Pricing of RES in the EU

Introduction to remuneration of RES

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Europe introduced competitive energy markets:

- Transmission networks are (mostly) neutral market facilitator through ownership unbundled from supply and demand
- Supply resources are competing in dispatch through marginal prices in the wholesale market (merit order)
- Investments into (fossil and renewable) supply resources are private (decisions)

⇒ Revenues based on hourly marginal wholesale prices (market clearing price)
Market prices as a result from demand and (renewable) supply

Market prices differ from hour to hour due to demand and supply, inclusive renewables energy supply

Source: Risø DTU
Example: an OCGT investment needs to consider energy related costs/benefits as

- Costs of access to gas infrastructure
- Costs for natural gas supply (wholesale market)
- Costs for emission rights (ETS)
- Costs of access to power network
- Revenues from power prices at wholesale market
Priority dispatch for renewable energy supported by unbundling

Typical energy company in Europe – unbundled from transmission and regulated access to distribution networks

<table>
<thead>
<tr>
<th>Generation</th>
<th>Trading</th>
<th>Supply</th>
<th>End customer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transmission</td>
<td>Distribution</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

All supply connected to network treaded equally
⇒ Legal right enforced by several court cases

RE priority dispatch executed by unbundled operators
⇒ Market value doesn’t matter, plus compensation for curtailment due to network constraints (in some states)

Source: DG Energy
Criteria for a integrating markets and renewables

“Adapt market design to renewables and support schemes to markets”*

“A functioning market with appropriately defined price zones would thus signal where and when electricity should be generated from renewable sources.”*

Where? → Investment decision

- low generation costs of renewables → best resources and low capital costs
- high market value → balanced spatial and technological RES distribution
- high public acceptance → avoid hot spots

When? → Dispatch decision

- according to lowest short term marginal costs (merit-order), incl. carbon price
- as long as targets exist: whenever the electricity price is higher than the negative green value of renewables (i.e. negative value of premium or green certificates)

* COM(2015) 340 final
Launching the public consultation process on a new energy market design
Risk exposure of RES investors under different support schemes

<table>
<thead>
<tr>
<th>Price based support</th>
<th>Volume based</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fixed feed-in tariff (FIT)</td>
<td></td>
</tr>
<tr>
<td>Feed-in premium (FIP)</td>
<td></td>
</tr>
<tr>
<td>Sliding/Cfd</td>
<td>Cap &amp; floor</td>
</tr>
<tr>
<td>No market price risk</td>
<td>Limited market price risk</td>
</tr>
</tbody>
</table>

Market integration through TSO

RES-E producer sells directly to the market

Source: Ecofys
Pros and cons of main RES-E support schemes

- **Feed-in premium with electricity price index (floating premium)**
  + low investment risk
  + high technology diversity
  + low windfall profits for mature technologies
  + broad spectrum of investors
  - low compatibility with electricity markets
  - limited elements for competitive price setting

- **Fixed Feed-in tariffs with administrative price setting**

- **Auction-based floating premium**
  + high compatibility with electricity markets
  + competition between generators
  - high risks and uncertainties (typically higher prices for RES)
  - low incentives for less mature technologies
  - windfall profits

- **Banded quota models offering long term contracts**

- **Technology neutral quota models**
Challenges of high shares of renewable energy

Example: residual load in Germany now and in 2020

- Inflexibility must run capacity
- Load 2013
- Residual load 2013
- Residual load 2020

Shift demand to periods of high supply
Reduce conventional “must-run” capacity
RES curtailment is least economic option

Periods of negative prices will be typical in future power system and RES curtailment cannot be the only answer!
Sliding Market Premium in Germany: Trader’s Perspective

→ additional revenues possible if:
→ the individual income at the spot market is above the benchmark
→ the management cost (for balancing, trading, etc.) are below the benchmark
Auctions as a tool to determine support levels

→ EU State Aid Guidelines:
  • Require support for renewables to be determined in a **competitive manner**
  • Support should be limited to what is necessary, should aim to make RES competitive in the market, should be adapted to technology cost and gradually be phased out
  • Support mechanisms should not be changed retroactively
→ While the remuneration measure can remain the same, the use of competitive bidding mainly changes the **determination mechanism**
→ **Adapting auction design** to the political and economic environment is crucial
→ **Policy goals** can be interlinked with characteristics of auction design
Policy goals and auctions

Cost reduction: reduce the cost for support
Volume control: achieve (national) targets, avoid boom-bust cycles
Actor diversity: enable smaller actors and civic participation
System integration: ensure (regional) system compatibility
Industrial development: foster economic growth
Acceptance: increase and uphold society’s support for transition
Key features of auction designs

Auction product
• What is tendered?
• Technology-specific vs. technology-open

Pre-conditions
• Which qualifications have bidders to fulfil?

Auction format
• How are winners determined?

Auction award
• What is the award winners receive?

Penalties
• What happens when winners do not fulfil the contract?
Overview: Countries with competitive bidding for renewables

- 14 countries used competitive bidding to determine support for some technologies, 6 countries plan or consider bidding.
- First cross-border auctions have been facilitated.
- Experiences with auctions vary due to:
  - Country specific factors such as potential for technology, finance cost, cost of labor and energy, exchange rates.
  - Investors’ behavior (trust in auctioneer, regulator and market, confidence with auction design).
  - General renewables policy.
  - Auction design.

Source: Ecofys
## Germany: overview on auction design

<table>
<thead>
<tr>
<th>Technology</th>
<th>Auction product</th>
<th>Pre-qualification</th>
<th>Auction format</th>
<th>Auction award</th>
<th>Penalties</th>
</tr>
</thead>
<tbody>
<tr>
<td>Large PV</td>
<td>Renewable electricity in kWh, defined volume</td>
<td>Specified size of plant, project developer may compete with more than one project, location has to be specified, needs to have planning approval, electricity may not be used for self-consumption</td>
<td>Static sealed-bid, pay-as-bid (with two trials on uniform pricing)</td>
<td>Sliding feed-in premium per kWh for 20 years</td>
<td>First-bid bond before auction, second-bid bond after notification</td>
</tr>
<tr>
<td>Wind onshore</td>
<td></td>
<td></td>
<td>Static sealed-bid, pay-as-bid, exemptions on grid-congested regions and citizen-owned projects</td>
<td></td>
<td></td>
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<tr>
<td>Wind offshore</td>
<td></td>
<td></td>
<td>Static sealed-bid, pay-as-bid</td>
<td>Sliding feed-in premium per kWh for 20 years, grid-connection</td>
<td></td>
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<tr>
<td>Biomass</td>
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<td>Static sealed-bid, pay-as-bid</td>
<td>Sliding feed-in premium per kWh for 20 years</td>
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</tbody>
</table>
Germany: first experiences

Auction results 2015-2017 for large PV (above 750 kWp)

<table>
<thead>
<tr>
<th>Month</th>
<th>ct/kWh</th>
</tr>
</thead>
<tbody>
<tr>
<td>Apr 15</td>
<td>9.17</td>
</tr>
<tr>
<td>Aug 15</td>
<td>8.49</td>
</tr>
<tr>
<td>Dec 15</td>
<td>8.00</td>
</tr>
<tr>
<td>Apr 16</td>
<td>7.41</td>
</tr>
<tr>
<td>Aug 16</td>
<td>7.25</td>
</tr>
<tr>
<td>Dec 16</td>
<td>6.90</td>
</tr>
<tr>
<td>Feb 17</td>
<td>6.58</td>
</tr>
<tr>
<td>Jun 17</td>
<td>5.66</td>
</tr>
<tr>
<td>Oct 17</td>
<td>4.91</td>
</tr>
</tbody>
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Bundesnetzagentur 2017

Auction results for onshore wind*

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<tr>
<th>Month</th>
<th>ct/kWh</th>
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<tbody>
<tr>
<td>May 17</td>
<td>5.71</td>
</tr>
<tr>
<td>Aug 17</td>
<td>4.28</td>
</tr>
<tr>
<td>Nov 17</td>
<td>3.82</td>
</tr>
</tbody>
</table>

Realization over 90%

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Challenges on European market set-up

Europe’s markets (bidding) zones are still along national borders instead of physics.

Today’s market revenues/value is not equal to system value (increasing redispatch costs).
Locational value isn’t visible to renewables nor fossil energy supply, not for investment nor for dispatch.

⇒ Latest EU energy package will address
  • bidding zone configuration
  • shift market operation from national TSO to (independent) regional operation centers

…pushback from member states e.g. Germany

Source: Tennet
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