Cornerstones of a Successful European Energy Transition

Key reform elements in the power sector

Matthias Buck
COPENHAGEN, 7 OCTOBER 2016
What do Europe’s 2030 climate and energy targets imply for the power sector?

(1) A share of 50% RES in its power mix

RES-E share in the EU generation mix 2030

RES-E are key for EU’s 2030 strategy:

→ EU’s 2030 climate target of -40% THG below 1990 puts power sector in centre: Emissions are to reduce by 65% by 2030 compared to 1990*

→ EU’s RES target of 27% by 2030 will largely be delivered by power sector, as biofuels and RES heating sources are limited

Thus, EU 2030 climate and energy targets imply

→ 50% Renewables in the power mix
→ 30% Wind and Solar in the power mix


Fraunhofer IWES (2015): Assumptions based on national energy strategies and ENTSO-E scenarios in line with EU 2030 targets
What do Europe’s 2030 climate and energy targets imply for the power sector?

(2) A decline of 68% of coal use in power generation

Matthias Buck | Copenhagen, 7 October 2016

A decline of coal use in power generation is key for the EU’s 2030 strategy:

→ Power sector emissions are to reduce by 65% by 2030 compared to 1990

→ In 2015, ~ 3/4 of total CO₂ emissions stem from coal- and lignite-fired power plants, although these make up only 1/4 of total EU power generation

Thus, EU 2030 climate and energy targets imply for coal power production

→ Minus 68% of coal use in power generation*

→ Decommissioning of roughly half of the coal fleet

What do Europe’s 2030 climate and energy targets imply for the power sector?

(3) Transition to more flexible mix

**Impact of thermal plant mix on plant utilisation rates and investments in a 45% RES-E system**

**Increasing share of flexible resources and decreasing share of inflexible resources** should go hand in hand with a growing share of variable renewables:

- If mix remains essentially unchanged during transition all power plants have lower utilisation rates compared with shift to more flexible capacity mix
- 40% less investment required if capacity mix is transformed towards greater flexibility
- In transformed scenario all market participants are economically better off
- System adequacy ensured at lower cost in a “transformed mix”

RAP (2014) based on IEA (2014)
Which market design will get us cost-effectively to a 2030 power system with 50% RES-E, -68% coal and a flexible mix?

<table>
<thead>
<tr>
<th>Market design based on simple textbook economics</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Energy-only market, System adequacy through peak pricing</td>
<td></td>
</tr>
<tr>
<td>Emissions Trading (with CO₂ price reflecting social cost of carbon, i.e. &gt; 60 EUR/t)</td>
<td></td>
</tr>
</tbody>
</table>

Agora Energiewende (2016): The Power Market Pentagon
Energy-only markets increasingly complemented by out-of-market mechanisms

<table>
<thead>
<tr>
<th>Market design based on simple textbook economics</th>
<th>Capacity mechanisms in the EU 2015</th>
</tr>
</thead>
<tbody>
<tr>
<td>Energy-only market, System adequacy through peak pricing</td>
<td>Emissions Trading (with CO₂ price reflecting social cost of carbon, i.e. &gt; 60 EUR/t)</td>
</tr>
</tbody>
</table>
Huge CO₂ allowance surplus in EU ETS will keep CO₂ prices well below 30 EUR/t for another 15 years

<table>
<thead>
<tr>
<th>Market design based on simple textbook economics</th>
<th>Cumulated allowance surplus in the EU Emissions Trading System</th>
</tr>
</thead>
<tbody>
<tr>
<td>Energy-only market, System adequacy through peak pricing</td>
<td><img src="image" alt="Cumulated allowance surplus in the EU Emissions Trading System" /></td>
</tr>
<tr>
<td>Emissions Trading (with CO₂ price reflecting social cost of carbon, i.e. &gt; 60 EUR/t)</td>
<td></td>
</tr>
</tbody>
</table>

Agora Energiewende (2016)
Which market design will get us cost-effectively to a 2030 power system with 50% RES-E, -68% coal and a flexible mix?

<table>
<thead>
<tr>
<th>Market design based on simple textbook economics</th>
<th>The Power Market Pentagon</th>
</tr>
</thead>
<tbody>
<tr>
<td>Energy-only market, System adequacy through peak pricing</td>
<td>Energy efficiency</td>
</tr>
<tr>
<td>Emissions Trading (with CO₂ price reflecting social cost of carbon, i.e. &gt; 60 EUR/t)</td>
<td>Revenue stabilisation for renewable energy</td>
</tr>
</tbody>
</table>

Agora Energiewende (2016): The Power Market Pentagon

Matthias Buck | Copenhagen, 7 October 2016
A market design that fits:
EU-level provisions on EOM, ETS, Smart retirement, RES-E revenue stabilisation and System adequacy safeguards

The Power Market Pentagon

- Smart & managed retirement of high carbon assets
- Revenue stabilisation for renewable energy
- Emissions trading
- Safeguarding system adequacy
- Enhanced energy only & balancing markets

Real-life constraints of EOM and ETS require broadening of perspective and consideration of policy interactions:

- Refining EOM design is no-regret, but reaches limits due to old, high carbon, inflexible capacity in legacy mix
- Smart retirement of old, high-carbon, inflexible capacity is prerequisite for market design reform to be fully effective
- Reformed ETS will not deliver smart retirement, but must complement it
- Reformed ETS will not close revenue gap for RES-E investments
- De-risking RES investments could make RES electricity cheaper than coal
- System adequacy safeguards must be consistent with RES-E integration and retirement of high-carbon assets

Agora Energiewende (2016)
**The real-life challenge:**
Designing the elements of the Power Market Pentagon so that they are mutually supportive and do not contradict each other

Matthias Buck | Copenhagen, 7 October 2016

---

**The Power Market Pentagon**

<table>
<thead>
<tr>
<th>Emissions trading</th>
<th>Energy efficiency</th>
<th>Enhanced energy only &amp; balancing markets</th>
<th>Smart &amp; managed retirement of high carbon assets</th>
<th>Revenue stabilisation for renewable energy</th>
</tr>
</thead>
</table>

**Things not to do include:**

- Introduce a capacity market which grants money to high-carbon & inflexible assets
- Reform the ETS under the assumption it would enable full refinancing of RES-e
- Enhance the energy-only market without letting demand side and RES-e fully participate in the balancing markets and implementing smart retirement policies
- Redesign renewables remuneration mechanisms without taking their effects on the energy-only market into account, …

Think of market design in a holistic way, combining all five elements sensibly!
More information and studies available at our website www.agora-energiewende.org
Thank you for your attention!

Questions or Comments? Feel free to contact me:
matthias.buck@agora-energiewende.de

Agora Energiewende is a joint initiative of the Mercator Foundation and the European Climate Foundation.
Element 1: Enhanced energy-only and balancing markets to manage the flexibility challenge

Electricity generation* and consumption* in the CWE region in a week in late summer 2030 (calendar week 32)

- Power market has to become highly flexible for continuous interplay between generation, consumption and storage
- Efficient dispatch requires power prices reflecting real-time value of electricity. Key features of market design:
  - Coupling energy markets and making them faster;
  - Improving predictability of scarcity prices;
  - Enable level-playing field for demand-side and supply side flexibility;
  - Balancing market design (products, contracting of reserves) must not distort incentives for energy market operations
  - Linking day-ahead, intraday and balancing markets to achieve prices that reflect real-time value of power

Fraunhofer IWES (2015) *Modelling based on 2011 weather and load data
Element 2: The EU Emissions Trading Scheme should provide a stable mid-level carbon price (~30 EUR/t CO2)

Comparison of the hard coal-to-gas CO₂ switching price* and the actual CO₂ price in the EU-ETS

- Main role of ETS in power sector: Shift fossil generation mix from high- to lower-carbon
- ETS not right instrument to drive investments in zero-carbon assets like renewables
- ETS cap must interact smartly with CO₂ reductions from other climate instruments (RES, EE and smart retirement policies) and should enable national climate policies
- Key measures for EU policies:
  - Cancellation mechanism for additional domestic or EU climate policy measures
  - Stabilisation of ETS price through carbon floor price (e.g. 30 EUR/t CO₂)
  - Cancellation of EU ETS surplus as part of EU’s contribution to Post-Paris-ratcheting-up mechanism

*Assuming an electrical efficiency of 35% for (old) hard coal plants and 58% for (new) gas-fired plants.
**Element 3: Smart & managed retirement – The active removal of old, high carbon, inflexible capacity**

Most urgent challenge of EU power markets are implications of legacy investments in high-carbon, inflexible generation; Market design alone reaches limits.

Smart retirement of old, high-carbon, inflexible capacity is prerequisite for successful market design.

**Required EU level action:**
- Closing gaps in Industrial Emissions Directive;
- Use appropriate emission performance standards where possible;
- Make power system flexibility part of market design reform;
- Reflect long-term decarbonisation pathway and system flexibility needs in national energy and climate plans;
- Assist lower-than-average GDP member states through EU budget.
**Element 4: Providing stable revenues for new RES-E investments to achieve EU target at least cost**

Wind / PV require revenue stabilisation throughout 2020-2030. High risks for investors lead to high cost of capital and LCOE*. 

Future RES framework should:
- Acknowledge role of revenue stabilisation to close gaps btw market revenues and returns on investment;
- Use competitive tendering to identify need for revenue stabilisation;
- Prohibit retroactive devaluing of investments;
- Translate elements from state aid guidelines into ordinary EU legislation;
- Maintain priority grid access and priority dispatch;
- Make national assessments of RES barriers obligatory;
- Include robust governance to close possible gaps between national contributions and EU-wide target;
- Include mechanism for de-risking RES investments.

Average wholesale prices versus market revenues of variable renewables

<table>
<thead>
<tr>
<th>Year</th>
<th>At low fuel and CO2 prices</th>
<th>At high fuel and CO2 prices</th>
</tr>
</thead>
<tbody>
<tr>
<td>2010</td>
<td>20</td>
<td>180</td>
</tr>
<tr>
<td>2015</td>
<td>40</td>
<td>160</td>
</tr>
<tr>
<td>2020</td>
<td>60</td>
<td>140</td>
</tr>
<tr>
<td>2025</td>
<td>80</td>
<td>120</td>
</tr>
<tr>
<td>2030</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>2035</td>
<td>120</td>
<td>80</td>
</tr>
<tr>
<td>2040</td>
<td>140</td>
<td>60</td>
</tr>
<tr>
<td>2045</td>
<td>160</td>
<td>40</td>
</tr>
<tr>
<td>2050</td>
<td>180</td>
<td>20</td>
</tr>
</tbody>
</table>

Wind / PV market revenues

*1% WACC increase yields 8% LCOE increase for wind onshore

**Ôko-Institut (2014)**
Impact of thermal plant mix on plant utilisation rates and investments in a 45% RES-E system

- Increasingly flexible power mix required ➔ Adequacy not only about “how much” but “what kind” of capacities
- Interventions must be consistent with long-term decarbonisation and flexibility needs
  - Strategic or capacity reserves operating fully outside energy and balancing markets
  - Energy-based payments by stabilising scarcity prices
  - Capability remuneration mechanisms: Resource capability rather than capacity has to be primary focus
- Cross-border adequacy assessment should be requirement for domestic CRMs
- MS to develop national/ regional roadmaps to enhance power system flexibility and NECPs used as reference point to ensure SoS interventions consistent with decarbonisation

RAP (2014) based on IEA (2014)