UNIVERSITY OF CAMBRIDGE | Energy Policy Research Group

Capacity remuneration mechanisms and system adequacy*

David Newbery

University of Cambridge

Spring Seminar, Cambridge

6th May 2020

* Revised version of slides presented on 6th May

Outline

- **Clean Energy Package** favours **E**nergy **O**nly **M**arket
  - Missing money and missing markets
- **Capacity Remuneration Schemes** (CRMs)
  - Capacity payments, Strategic Reserves or none = EOM?
  - CRM design – emissions limits to receive contract
- **Capacity adequacy**
  - Forecasting deliverable supply
    - Nuclear/coal capacity and Covid-19 **uncertainty**
  - Balancing markets => final SO intervention

⇒ Coordinating SO responses

⇒ Implications of uncertainty

Clean Energy Package

- **Clean Energy Package**:
  - Energy-Only Market (EOM) design
    - Failing which, **Strategic Reserves**, only then **Capacity Payments**
- Regulation (EU) 2019/943:
  - Capacity Remuneration Mechanism (CRM) **only** if adequacy problems cannot be solved by removing market distortions
    - e.g. failure to adequately **remunerate ancillary services** for security of supply - frequency & voltage response, reserves, ramping, etc.
    - Failure to reach **true scarcity price** in real time
- Solutions:
  - imbalances price = VoLL*LoLP, if necessary with **scarcity adder**
    - As in I-SEM; Texas has Operating Reserve Demand Curve

Minimise "missing money" essential

But fails to address "missing markets"

Missing Markets

- Futures markets open for 2 years, not 20 years
  - Acceptable (?) with large companies and only commercial risks
    - Even then GB "dash for gas" based on **long-term PPAs and franchise market**
  - Problematic given political determination of future carbon prices, renewables and nuclear policy
- Renewables need flexible back-up and inertia
  - Future value of flexibility hard to predict:
    - battery prices falling, DSR aggregation developing
    - I-SEM aiming at 75% wind penetration by increasing RoCoF* standards
  - How choose back-up technology without future prices?
- Recognised need to de-risk RES with long-term contracts

Similar logic applies to delivering future SoS

* Rate of change of frequency – in I-SEM to 1 Hz/sec (GB has 0.25 Hz/sec)

Capacity Mechanisms

- **For EU approval** (max length 10 years)
  - Demonstrate that a Strategic Reserve insufficient
  - Satisfies the ENTSO-E European Resource Adequacy Assessment
    - Methodology not expected until Aug 2020, gradual updates from 2021
  - Has coordinated and assessed interactions with linked neighbours
  - Has plans for phase-out after 3 years of no new contracts
- Contracts
  - Must be open, transparent non-discriminatory ***and*** non-distorting
  - Tough emissions limits
    - Forces closure of all coal after 2025, limits hours of distillate peaking plant
- LOLE – net CONE/VOLL in hrs/yr (3? 8? Country-specific?)
  - Considerable **uncertainty** about VOLL, net CONE (depends on future prices on all markets)

Strategic reserves or CRMs?

Lambin and Léautier (2019) on ***long run impacts:***

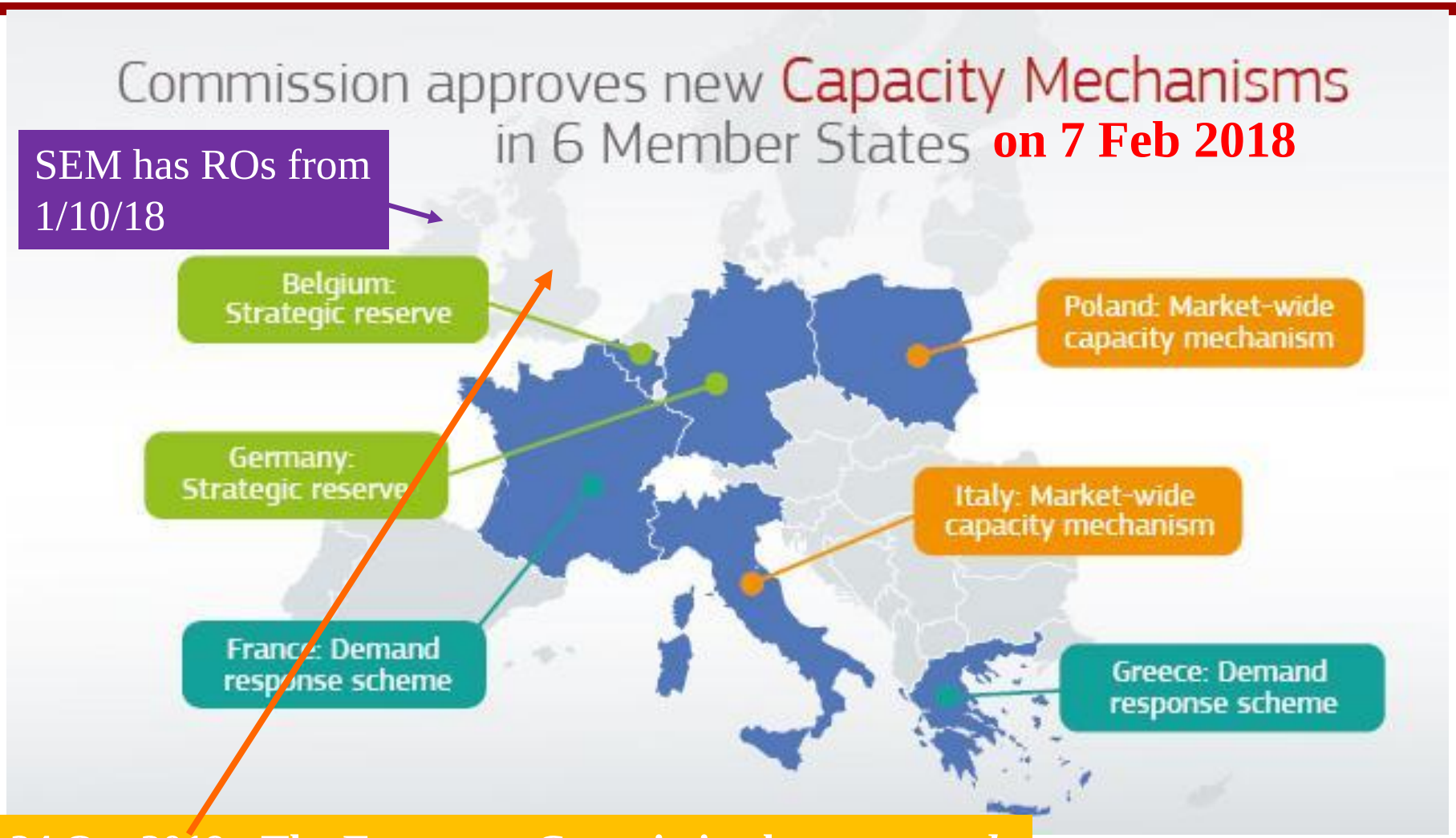
Local scheme	**Gains from**	**Suffers from**
Energy–Only	Strategic Reserve	Capacity Payment
Strategic Reserve	Energy Only	Capacity Payment
Capacity Payment	Strategic Reserve ~ Energy Only	-

- EU likes EOMs, so argues for Strategic Reserves

But Capacity payments or Reliability Options superior

UNIVERSITY OF CAMBRIDGE | Energy Policy Research Group

State-aid approval to CRMs



24 Oct 2019 - The European *Commission* has *approved* Britain's *Capacity* Market scheme

Reliability Options to replace Capacity agreements

- RO sets strike price, ***s*** (e.g. at €500/MWh)
- Market price ***p*** reflects scarcity (Voll x LoLP)
  - SO sets floor price to reflect spot conditions
  - Wholesale price signals efficient international trade
- RO auctioned for annual payment ***P***
  - 7-10 yrs for new, 1 yr for existing capacity
- Gen pays back wholesale price ***p***
  - less strike price if available (***p – s***)
  - G chooses whether to be paid ***p*** or ***s + P***
- Suppliers hedged at strike price ***s*** for premium ***P***

Trade over interconnectors efficient

No need to pay foreign generators

Clean Energy Package
Emissions limits

- **C**lean **E**nergy **P**ackage: Capacity contracts only if
  - Plant commissioned before 4/7/19 with > 550gmCO_2/kWh limited to 350kgCO_2/kWyr from July 2025
  - plant built after 4/7/19: < 550gm/kWh
- Until 2025: pre-2019 least efficient plant still eligible for CRM
  - Coal likely uneconomic from 2025 as limited to 350-400hrs/yr
  - Diesel recip engines (602gm/kWh, 580hrs/yr) still viable for peaking
- OCGTs (460gm/kWh) and gas recip engines (497gm/kWh) eligible (700 MW gas recips cleared in GB T-4 March 2020)

$\Rightarrow$ Coal phase-out to be completed by July 2025

Driven by adequate CO_2 price in GB
Emission standards needed otherwise

Capacity adequacy

- Need to decide volume to procure (or Demand curve)
  - T-1 to guide exit and T-4 for new build
  - Need to forecast stress period demand under range of scenarios
    - High/low wind, high/low winter temperature, systemic nuclear outages, …
  - Balance cost of LoLE (at VoLL) against net CoNE
  - GB follows Least Worst Regret approach, may over-procure
- Need to de-rate plant types
  - Problematic for interconnectors, harder still in meshed system
  - For wind need to worry about correlations with linked systems
  - Need access to forecasts of supply and demand in linked markets
  - Need to know how supply allocated in coincident stress periods
  - And confidence in working of EU balancing market integration

Predicting future

- **Nuclear policy** in disarray
  - DE: nuclear phase-out completely offset CO_2 reduction of RES
  - FR *loi de transition énergétique*: nuclear fall from 59GW to 38 GW?
  - BE – will existing nuclear plant be life-extended?
  - GB – will Sizewell C be authorised?
- Covid-19 complicates predictions of **future D & S**
  - EdF expects 2020 fall in nuclear **output** from 390 to 300 TWh
    - Recovering to 330-360 TWh in 2021 and 2022
  - Sustained fall in GDP/**demand** may last several years
    - Many companies exit

Greater uncertainty => more optionality

Pre-authorise sites, increase T-1 relative to T-4

SO coordination

- **DC**-linked systems: **SO can deny exports**
  - Unless contracted with other SO's

  => ensures domestic capacity adequacy + de-rated ICs
- **Meshed** systems: SOs re-dispatch to satisfy T limits
  - Rely on balancing markets/adder to LoLP*VoLL

  => lower LoLE=> higher VoLL=> outbid neighbours
  - Relies on sensible release of **Strategic Reserve**
    - And strict following re-dispatch rules using flow-based calculations

    => requires **agreement and trust**

Likely to lead to over-emphasis on domestic SoS

And excess EU adequacy?

Conclusions

- **Security of supply paramount**
  - ⇒ Makes international solidarity harder
  - ⇒ likely to lead to over-procurement
  - ⇒ ROs trump CRMs trump Strat. Res. trump EOMs in long run
- **Clean energy package** eliminates coal by 2025
  - Pre-2019 distillate peaking plant limited to 580 hrs/yr after 2025
- **Sharing reserves** cross-border hard to achieve
  - But Reliability Options the best way forward
  - With suitable adders to bring balancing prices up to LoLP*VoLL

UNIVERSITY OF CAMBRIDGE | Energy Policy Research Group

Capacity remuneration mechanisms and system adequacy*

David Newbery

University of Cambridge

Spring Seminar, Cambridge

6th May 2020

* Revised version of slides presented on 6th May

Acronyms

CCGT	Combined cycle gas turbine
CEP	Clean Energy Package
CoNE	Cost of New Entry
CRM	Capacity Remuneration Mechanism
EOM	Energy-only market
D	Demand
DSR	Demand Side Response
IC	Interconnector
I-SEM	Integrated Single Electricity Market of island of Ireland
LoLE	Loss of Load Expectation in hours per year
LoLP	Loss of Load Probability (in relevant time period)
PPA	Power Purchase Agreement = long-term contract
RES	Renewable Electricity Supply
S	Supply
SO	System Operator
SoS	Security of Supply
T	Transmission
T-1, T-4	auctions for delivery 1 or 4 years ahead
VoLL	Value of Lost Load

References

- Lambin, X. and T-O.Léautier, 2019. Cross-border Effects of Capacity Remuneration Schemes in Interconnected Markets: Who is Free-riding? *The Energy Journal*, 40(6), 79-109.
- Newbery, D. 2020. Capacity Remuneration Mechanisms or Energy-Only Markets? The case of Belgium's market reform plan, at https://www.eprg.group.cam.ac.uk/comment-capacity-remuneration-mechanisms-or-energy-only-markets-the-case-of-belgiums-market-reform-plan-by-d-newbery/
- REGULATION (EU) 2019/943 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 5 June 2019 on the internal market for electricity (recast) at https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32019R0943