Capacity Remuneration Mechanisms

23rd Energy Community Electricity Forum

7 June 2018, Athens
“Missing money”

How to “Create a stable regulatory and market framework, capable of attracting investment” + “Develop Network Energy market competition”?

Fears that

- Reliance on market prices leads to cyclical periods of under and over-capacity and price volatility
- Price caps below VOLL to avoid price surges disincentivise required investment as fixed costs of marginal units cannot be recovered
- Merit order effect from promotion of RES may reduce space for new investment in conventional plants, eg in the UK market no new large CCGTs built for many years

Source: Digest of UK Energy Statistics (DUKES), 2017
The risk of generator “mathballing”

The impact of average mothballing on LOLE in 2020

Inner circle: base LOLE
Outer circle: LOLE after mothballing

Source: ENTSO-E, Mid-term adequacy forecast, 2017 Edition
Any type of “Capacity”?  

- Power generation not equally fast, neither equally sustainable among different technologies  
  - Hydro: fast / restricted by dam size  
  - Coal plant: slow / sustainable  
  - Diesel, open cycle gas turbine: fast / sustainable (expensive)  
  - Batteries: very fast / not sustainable  

- Different type of capacity needed or appropriate to follow load, or provide reliability margin  

- Part loading, load following and plant cycling have an impact on efficiency, emissions, and power plant life

### Flexibility of Conventional Power Generation Technologies

<table>
<thead>
<tr>
<th></th>
<th>Nuclear</th>
<th>Hard coal</th>
<th>Lignite</th>
<th>CCGT</th>
<th>Pumped storage</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Start up time</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&quot;cold&quot;</td>
<td>~40h</td>
<td>~6h</td>
<td>~10h</td>
<td>&lt;2h</td>
<td>&lt;0.1h</td>
</tr>
<tr>
<td>&quot;warm&quot;</td>
<td>~40h</td>
<td>~3h</td>
<td>~6h</td>
<td>&lt;1.5h</td>
<td>~0.1h</td>
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<tr>
<td><strong>Load Gradient</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(±% of Nominal Output)</td>
<td>~5%/min</td>
<td>~2%/min</td>
<td>~2%/min</td>
<td>~4%/min</td>
<td>&gt;40%/min</td>
</tr>
<tr>
<td><strong>Minimal Shutdown Time</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>~10h</td>
</tr>
<tr>
<td><strong>Minimal Possible Load</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>50%</td>
<td>40%</td>
<td>40%</td>
<td>&lt;50%</td>
<td>~15%</td>
</tr>
</tbody>
</table>

Source: Flexible Generation: Backing up Renewables, 2011, EURELECTRIC
“Member States proposing capacity mechanisms should make appropriate efforts to address their resource adequacy concerns through market reforms. In other words, no capacity mechanism should be a substitute for market reforms“ (EC, Final Report of the Sector Inquiry on Capacity Mechanisms, 2016)

- **35 CRM in 11 MS**
  - Volume based: Targeted – Market-wide
  - Price based
- **Use of interconnectors?**

Source: ACER, Annual report on the results of monitoring the internal electricity markets in 2016
Capacity Remuneration Mechanisms in the EU

- **Capacity Payments**
  - TSO pays fixed amount for firm capacity to all

- **Capacity Market**
  - **Capacity obligations** imposed on suppliers relative to their contracted or expected supply, or
  - **Capacity auctions.** Costs allocated to suppliers pro rata, or through tenders. Firm or option contracts, eg reliability options

- **Strategic Reserves**
  - Tenders for required capacity. Long term. Withdrawn from wholesale market. Only activated if DAM is unable to cover demand

Source: ACER, Annual report on the results of monitoring the internal electricity markets in 2016
The UK capacity market – auction design

- **Central auction**
  - Primary auction (T-4) 4 years ahead of delivery year
  - T-1 for fine tuning

- **Market wide - participants**
  - Generation
  - Demand Side Response (DSR)
  - Storage

- **Capacity not withdrawn from wholesale market**

- **Contract duration:**
  - New plant up to 15 years
  - Refurbished above a threshold 3 years
  - Existing plant, DSR, etc 1 year

- **Penalties for non availability of capacity providers in the delivery year**

- **Costs of capacity shared between suppliers**

- **Eligibility – excluded facilities:**
  - Under short term operating reserve contracts
  - Receiving support (FiT, RHI, ROO, NER300, CCS) and low carbon

- **Reverse auction, pay as clear (clearing algorithm maximizing consumer welfare)**
The UK capacity market – auction parameters

- **Capacity to target annually**
  - Electricity Capacity Report (NG),
  - Independent Panel of Technical Experts
  - Reliability standard = 3 h of LOLE/y

- **Net Cost of New Entrant**
  - after accounting for wholesale and ancillary market revenues
  - Reference technology (from OCGT in 2013 to CCGT in 2015)
  - Capital, O&M, expected operating performance
  - NetCONE = 49 £/kW-year

- **Price cap** (netCONE estimate uncertainty)
  - 1.5 x netCONE = £75/kW-year

- **Price-taker threshold**
  - Cover majority of existing plant, so that total revenues (from wholesale market, AS and CM combined) do not significantly exceed that of a competitive outcome
  - £25/kW (50% of netCONE)

- **Capacity tolerance** (anti-gaming)
  - Target capacity ± 1.5 GW
The UK capacity market – problems, calibration

- Plenty of diesel units, increasingly batteries, but only 2.6 GW of new CCGT in 2014, very low DSR
  - Of which, the only one 15-year contract (Trafford) withdrawn in 2016 due to lack of financing.
  - Low capital costs, fast response, benefitting from other revenue streams (e.g., avoided transmission costs)

- Review in 2016
  - Removal of double payment for Capacity Market Supplier Charge providing unfair advantage to small scale embedded generators
  - New emission limit rules penalizing mainly diesel generators
  - Derating for limited sustainable delivery period (e.g., 60-minute batteries)
  - Eligibility threshold reduced to 500kW to enable a wider range of DSR resources enter the 2017 TA

<table>
<thead>
<tr>
<th>Date</th>
<th>Type</th>
<th>Delivery from</th>
<th>Contracted</th>
<th>Clearing price (£/kW)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dec 2014</td>
<td>T-4</td>
<td>2018/19</td>
<td>49.3 GW</td>
<td>19.4</td>
</tr>
<tr>
<td>Dec 2015</td>
<td>T-4</td>
<td>2019/20</td>
<td>46.35 GW</td>
<td>18</td>
</tr>
<tr>
<td>Jan 2016</td>
<td>TA</td>
<td>2016/17</td>
<td>803 MW</td>
<td>27.5</td>
</tr>
<tr>
<td>Dec 2016</td>
<td>T-4</td>
<td>2020/21</td>
<td>52.42 GW</td>
<td>22.5</td>
</tr>
<tr>
<td>Feb 2017</td>
<td>T-1</td>
<td>2017/18</td>
<td>53.6 GW</td>
<td>6.95</td>
</tr>
<tr>
<td>March 2017</td>
<td>TA</td>
<td>2017/18</td>
<td>312 MW</td>
<td>45</td>
</tr>
</tbody>
</table>

Source: EMR Delivery Body
T-4 capacity auction, 2018 (delivery 2021-22): record low price

- Clearing price 8.40 £/kW
- 50.4 GW awarded
- 8 GW of coal not awarded
- 14.1 GW of new generation not awarded

Awarded and exited capacity by type and technology

Source: National Grid, Provisional auction results T-4 Capacity market auction for 2021/22
The UK capacity market – concerns, criticism

- Prices too low to incentivise major investments, especially in CCGT
- Market pays existing plant, which may be already amortised and would have remained in operation even without the capacity payment (e.g., coal plants)
  - Open to existing capacity
  - Payments at marginal price
  - **Alternative:** only contract for existing capacity needed for security and would otherwise close (e.g., the short term operating reserve [STOR] payment to coal plants); and procure new capacity

- **Procurement of peakt ime capacity, rather than firm energy**
- **Alternative:**
  - Procure a given amount of energy delivery over time, through distributed load obligation, capacity payments, or a reliability option.
  - Underlying requirement: firm generation (based on a probabilistic calculation across the full supply curve) according to its ability to offer firm energy across the year, not just at peak

- *(Or leave it to the market...)*