Capacity Mechanisms: management of Interconnectors and cross-border effects

David Newbery
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Cambridge Spring Research Seminar
16th May 2014
http://www.eprg.group.cam.ac.uk
Outline

• What is the problem?
• Energy-only markets and capacity payments: theory
  – policy failures, price caps
• Proposed EMR capacity auction
  – defended by missing money (VOLL > max energy price)
  – complications: risk, market coupling rules
• Interconnectors: problems
What is the problem?

Ofgem’s derated capacity margin

Source: DECC IA
<table>
<thead>
<tr>
<th>Interconnectors by 2018</th>
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<tbody>
<tr>
<td>IFA to France</td>
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<tr>
<td>Britned to NL</td>
</tr>
<tr>
<td>Moyle to NI</td>
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<tr>
<td>EWIC to RoI</td>
</tr>
<tr>
<td>NEMO to Belgium</td>
</tr>
<tr>
<td>Eclink to France</td>
</tr>
<tr>
<td><strong>Total</strong></td>
</tr>
</tbody>
</table>

- potential swing 12 GW = 20% peak demand
- emergency SO actions cannot reverse IC flow

**Key question - what contribution to derated capacity?**

*Poyry (2012): 50-80% depending on margins abroad*
Energy-only markets

• If generators can (and are allowed to) bid scarcity prices no problem?
  – France (*de facto* monopoly) bids high peak prices
  – GB has adequate capacity and flat prices

• Wind, PV, cheap coal, low C prices drive clean spark spreads negative (in DE especially)
  – electricity prices affected by policy

=> *policy uncertainty undermines peaking investments needed*

*Capacity contracts to address policy failure*
France much peakier than GB

European power exchanges 2012

Graph showing the percent time price higher than various Euros/MWh values for France, UK MIP (Euros), Germany 2012, and Netherlands.
Capacity payments: theory

Efficient price = SMC + CP
SMC = system marginal cost, CP = capacity payment
CP = LoLP*(VoLL - SMC)

LoLP = Loss of Load Probability in each hour
LOLE = ▲ LoLP over year (Loss of Load Expectation)
set at 3 hrs in GB

=> VoLL = Value of Lost Load = £17,000/MWh

• Max price in Euphemia day-ahead = €3,000/MWh
  – Max price in France = €3,000/MWh
  – Max price in SEM (Ireland) = €1,000/MWh
Experience in the Pool and BETTA

- The Pool (1990-2001) had an explicit CP at LoLP*(VoLL-SMP), VoLL = £(2013)5,000/MWh
  - (but SMP is as bid, not SMC)
- NETA/BETTA was an energy-only market with a Balancing Mechanism, System Buy and Sell prices
  - reformed many times, long side defaults to prompt price
  - initially pay-as-bid, then average of last $N$ MW
  - consulting on Significant Code Review to deal with 2015/16

How well did they signal scarcity?
Pool prices were peakier than spot market as they had a capacity payment.
CP in the Pool - 50% revenue in 1.8% (158) hours

PPP-SMP 1998-9 at 2012 RPI prices

capacity payment

percent total capacity revenue
Pool prices 1998-9 and System Buy Price 2008

Price duration curves Pool 1998-99 and Balancing 2008 at 2013 CPI prices

Balancing prices peakier than Pool
Imbalance prices not adequately marginal?
• Ofgem conducts **Significant Code Review** of BM

• Proposes:
  
  – single marginal price
  
  – load shedding bids at proxy Value of Lost Load
    
    • pVOLL = £3,000 rising to £6,000/MWh by 2018
    
    • DECC sets VOLL at £17,000/MWh
  
  – STOR bids in at $f(pVOLL,LoLP)$

**BM price has never hit even £3,000/MWh**

*Missing money: 3hrs*(£17,000-6,000)/MWh
Capacity to be replaced

Seems small - can it be covered by interconnectors?

Source: DECC IA
• Pay-as-clear descending clock auction in 2014 for delivery 2018/19  
  – max energy price assumed £6/kWh  
  – LOLE = 3 hrs => VOLL = £17/kWh  
  – => missing money = 3 hrs*(17-6)/kWh = £33/kW  
• new build gets 15 yr contract at auction price  
  – existing plant: 1 yr contract unless major refurbish  
    • must be price taker unless good cause, entrants set price  
    • existing plant can delay until later auction (2017)  
• DSR auctioned from 2016: 1 yr contracts
Illustrative auction demand curve

Source: DECC·IA

- New plant sets high price for all
- No new plant and price is low

£75/kW year
Net benefit is difference between large producer surplus and large consumer loss. Initially adverse.
GB coupled to NWE 4/2/1

SEM not until 2016

SWE coupled to NWE 13/5/14
Issues with interconnectors

• Interconnectors increase security of supply
  – provided they are free to respond to scarcity
=> they should have a positive derated capacity
  – Poyry estimates 50-80%

• Efficient pricing benefits trading country
  – if partner mis-prices they lose
=> efficient pricing drives out inefficient pricing

• But Euphemia imposes €3,000/MWh cap
Cross-border capacity procurement

- EU wants any capacity market to be EU-wide
- What contract can deliver capacity from abroad?
  - How does specific foreign plant guarantee to export to GB in stress hours?
    - PTR defaults to FTR on the day, but GB price may not signal true scarcity (and there is a price cap)
      - Would it not likely do so anyway without a CP?
- Why not have a contract with the SO for imports over the interconnector in stress hours?
  - Devolve to SO securing supply
  - or SO auctions for capacity over IC?
Investment in interconnectors

• The economics of investment look good anyway
  – and get better with more wind, PV, carbon price floor
• recognising contribution to security increases value
  – DC interconnectors are controllable
  – GB Interconnectors are logical suppliers of capacity
• problem: TO’s cannot contract for generation
  – but SO (abroad) could run auction for capacity and access
  => rent collected by ICs

EU open access to CP needs firm access to ICs and penalties for non-delivery
Conclusions

• Theory of scarcity pricing clear
  – leads to $CP = \text{LoLP} \times (\text{VoLL} - \text{SMC})$
  – energy-only markets could do this in theory
    • and hedge with reliability options

• main failures: policy uncertainty and price caps
  – and lack of credible distant futures markets

• Capacity markets can address these
  – but potentially large transfers from consumers

And need much higher Euphemia price cap
Appendix

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<table>
<thead>
<tr>
<th>Acronym</th>
<th>Description</th>
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<tbody>
<tr>
<td>BM</td>
<td>Balancing mechanism (or market)</td>
</tr>
<tr>
<td>CONE</td>
<td>Cost of new entry (net = net of revenue from selling power)</td>
</tr>
<tr>
<td>CP, CM</td>
<td>Capacity payment, capacity market</td>
</tr>
<tr>
<td>DSR</td>
<td>Demand side response</td>
</tr>
<tr>
<td>EMR</td>
<td>(UK) Electricity Market Reform</td>
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<tr>
<td>F(P)TR</td>
<td>Financial (physical) transmission right</td>
</tr>
<tr>
<td>IC</td>
<td>Interconnector</td>
</tr>
<tr>
<td>LOLE</td>
<td>Loss of load expectation = ♦ LoLP over year</td>
</tr>
<tr>
<td>LoLP</td>
<td>Loss of Load probability</td>
</tr>
<tr>
<td>PV</td>
<td>Photo voltaic</td>
</tr>
<tr>
<td>SEM</td>
<td>Single Electricity Market for Ireland</td>
</tr>
<tr>
<td>SMC(P)</td>
<td>System marginal cost (price)</td>
</tr>
<tr>
<td>SO</td>
<td>System operator</td>
</tr>
<tr>
<td>SRMC</td>
<td>Short-run marginal cost</td>
</tr>
<tr>
<td>STOR</td>
<td>Short-term operating reserve</td>
</tr>
<tr>
<td>TEM</td>
<td>Target Electricity Market</td>
</tr>
<tr>
<td>TO</td>
<td>Transmission owner</td>
</tr>
<tr>
<td>VOLL</td>
<td>Value of Lost Load (£17,000/MWh in GB)</td>
</tr>
</tbody>
</table>
References

• DECC (2102) Electricity Market Reform – Capacity Market Impact Assessment at

Capacity payments in Irish SEM

• Bidding Code of Practice requires generation to bid into Pool at SRMC

=> missing money => CP based on VoLL & LoLP

• generators get *ex post* system MC (SMC) + CP

• VoLL scaled to deliver adequate payment for new entry, paid part on *ex ante* LoLP, part on *ex post*
  – stabilises revenue, reduces volatility

• paid on imports, charged to exports

*ex post pricing incompatible with TEM*
SEM Capacity Payments 2012 and 2013

Average €7/MWh

50% revenue in 12% hours

Average €7/MWh
Base case: each country matches average production to consumption arbitrages over coupled IC’s, no shared balancing or reserves

Source: DG ENER (2013)