Electricity Market Reform – a shared complex challenge

Dr. Ronan Bolton

Lecturer in Science, Technology and Innovation Studies, University of Edinburgh

Presentation at European Union Centre on Shared Complex Challenges, University of Melbourne, Australia. 13.7.16
Electricity market design – a shared and complex challenge
Overview

1. Research perspective: socio-technical systems and energy transitions (Science and Technology Studies - STS)

2. Key debate about electricity market design in Europe

3. The need to ‘open the black box’ of electricity system design
Large Technical Systems & Society

"Electric power systems embody the physical, intellectual, and symbolic resources of the society that constructs them...electric power systems, like so much other technology, are both causes and effects of social change.” (Hughes, 1983)
A socio-technical approach

- **The ‘seamless web’**: “An artifact-either physical or nonphysical-functioning as a component in a system interacts with other artifacts, all of which contribute directly or through other components to the common system goal” (Hughes, 1987)

- **Socio-technical regimes**: “the ‘deep structure’ that accounts for the stability of an existing socio-technical system...the semi-coherent set of rules that orient and coordinate the activities of the social groups that reproduce the various elements of socio-technical systems “ (Geels, 2011)
Energy transitions: Simple narratives of disruption and decline

**BOOM! BOOM! BOOM! SOLAR ENDS FOSSIL FUEL**

- 2014 Solar = 1% of electricity.
- Solar grew 41% last year. 36% = doubling 2 years.
- 2016 2%
- 2018 4%
- 2020 8%
- 2022 16%
- 2024 32% **BOOM!** Solar ENDS use of coal
- 2026 64% **BOOM!** Solar ENDS use of natural gas
- 2028 128%
- 2030 256% **BOOM!** solar + electric cars + self-driving cars ENDS use of oil

Source: Alex Lightman TEDxHighpoint (2014)
Lessons from the history of energy transitions

Energy Transitions: “A study of a fluid process, rather than understanding it as a pretext for establishing rigid barriers between specific energy eras...older sources of energy (muscle power, renewable resources) are not replaced totally by newer sources (fossil fuels, nuclear energy). Instead they are supplemented, complemented, or slowly displaced according to use" (Melosi, 2006)

Type I and II energy transitions

<table>
<thead>
<tr>
<th>Evolutionary transition (&quot;type 1&quot;)</th>
<th>Transformational transition (&quot;type 2&quot;)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Multiple energy transitions</td>
<td>Singular transition to renewable energy</td>
</tr>
<tr>
<td>Fossil fuels (with or without CCS)</td>
<td>100% renewables</td>
</tr>
<tr>
<td>Continued/expanded use of nuclear power</td>
<td></td>
</tr>
<tr>
<td>Partial recourse to renewables</td>
<td></td>
</tr>
<tr>
<td>Energy efficiency understood as greater energy intensity</td>
<td></td>
</tr>
<tr>
<td>A “low carbon” economy</td>
<td>Energy efficiency understood as major energy savings</td>
</tr>
<tr>
<td>A slow- and long-term set of transitions</td>
<td>A “zero carbon” economy</td>
</tr>
<tr>
<td>An open-ended perspective</td>
<td>A rapid and near-term transition</td>
</tr>
<tr>
<td>A process-oriented frame</td>
<td>A deterministic perspective</td>
</tr>
<tr>
<td>Little or no belief in transition management</td>
<td>A product-oriented frame</td>
</tr>
<tr>
<td>Modest policy prescriptions, mainly by incumbent energy majors and established policy communities</td>
<td>Ambitious policy prescriptions, mainly by renewables lobby and environmental NGOs</td>
</tr>
</tbody>
</table>
Electricity markets in Europe
European electricity integration

1929: George Viel's 400 kV network for Europe (Vincent Lagendijk)
1920s - Early regional power pools
Hidden integration

"The creation of a European electricity system remained for a long time separate from the processes of political and economic integration that led to the EU. In fact, the notion of such a system was already conceived of during the interwar period and the process that led to its realization was initiated after 1921" (Lagendijk, 214)
Early 1990s: A new phase of market liberalisation
Three energy packages

Core components

- Market opening
- Third-Party Access
- Market regulation
- Unbundling of TSOs
- Network Development

First package 1996/1998
- Gradual and restricted
- Negotiated, Regulated or Single Buyer
- Any competent authority
- Accounting

Second package 2003
- 100%
- Regulated access only
- Independent National Regulator
- Legal

Third package 2009
- Directive 2009/72/EC
- Directive 2009/73/EC
- Regulation (EC) No 713/2009
- Regulation (EC) No 714/2009
- Regulation (EC) No 715/2009
- Coordination of regulators by ACER
- TSO as a separate entity
- Ten year Network Development Plans
- Coordination of TSOs by ENTSO-E and ENTSO-G

Source: European Court of Auditors.
The “target model” and a new institutional architecture

- Practical steps for implementing the 3rd energy package

“The internal market should be completed by 2014 so as to allow gas and electricity to flow freely” (European Council conclusion of February 4, 2011)
 Structural changes in the European electricity system
Rise in investment

Figure 2: Evolution of installed generation capacity by technology in the EU28 as a whole. Source: Eurostat.
Falling demand

Figure 6: Evolution of generated electricity in the EU28 as a whole

Source: Eurostat
Figure 9: Evolution of average demand and generation capacity for the EU28 as a whole

Source: Eurostat
Falling prices

Figure 14: Evolution of spot electricity prices in France and Germany

Source: European Commission on the basis of Power Exchanges data
Diverging views on electricity market design
EU Commission investigation

- Launched in April 2015:

  “concerns that capacity mechanisms may unduly favour particular producers or technologies and that they may create obstacles to trade in electricity across borders”

- EU also consulting on its ‘Market Design Initiative’
An interventionist trend

<table>
<thead>
<tr>
<th>Tender for new capacity</th>
<th>Strategic reserve</th>
<th>Targeted capacity payment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Belgium **</td>
<td>Belgium</td>
<td>Italy</td>
</tr>
<tr>
<td>France</td>
<td>Denmark **</td>
<td>Poland</td>
</tr>
<tr>
<td>Ireland **</td>
<td>Germany ***</td>
<td>Portugal ***</td>
</tr>
<tr>
<td></td>
<td>Poland</td>
<td>Spain ***</td>
</tr>
<tr>
<td></td>
<td>Sweden</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Germany (Interruptibility Scheme)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Ireland (Interruptibility Scheme)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Italy (Interruptibility Scheme) ***</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Poland (Interruptibility Scheme)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Portugal (Interruptibility Scheme)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Spain (Interruptibility Scheme)</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Central buyer</th>
<th>De-central obligation</th>
<th>Market-wide cap. payment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ireland *</td>
<td>France *</td>
<td>Ireland</td>
</tr>
<tr>
<td>Italy *</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* Planned Mechanism (or being implemented)
** Past Mechanism (or never implemented)
*** Multiple capacity mechanisms of the same type

Source: European Commission based on replies to sector inquiry
Electricity market reform processes

An electricity market for Germany’s energy transition

White Paper by the Federal Ministry for Economic Affairs and Energy

Energy Act 2013

CHAPTER 32

Explanatory Notes have been produced to assist in the understanding of this Act and are available separately.
UK EMR – innovation friendly?

“Encourage the investment we need to replace older power stations and provide backup for more intermittent and inflexible low-carbon generation sources” (Amber Rudd)
• Capacity reserve for extreme events – key difference is plants taken out of energy market
• 2.7GW Lignite reserve – achieving climate target and phase out by 2020
The new politics of electricity market design – towards hybrid markets

- **Market purists** - “remove all policy intervention that distorts market prices and internalise the climate externality with a strong carbon price”

- **Climate change planners** - “minimise the financing cost of low-carbon generation investments by insulating investors from market risk, introducing procurement auctions for power purchase agreements for low-carbon generation projects. Ultimately, following this logic would lead to the abandonment of competitive markets”

IEA, 2016
Concluding remarks
Electricity market design as a form of ‘technopolitics’

“Many fundamental technical choices – such as choices about system design and programmatic development – have significant and inseparable political dimensions” (Gabrielle Hecht)
Electricity markets and system transition
Thank you!!

- **Contact:** Ronan.Bolton@ed.ac.uk
- **Publications:**
- **Twitter:** @EdinburghEnergy
- **Energy and Society Research Group:**
  [http://www.sps.ed.ac.uk/research/research_centres/cross_school_research_clusters/energy_and_society_research_group](http://www.sps.ed.ac.uk/research/research_centres/cross_school_research_clusters/energy_and_society_research_group)