Volatility, risk, and risk-premium in German and Continental power markets

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Agenda

1. What are the market fundamentals telling us?

2. What can we observe in the traded market?

3. How will future developments impact merit order economics?

4. Summary and conclusions
Various fundamental factors influence power prices on the long-term forward market.
With the exception of coal, energy prices moved mostly sideways over the last two years.

- **CO₂ 2014 (EUR/EUA)**
- **Coal Cal2014 (USD/t)**
- **TTF Sum2014 (EUR/MWh)**
- **German Power Cal2014 (EUR/MWh) (coal at the margin)**
German power supply – renewable capacities continue to grow

German photovoltaic and wind installations account for 46% of installed capacity and 19% of generated power in 2013
For a number of thermal plants the energy only market is no longer viable

Closure announcements are cause for concern

> Based on current announcements Germany will lose more than 3 GW of firm generation between now and 2018
> 2014 will be the last year of capacity additions as delayed new-builds get finally commissioned
> From 2015 onwards announced plant closures will tighten the capacity

Plant additions and closures in Germany (MW)$^1$

$^1$ According to BNetzA (February 2014)
Additional plant closure announcements will eventually tilt the German system

The BNetzA’s view on security of supply has been assessed starting from 2013 figures and adding known capacity changes (net capacity development is negative to 2018)

To ensure security of supply TSO’s will require 5 GW capacity margin above expected load for every hour

In this assessment mothballed capacity is assumed to contribute to security of supply as it can be reactivated when necessary however some lead time required

Without any additional decommissioning, security of supply will not be seen as endangered (much) before 2020

Assuming that the regulator wants to maintain 5 GW capacity margin to cover forecast errors additional 3-5 GW plant decommissioning would intensify the discussion on security of supply

1 IEC - Industrial Emissions Directive
Source: RWE
E.ON just announced early nuclear shutdown

E.ON nimmt Kernkraftwerk Grafenrheinfeld vor Ende der Laufzeit außer Betrieb

28.03.14 | Themen: Stromerzeugung


German power demand – power consumption remains weak

Energy-intensive industries are cutting production and consumers produce their own energy

Average change of weekday load compared to previous year

Low load in May (-12%) not representative due to higher number of bank holidays

Source: Entso-E Power Consumption (preliminary hourly data)
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The power price development over the last twelve years in Germany show…

Forward versus spot prices (EUR/MWh)

1 365d spot moving average
…that the risk premium has been mainly in forward parts of the price curve (spike risk)

Spread between forward and spot prices (EUR/MWh)

1 365d spot moving average
With plenty of generation capacity available, the market does no longer price in a risk premium. Contango has been reinstated in the front of the curve.

Spread between implied versus front year (EUR/MWh)

1 German power baseload
2 Implied Cal as weighted average of spot settlements and balance-of-year forwards
The market expects that renewable generation is growing faster than utilities will close their plants.
The market expects also that German dark spreads will follow the decline of spark spreads

Average clean dark and spark spreads (EUR/MWh)¹

<table>
<thead>
<tr>
<th></th>
<th>2013 forward</th>
<th>2014 forward</th>
<th>2015 forward</th>
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<tbody>
<tr>
<td>Dark</td>
<td>Ø 9.86</td>
<td>Ø 7.86</td>
<td>Ø 6.35</td>
</tr>
<tr>
<td>Spark</td>
<td>Ø -2.37</td>
<td>Ø -11.63</td>
<td>Ø -12.98</td>
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Trading year 2012       Trading year 2013       Trading year 2014

Expectations for dark spreads (EUR/MWh)

- CDS Cal 2013 – 15 Base load (€/MWh)
  (assumed thermal efficiency: 36%)
- Average CDS Cal 2013 – 15
- CSS Cal 2013 – 15 Peak load (€/MWh)
  (assumed thermal efficiency: 49%)
- Average CSS Cal 2013 – 15

Something has to give!

¹ RWE Supply & Trading, prices until 25 February 2014
Germany’s oversupply is dragging adjacent markets lower as long as there is sufficient border capacity.

> European power price convergence until 2012

> Since then prices diverged

> In the Netherlands and UK gas-fired power plants mostly set prices; whereas in Germany, France and Poland cheaper coal-fired plants are price setting

> Renewable additions exceed the extension of cross-border capacities

> Germany is increasingly no longer able to export its surplus renewable power production
The volatility in the German power market is shifting to the front of the curve...

![Annualised volatility compared to 2001: Forward versus spot](image)

1 Front year baseload
2 Day-ahead baseload
…and intraday market becomes more relevant to trade around actual solar and wind production
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German merit order in 2013: prices and volatilities for different hours of the year

1 Excluding nuclear fuel tax
Source: RWE
What will happen over the next five years?

**More renewables: merit order will shift further to the right**
- More fuel switch coal to lignite
- Lower prices
- Higher spot volatility

**Plant closures will accelerate**
- Capacity ranges for coal and gas in merit order will shrink
- Gas will be running more often
- Higher prices
- More price spikes (spot/intraday)
- Higher spot and then higher forward volatility
- Re-appearance of risk-premium in forward prices

**Rise in gas and/or CO₂ prices**
- Higher prices
- Higher forward volatility

Source: RWE
Volatility, risk and risk premium is moving along the curve in the course of time

> Volatility and risk in German and Continental power markets have moved to the very front end of the curve

> This development led to backwardation of long-term contracts

> During the last decade seasonal patterns became more pronounced: As a result generators react with seasonal mothballing

> Such cycles can also be observed in other markets
Experiences from other markets prove as well that risk premiums fluctuate

USA: Back and forth shifting of the risk premium in PJM power market

Spread between forward and spot prices (USD/MWh)

- Result of the bull market in fuels...
- ...and corresponding correction of prices
- The reduction of risk premium was also a supply glut due to rising shale production

1 Rolling front calendar year for that day
2 365d spot moving average
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Summary & conclusion

1. What are the market fundamentals telling us?
   - Prices for fuel commodities and CO₂ are drifting sideways
   - Despite reduction in subsidies, solar and wind generation will continue to grow in Germany
   - From 2015 onwards plant closures will reduce the current generous capacity margin
   - Electricity demand will drift sideways at best (assuming no major break-through on electric cars)

2. What can we observe in the traded market?
   - The markets assume that renewable generation capacity will grow faster than thermal plants are being closed
   - Lower dark spreads would signal to plant operators that their capacity is no longer required
   - More than 70 GW of renewable capacity in Germany push up intra-day volatility; sufficient flexibility in the system for the time being but more and more closures of conventional capacity will lead to spikiness in spot and intraday markets

3. How will future developments impact merit order economics?
   - Forward volatility is low right now as (1) coal plants are mostly price setting in average weather (assumption of forward market), (2) the volatility of coal is low
   - Spot/intraday volatility has gone up and is expected to rise further
   - Forward volatility likely to be pushed up if intraday price spikes become more frequent

4. Conclusions
   - Price to drift sideways for a while before markets tighten
   - More short-term price spikes will induce rising forward volatilities and risk premium and a change in hedging behaviour of large power consumers