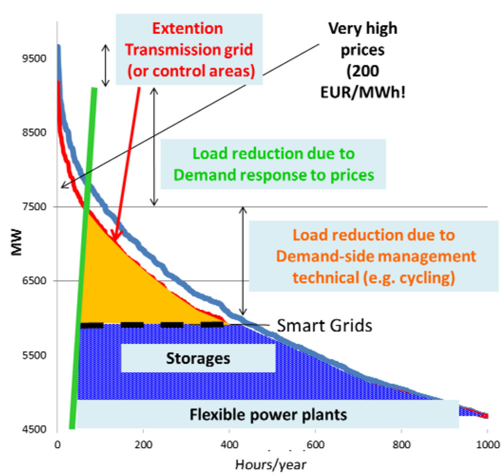


*Figure 4. Options for coping with peak residual load in electricity markets*

**Conclusions**

The major conclusion of our analysis is that capacity markets are a step back to a planned economy with – all in all – much higher costs for society. The only "negative" aspect of a market without capacity component will be that – at least in the short run –temporarily higher costs than the short-term marginal costs will occur. However, after some time the market will learn to benefit from these higher costs and also from the very low costs at times when RES are abundant. A reasonable price spread will come about that provides incentives for different market participants to benefit from these spreads. In total we think that in addition to pure power generation capacities other elements like Smart grids, technical and economic demand-side management, short-term storage options will even out a large part of the residual load profile (the difference between demand and supply from RES).

The most important conclusion is that the evolution of such a creative system of integration of RES in Western Europe may also serve as a role model for largely RES-based electricity supply systems in other countries world-wide. So there is especially NOW no need for CCP. If all our arguments would turn out to be wrong it would still be sufficient to introduce such a model and to abolish the electricity markets.

**References:**


Cramton P., Ockenfels A. (2012) "Economics and Design of Capacity markets for the power Sector", Zeitschrift für Energiewirtschaft, 36, 113-134.

Erdmann G.,(2012) "Kapazitätsmechanismus für konventionelle und intermittierende Elektrizität". In: Agora: Brauchen wir einen Kapazitätsmarkt? Agora Energiewende, Berlin, www.agora-energiewende.de.

Haas R., Lettner G., Auer J., Duic N.(2013). "The looming revolution: How Photovoltaics will change electricity markets in Europe fundamentally", Energy ,57, 38-53.

Hammons T.J. (2008) "Integrating renewable energy sources into European grids", International Journal of Electrical Power & Energy Systems, Volume 30, Issue 8, 462-475,

Inagendo (2013) Funktionsweise und Nebenwirkungen von Kapazitätsmechanismen, 2 Inagendo GesmbH, Niederkassel, www.inagendo.com

Koch Oliver, "Electricity market design", Presentation at IAEE-conference, 18-21 July 2013 Düsseldorf.

Praktiknjo, A. (2013) Sicherheit der Elektrizitätsversorgung im Spannungsfeld der energiepolitischen Ziele Wirtschaftlichkeit und Umweltverträglichkeit, PhD thesis, Technische Universitaet Berlin, 2013.

Stoft, S. (2002 Power System Economics, IEEE Press, Piscataway.


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## IAEE/Affiliate Master Calendar of Events

**(Note: All conferences are presented in English unless otherwise noted)**

| Date | Event, Event Title and Language | Location | Supporting Organization(s) | Contact |
|---|---|---|---|---|
| **2014** | | | | |
| September 19-21 | 4th IAEE Asian Conference<br>*Economic Growth and Energy Security: Competition and Cooperation* | Beijing, China | CAS/IAEE | Ying Fan<br>*yfan@casipm.ac.cn* |
| October 28-31 | 14th IAEE European Conference<br>*Sustainable Energy Policy Strategies For Europe* | Rome, Italy | AIEE | Andrea Bollino<br>*bollino@unipg.it* |
| **2015** | | | | |
| February 23-24 | 8th NAEE/IAEE International Conference<br>*Future Energy Options: Assessment, Formulation and Implementation* | Ibadan, Nigeria | NAEE/IAEE | Adeola Adenikinju<br>*adeolaadenikinju@yahoo.com* |
| March 15-18 | 5th ELAEE Conference<br>*Energy Outlook in Latin America and Caribbean: Challenges, Constraints and Opportunities* | Medellin, Colombia | ALADEE/IAEE | Isaac Dyner<br>*idyner@yahoo.com* |
| May 24-27 | 38th IAEE International Conference<br>*Energy Security, Technology and Sustainability Challenges Across the Globe* | Antalya, Turkey | TRAEE/IAEE | Gurkan Kumbaroglu<br>*gurkank@boun.edu.tr* |
| October 25-28 | 33rd USAEE/IAEE North American Conference<br>*The Dynamic Energy Landscape* | Pittsburgh, PA, USA | 3RAEE/USAEE | David Williams<br>*usaee@usaee.org* |
| **2016** | | | | |
| February 18-19 | 9th NAEE/IAEE International Conference<br>*Theme to be Announced* | Abuja, Nigeria | NAEE NAEE/IAEE | Adeola Adenikinju<br>*adeolaadenikinju@yahoo.com* |
| June 19-22 | 39th IAEE International Conference<br>*Energy: Expectations and Uncertainty Challenges for Analysis, Decisions and Policy* | Bergen, Norway | NAEE | Olva Bergland<br>*olvar.bergland@umb.no* |