German Green Paper on the Future Electricity Market

The German Federal Ministry for Economic Affairs and Energy has published a discussion paper[1] on challenges and possible solutions for the electricity market during Germany's energy transition. The paper is available in German and English.

The report is organized in three parts:

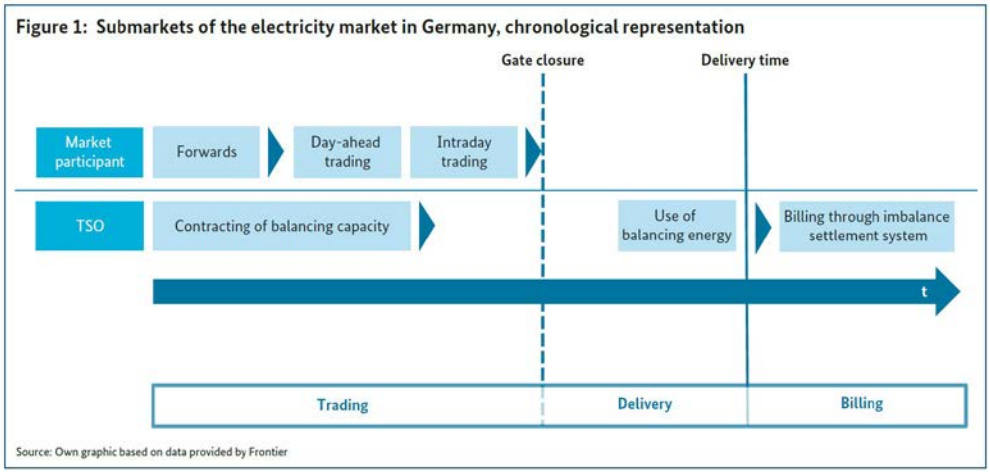
I. The electricity market today and in the future
II. Measures for the secure, cost-effective and environmentally compatible dispatch of all producers and consumers
III. Solutions for the sufficient, cost-effective and environmentally friendly capacity maintenance

The report is informative, but may also be biased. The report is interesting from a Danish point of view because the German decisions will have a strong impact on the electricity market in Denmark.

A White Paper will follow at the end of May 2015. Another public consultation will run until September after which the necessary legislation will be drafted.

Part 1: The electricity market

Fig. 1 of the report gives an overview of the German electricity market:



It shows the basic elements of the market structure, which was first developed for Nordpool. The trade with electricity can be bilateral (over the counter, OTC) or via a power exchange. In 2012 the volume of the EPEX day-ahead market was about 40% of the physical wholesale trade[2]. The corresponding Nordpool figure for 2013 is 84%[3].

[1] "An Electricity Market for Germany's Energy Transition", the Federal Ministry for Economic Affairs and Energy, October 2014
[2] "Monitoringbericht 2013", Bundesnetzagentur, Juni 2014.
[3] "Central to European Power Integration - Annual Report 2013", Nordpool Spot.

Germany is one common price zone (or bidding zone). Therefore, the EPEX day-ahead market cannot handle grid congestion. The tool for congestion management is **redispatch**. It is difficult to estimate the volume of redispatch in Germany, but according to the report, the cost was € 113 million in 2013. Besides, constraints on interconnections may have contributed.

Challenges

The transition:

- The EU internal market for electricity has contributed to a 60 GW overcapacity in central Europe.
- Overcapacity and low CO_2-prices are driving down wholesale prices.
- Germany will phase out nuclear capacity by 2022.
- The expansion of renewables will continue.
- There is a decreasing need for base-load and mid-merit power plants.
- The demand for peak load technologies and demand side management is rising.

The synchronization (market functions for capacity balance and load dispatch)

- Pricing signals must encourage producers and consumers to timely investments in new capacity.
- Adequate capacity is available on the short to medium term.
- It is being discussed how the electricity market can provide sufficient capacity over the long term.
- Price signals must ensure that sufficient capacity is available for operation, when needed.
    - The report mentions two critical cases when existing capacity was kept out of market: Germany, February 2012, and US East Coast January 7th, 2014. A better market design must prevent such cases.
- Extreme residual loads[4]:
    - Both high and low residual loads present challenges to the electricity market.
    - High residual loads: Shortage of power causes import or load shedding.
    - Low residual loads: Overflow causes export or curtailment of renewables. There is overflow, when the minimum generation of must-run-units (for heat production, for security reasons or just too expensive to stop for a few hours) exceeds the residual load.
    - Today the minimum residual load in Germany is about +15 GW, but could be -25 GW in 2035.
    - A chart in the report shows the minimum generation in Germany to be 20 GW.

Part 2: Measures

Stronger market price signals

It is a natural first step to analyse the present electricity market in order to optimize its functions. More sensitive price signals are supposed to reflect the need for flexibility and to encourage investments in flexible measures.

Expanding the power grids

Congestion is an increasing problem in the German power grid. Wind power in the northern part of Germany replaces traditional power plants in the southern part of Germany and

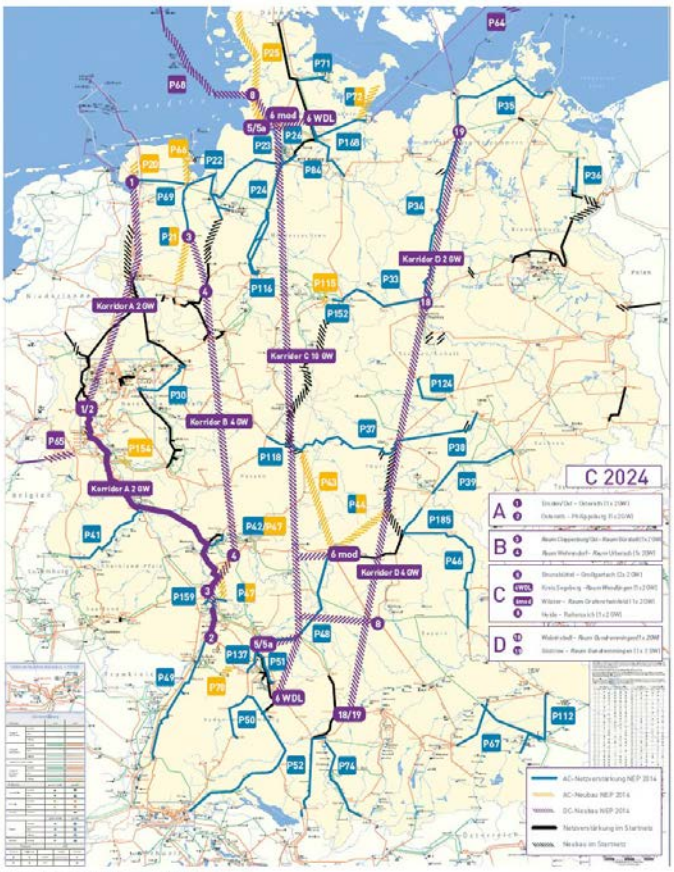
[4] Residual load = electricity demand – renewable generation

causes increasing transfer of power from north to south. In many cases, the transfer capability of the grid is insufficient, and **redispatch** is necessary.

Therefore, the expansion of the power grids is crucial. The grid development plan includes the establishment of corridors with new strong HVDC links.

The report seems to avoid mentioning the challenge of implementing such huge projects in accordance with time schedule. Strong public resistance has already been reported. The report just states: “The grid expansion projects … will be implemented.”

The report is confident that it will be possible to provide the necessary ancillary services with less minimum generation than now. This is another crucial issue, which will require both the development of new methods and investments in the new technology.



Source: Netzentwicklungsplan Strom 2014

Maintaining a single price zone

The German (and Austrian) electricity market model assumes the existence of a grid without congestion. This is in practice an unattainable ambition. Bottlenecks are unavoidable, at least temporarily.

An electricity market model for an optimal resource allocation would use the so-called **nodal pricing** principle. The model can handle all grid constraints and may find individual market prices for each node of the grid. The use of nodal pricing is unrealistic for most grids.

The use of **price areas** (or price zones or bidding areas) is the realistic compromise. It serves the Nordpool area. Until 2010, Sweden was one price area. However, Sweden had to split the country up into four price areas in order to obtain an acceptable utilization of the interconnections.

With a single price zone, all parts of Germany and Austria have the same wholesale prices.

The report does not really discuss why this is important. It says that redispatch drives up costs, which is true. Congestion has a cost irrespective of the congestion management policy.

> Such measures are known as redispatch measures (cf. section 1.6). Grid operators advise electricity producers on one side of the anticipated bottleneck to reduce production in their plants. On the other side of the grid bottleneck, power stations are ramped up to replace the curtailed electricity production to the same extent. This process currently guarantees secure system operation but will reach its limits if grid congestion is aggravated.

*Explanation of **redispatch** from the green paper. The market could do the same job in a more regular way.*

In the long term, grid expansion is the proper way to reduce that cost, but until sufficient grid transfer capability has been implemented, there will be a risk of malfunction of the market coupling in Europe.

Intensified European co-operation

This section stresses the importance of an open and efficient European market, but without mentioning a German grid without congestion as an important condition. It is uncertain when this condition can be met.

Delivering on climate protection goals

There are a few important messages in this section:

- In 2050 there will still be thermal power plants
- These power plants should
    - have very low emissions
    - use fuels very efficiently
    - offer very flexible start-up and close-down
    - survive with a low number of operating hours
- The future role of CHP is under consideration

Part 3: Solutions

Capacity market or energy-only market?

This question is presented as an open choice. The report refers to the current overcapacity, which is supposed to fade out over a decade. Scientific studies claim that an improved electricity market will be able to give market participants sufficient incentives to invest in new capacity and to operate that capacity.

The improved market is called "**Electricity Market 2.0**". One distinctive feature of Market 2.0 should be very high price peaks without any formal price ceiling. Market 2.0 will have a high price volatility. The comments also demonstrate a worry about the risk of abuse of market power in this model.

The alternative is a separate capacity market. The report mentions three different approaches:

- The central comprehensive capacity market with tendering and reliability contracts
- The central focussed capacity market
- The decentralised comprehensive capacity market with capacity obligations

The consequences of the choices are presented and discussed. The calculated emissions and costs indicate that the outcome of Market 2.0 will be close to the theoretical optimum.

This result is not a surprise. The question is if the market will respond in accordance with the theory.

Collaboration with neighbouring countries

This brief chapter emphasizes the message from the corresponding chapter in part two. It states that independent national approaches might cause inefficiency in the internal market, and that capacity markets must be coordinated among European Member States at least.

Capacity reserve as a safeguard
There is a risk that the changes over the next few years will cause uncertainty and reluctance among investors. A capacity reserve may be necessary during the transition phase. A capacity reserve is procured by the transmission system operator (TSO) and is dispatched exclusively by the TSO. The capacity reserve is not assumed to have any influence on the incentives for investments in regular electricity market. A capacity reserve is different from the network reserve, which is necessary for the redispatch.

Though the energy-only market without price limits is the theoretically perfect market, the report envisages the use of additional tools either temporarily or permanently.

Corresponding Considerations in Denmark

In 2014, the wind energy production in Denmark was 13.1 TWh or 39% of the electricity demand. A further increase to 50% is planned for 2020.

The Danish TSO, Energinet.dk, has initiated a review of the Danish market model[5]. A report on phase 1 of the review is available.

A summary of the report is available in English[6]. The title of the summary report is “Market Model 2.0 – Phase 1 Report”.

The name does not indicate any direct relationship with the German project, but the main options are the same:

- Clear price signals providing improved framework for investments in flexibility.
- Strategic reserves ensuring capacity in the market in extreme situations.
- Capacity market, which is a direct payment for capacity.

“Clear price signals” is practically the same as the German “Electricity Market 2.0”.

“Strategic reserves” is called “capacity reserve” in the green paper. The Germans consider a capacity reserve to be necessary during the transition phase, but later rendered superfluous by grid reinforcements.

Even the Danish report emphasizes the importance of an international coordination.

Energinet.dk expects phase 2 of the project to be complete in August 2015.

[5] http://energinet.dk/EN/El/Engrosmarked/Ny%20markedsmodel/Sider/default.aspx
[6] http://energinet.dk/SiteCollectionDocuments/Engelske%20dokumenter/El/Market%20model%202%200_Energinet%20dk.pdf