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The Final Hurdle? Security of Supply, the Capacity Mechanism and the role of interconnectors*

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EPRG Winter Seminar

Cambridge, 14th Dec 2014

http://www.eprg.group.cam.ac.uk

* Based on Newbery and Grubb EPRG WP1412

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Outline

- Security of supply
  - What is the problem?
  - Misperceptions
- The EMR Capacity Mechanism
  - Design, impact assessment, amount announced
  - Prequalification results
  - Criticisms: interconnectors, optionality
- Consquences

Who should decide on capacity adequacy?

Are there other ways of delivering security?

What is the problem?

- Ambitious RES targets increase intermittency
  - Need flexible peaking reserves
  - Normally comes from old high cost plant = coal
    - Large Combustion Plant Directive 2016 limits coal
    - Integrated Emissions Directive further threat to coal
    - Carbon price floor => close old coal
  - high EU gas prices and low load factors
    - gas unprofitable, new coal prohibited by EPS
- Future prices now depend on uncertain policies
  - on carbon price, renewables volumes, other supports
  - on policy choices in UK and EU

Hard to justify investing in reliable power

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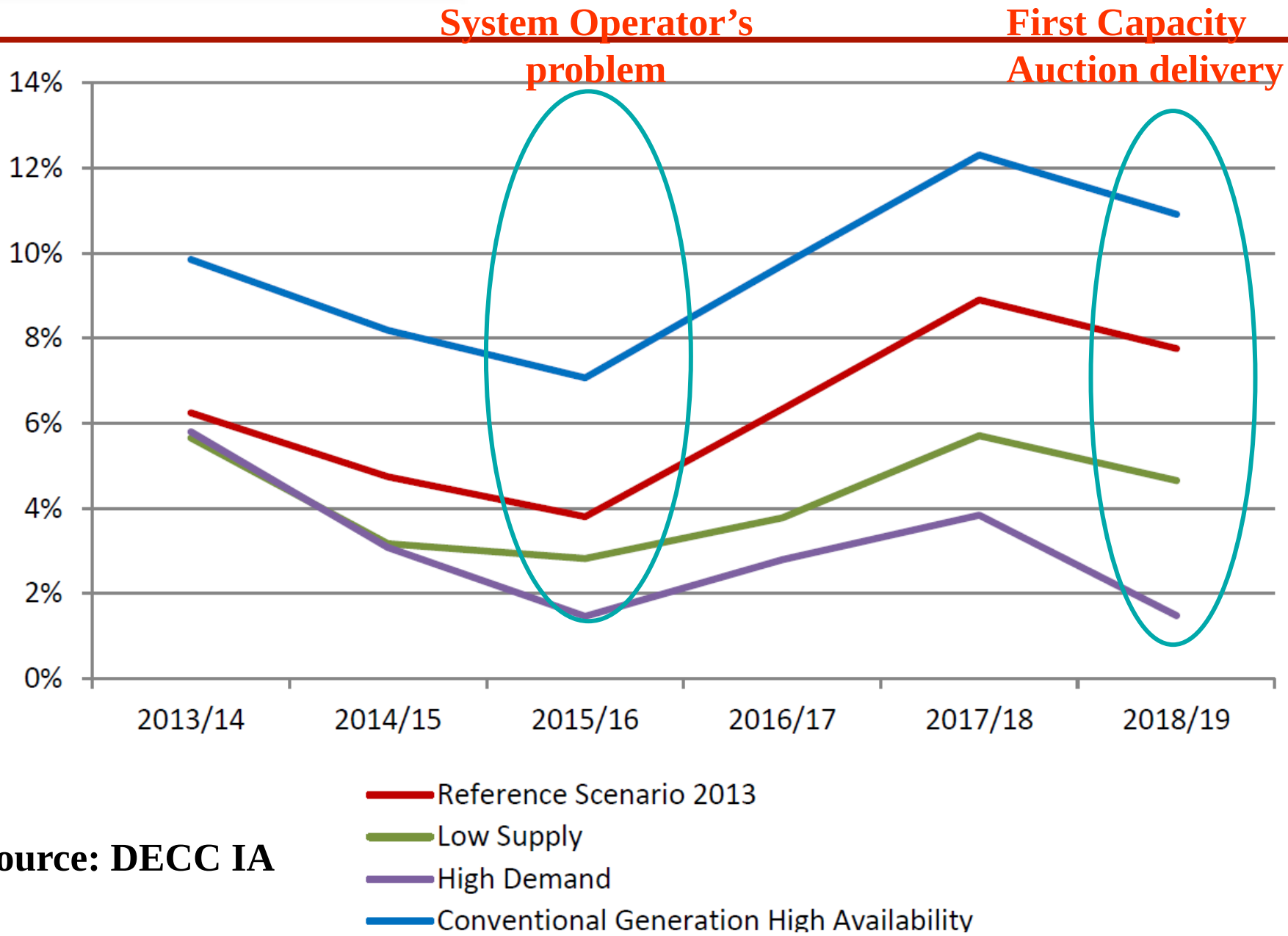
When is the problem?

Ofgem's derated capacity margin



Source: DECC IA

Measuring SoS

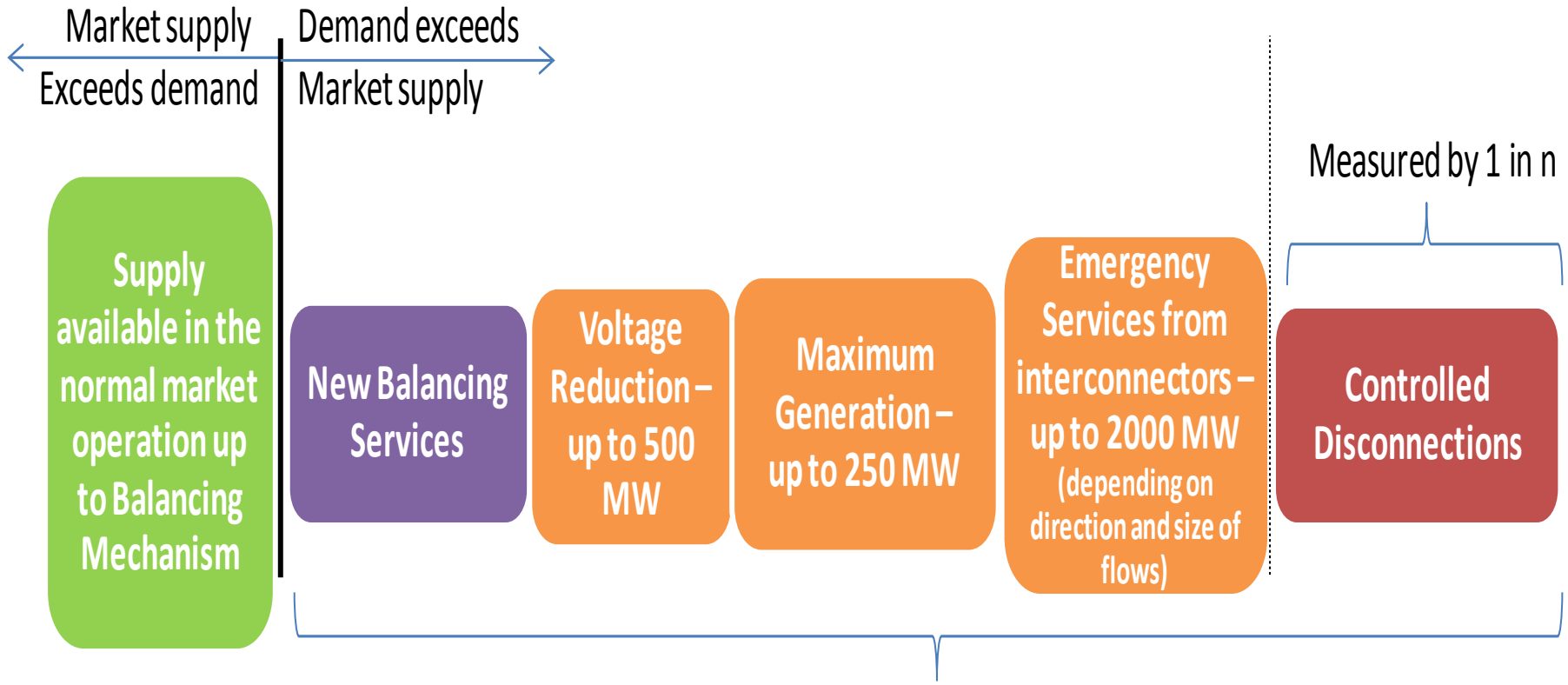
- SoS Measured by Loss of Load Expectation, LoLE
  - 3 hours per year => Value of Lost Load = £17/kWh
- But spot and balancing prices capped
  - Balancing actions costs will increase to £6/kWh
- Missing money = (£17-£6/kWh) x 3 hrs/yr =£33/kW yr

⇒ Auction to pay for missing money

But what does a "Loss of Load" mean?

Demand exceeds offered market supply

What does "Loss of Load" mean?



These actions have lower cost/value than £17/kWh

Source: Ofgem (2014) *Capacity Assessment 2014*

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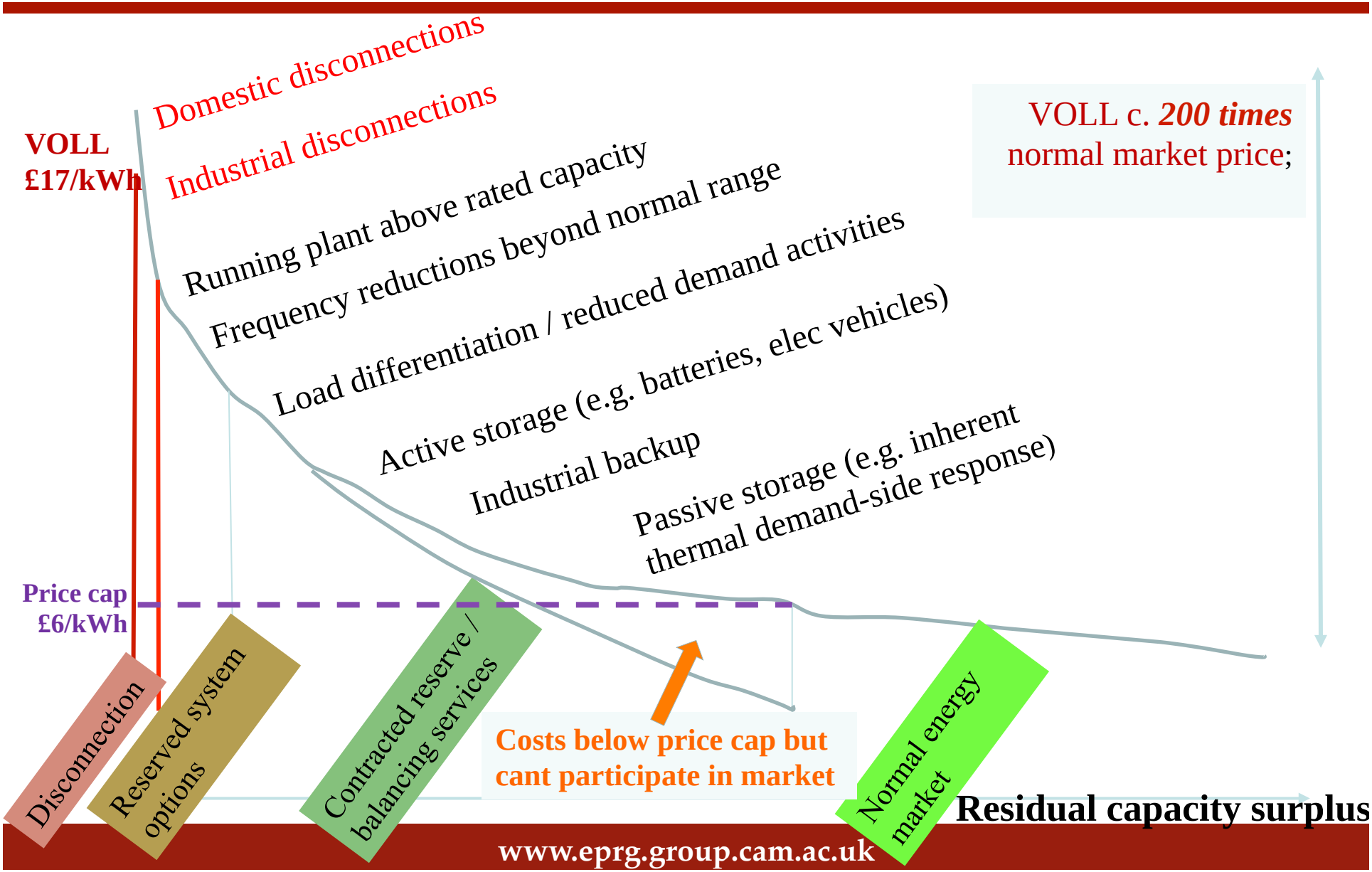
Supply curve of options



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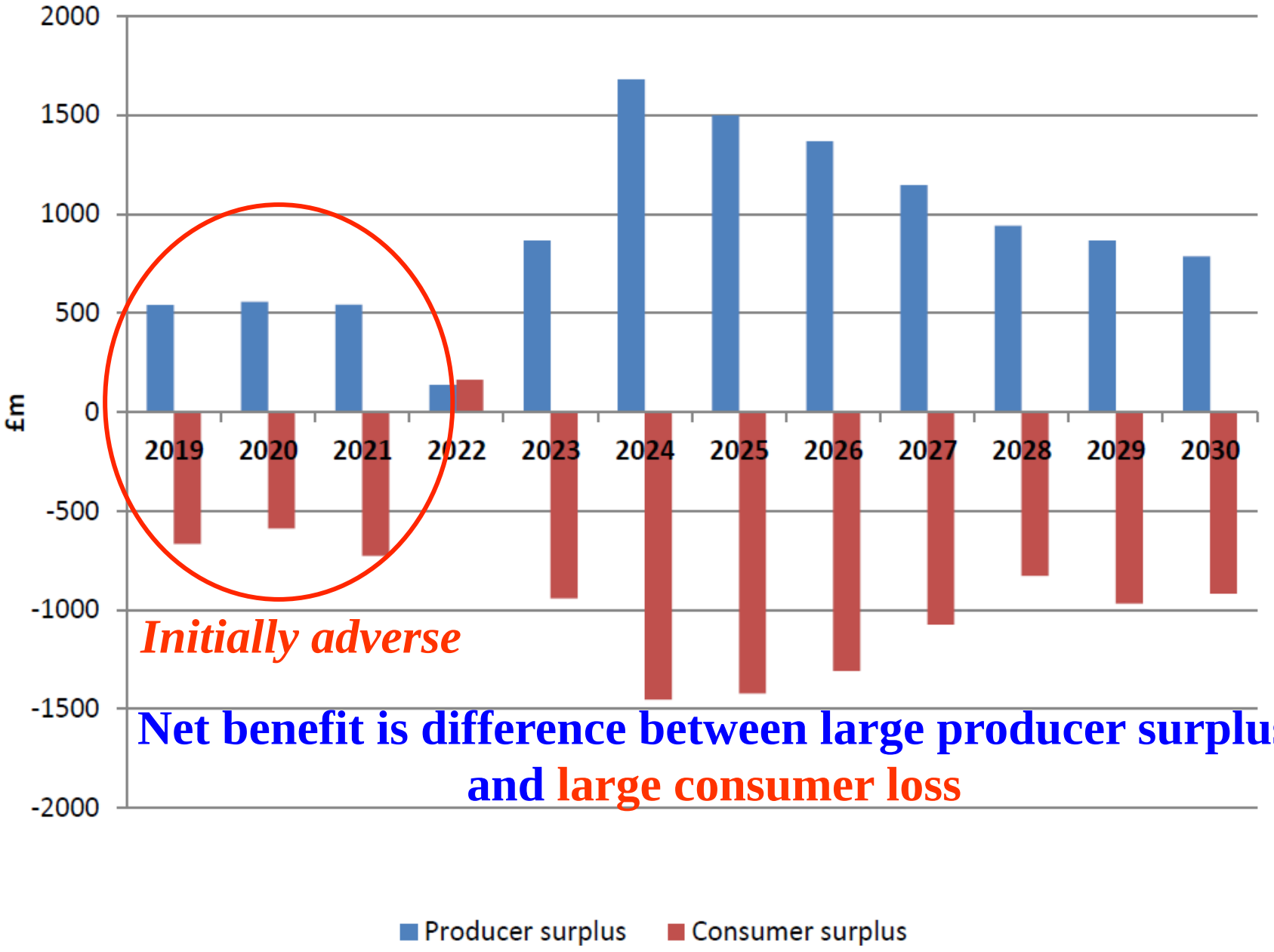
Capacity auction

Pay-as-clear descending clock auction in 2014 for 2018/19

- 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
- Need to forecast amount of capacity likely at T-1
- And capacity that is available but not paid
  - Renewables, ***Interconnectors?*** passive DSR, etc.

Figure 13: Change in producer and consumer surplus as a result of a Capacity Market



DECC Impact Assessments

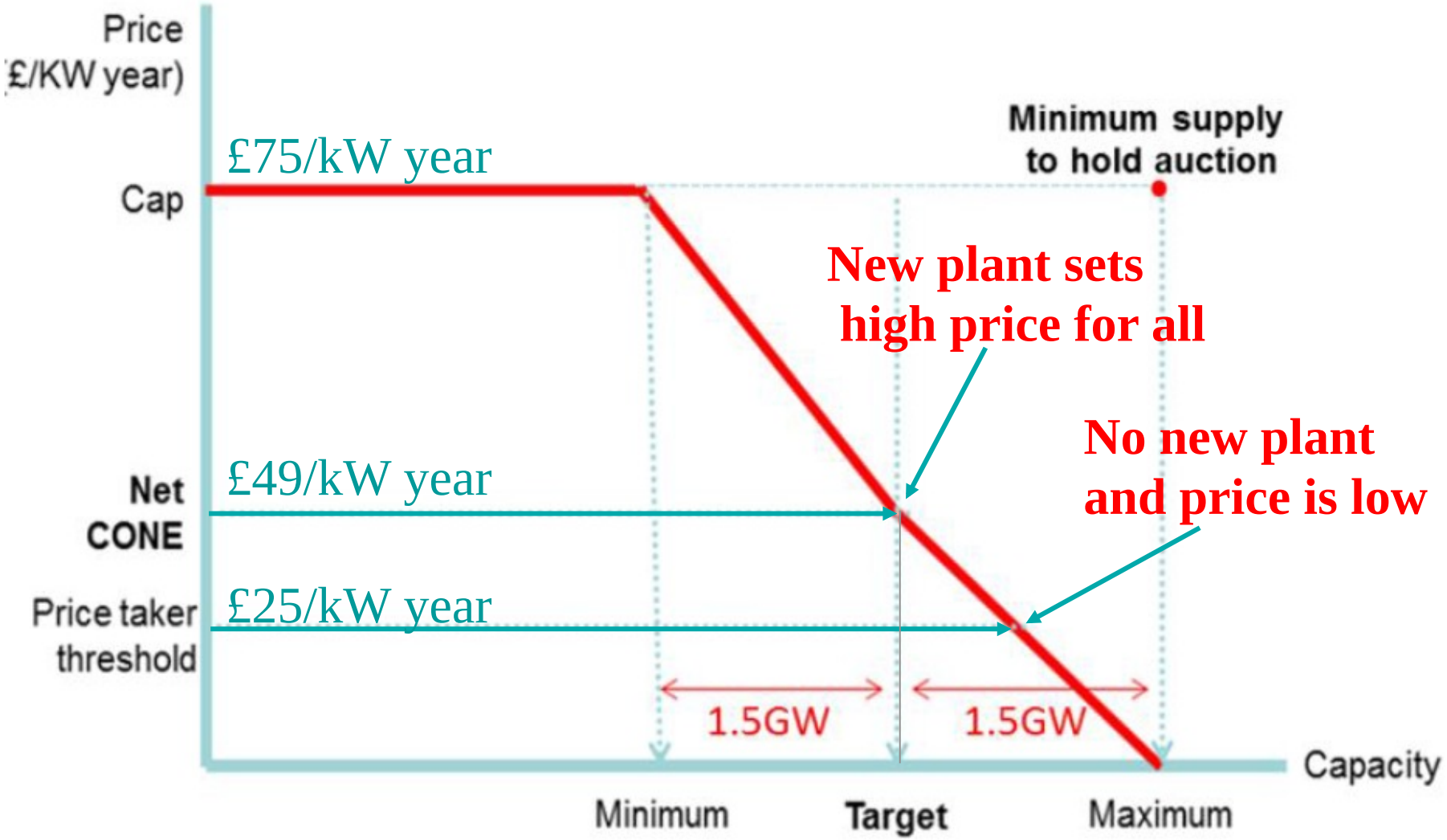
Table 3: **Estimated costs and benefits of a Capacity Market**

2012-2030	£m (2012 prices)		
	October 2013	June 2014	August 2014
Carbon cost[38]	854	46	85
Generation cost[39]	176	104	108
Capital cost[40]	-1415	-116	-218
System cost[41]	1184	529	535
Interconnection cost [42]	44	-248	-246
Energy System Costs	**843**	**315**	**264**
Institutional costs	**32**	**41**	**41**
Administrative costs	**231**	**112**	**112**
Energy System Benefits (Reduction in unserved energy[43])	**1,290**	**848**	**762**

Source: DECC modelling

DECC Impact Assessment Sep 2014

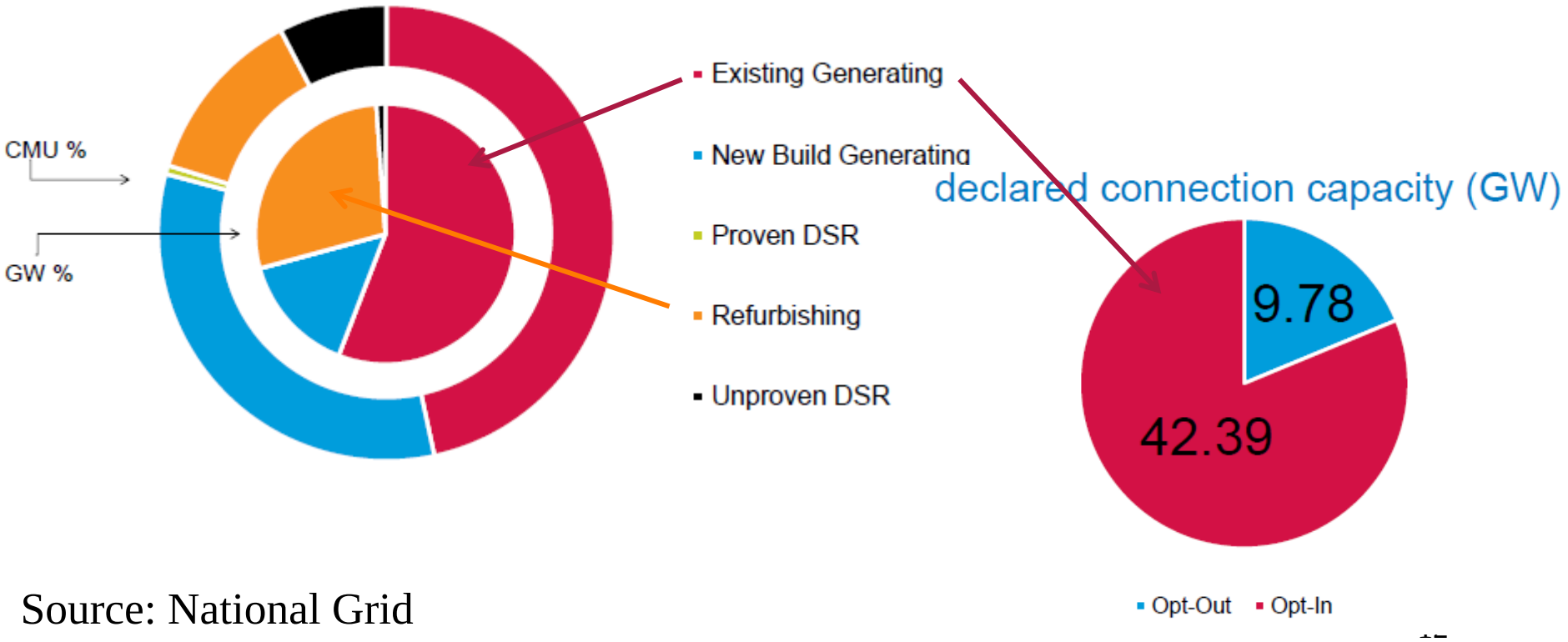
Illustrative auction demand curve



Source: DECC IA

Results of prequalification

- Total procurement: 53.3 GW incl. future DSR, STOR, etc.
- Auction requirement: 50.8GW (derated)
- Prequalified offers: 71.2GW = 62.6 GW (derated)



Source: National Grid

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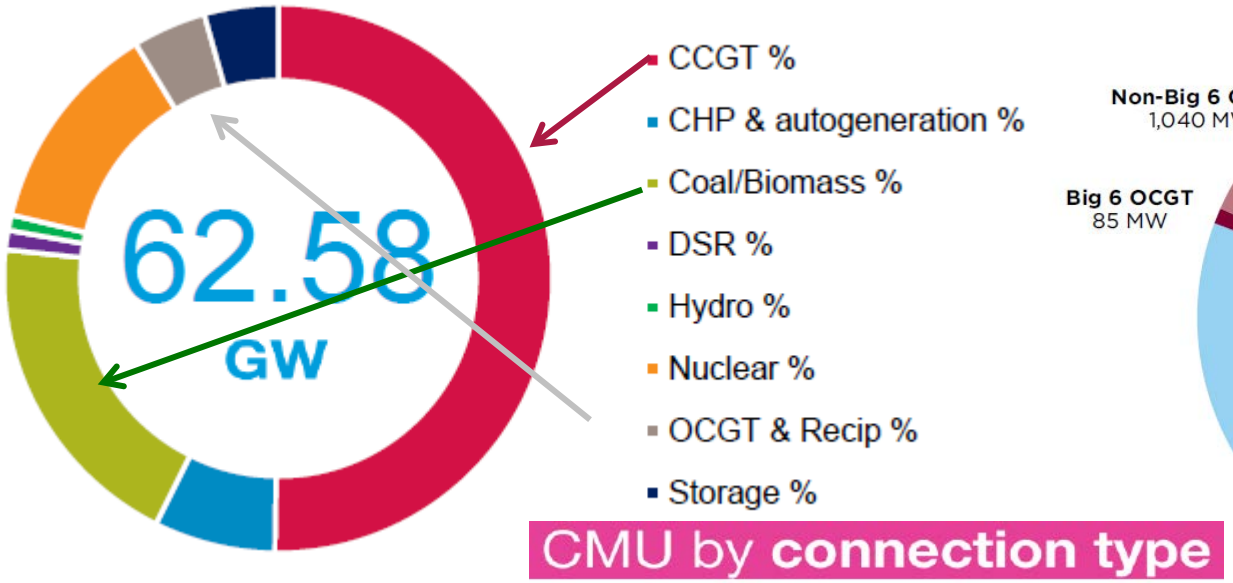
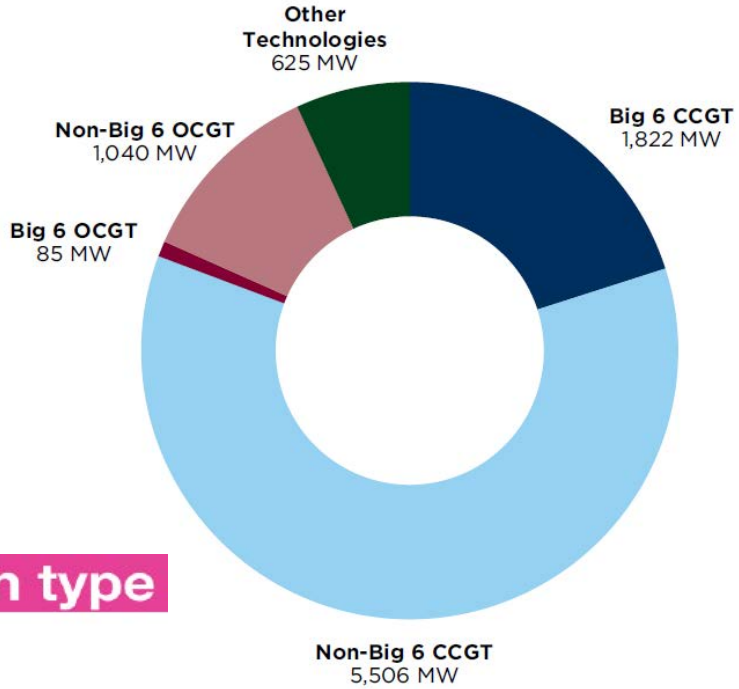
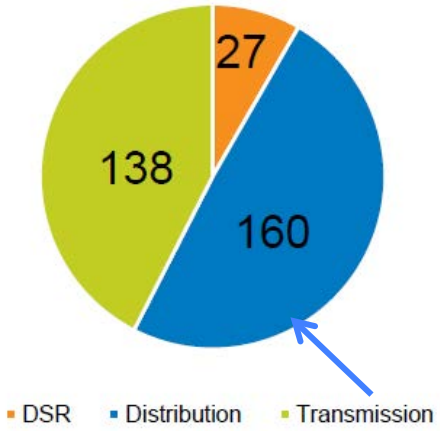
Derated capacity by type



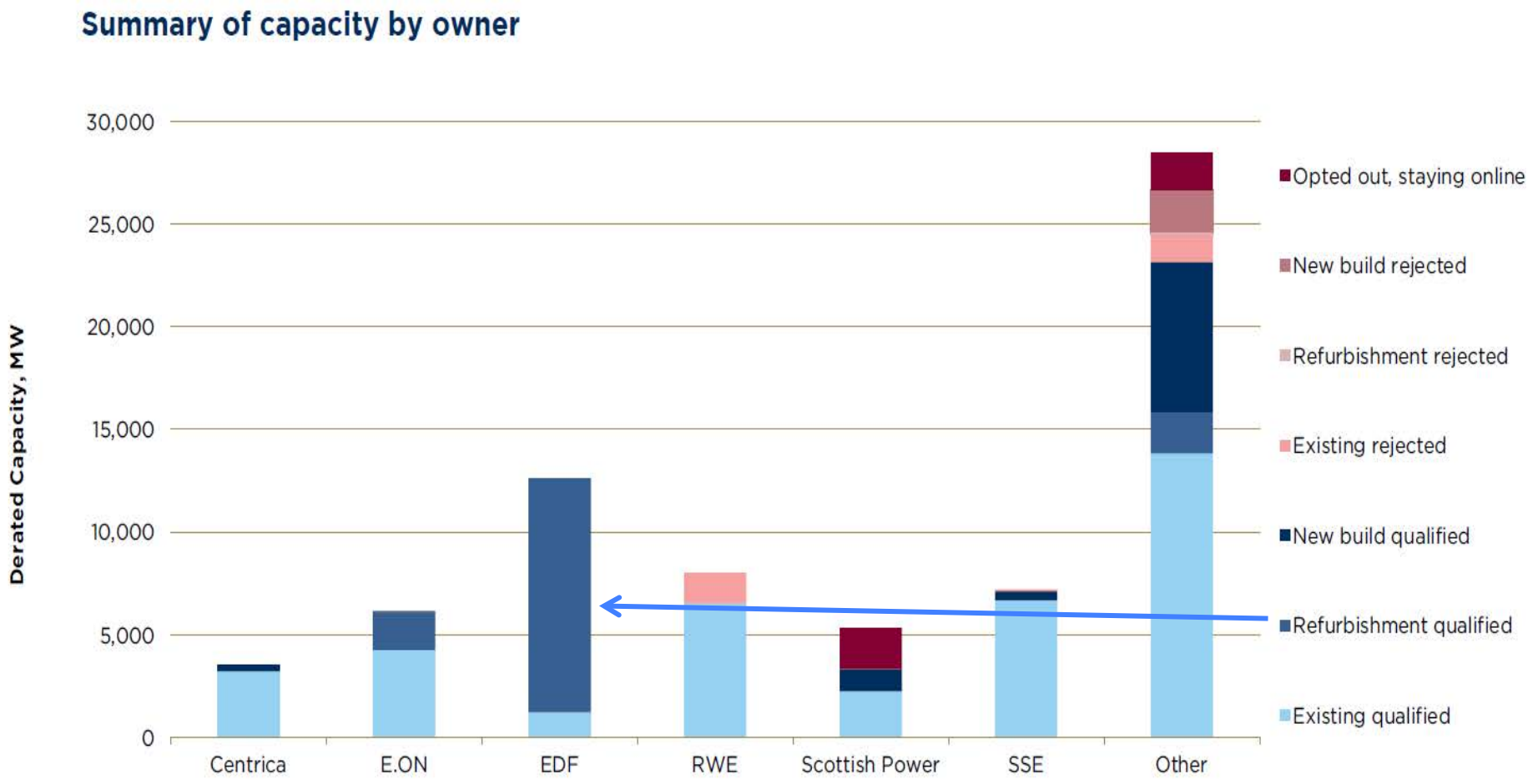
CMU by **connection type**





Source: National Grid

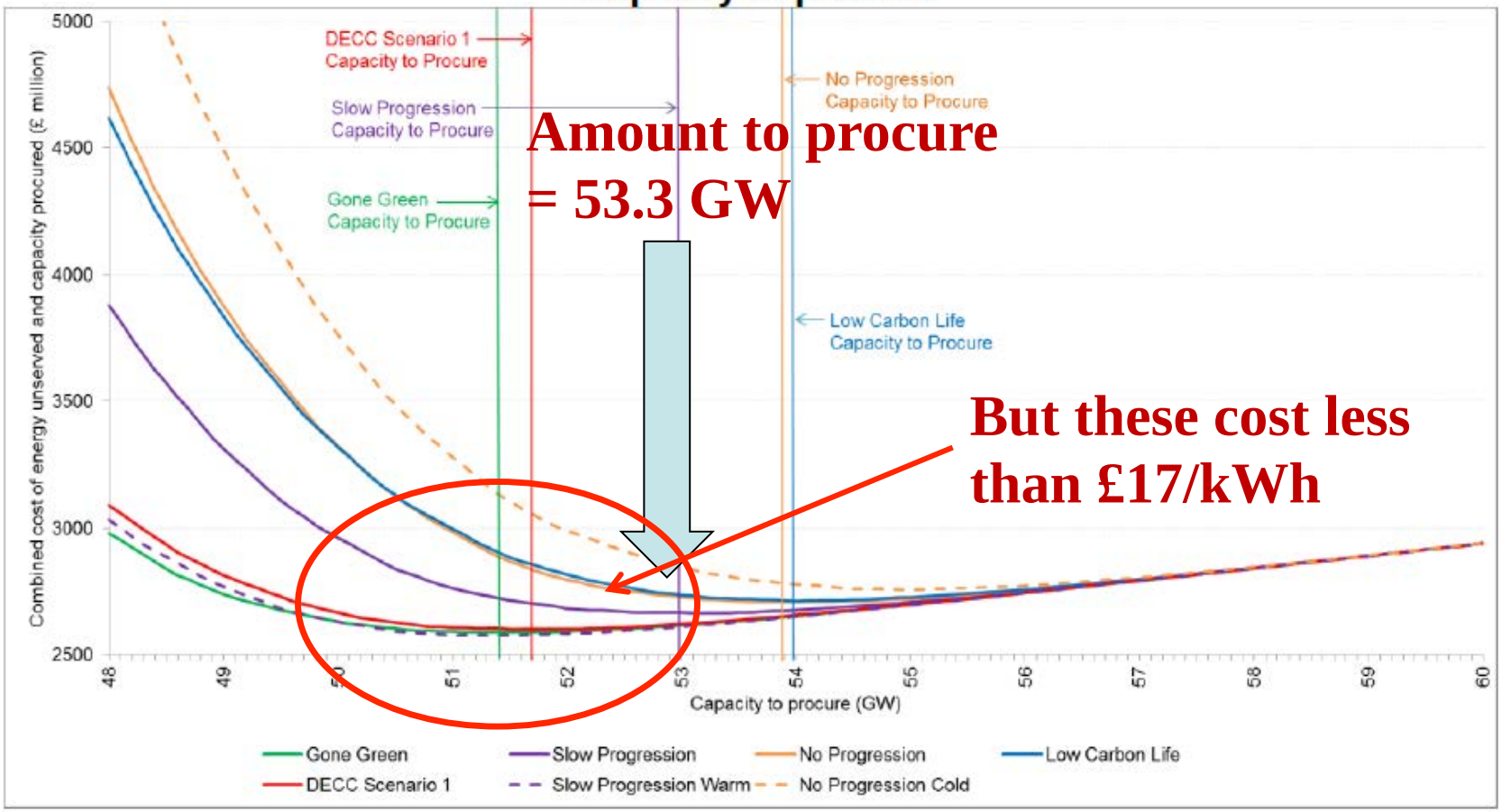
Most nuclear refurbishes



LCP/Frontier October 2014

Cost of "energy unserved" = £17/kWh

Figure 12: Combined cost of energy unserved and procured capacity against capacity to procure



Source: National Grid (2014, p50)

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Interconnectors and coupling - status 2014

Existing

Due 2016-19

GB coupled to NWE 4/2/14

SWE coupled to NWE 13/5/14

Interconnectors and capacity markets

- Interconnectors increase security of supply
  - provided they are free to respond to scarcity

=> they should displace domestic reserve capacity

  - Pöyry estimates 50-80% for GB
  - France imported 9 GW at 2012 Feb stress moment
- EU Third Package aims at Single Market
  - Single auction platform for day ahead and intra-day
- But GB is aiming at autarky for capacity!

Reluctance to rely on imports => over-procure

⇒ reduce cross-border price differences

⇒ undermine interconnector investment

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Trading with capacity markets

- Day-ahead supply and demand bids to Euphemia
  - Adjustments via intraday and balancing
- Efficient capacity design drives out inefficient design if no price cap
  - If price reflects scarcity value then willing to trade
    - If not face inefficiencies – your problem!
  - But DA Euphemia capped at €3,000/MWh
- Critical to ensure efficient rationing

Ensure spot price or allocation is efficient

=> Hedge with reliability options

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Optionality

- 2014 auction is for delivery in 2018/19
  - Allows time to build CCGT
- But information about future D & S uncertain
  - Especially DER and DSR

=> retaining flexibility has option value

- If planning and connections secured CCGT can be built in 2 years (2,000 MW Teeside in 27 months)
  - OCGTs can be built even faster

=> procure less now, more later

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Consequences of excessive procurement

- Excess capacity in auction depresses prices post-2018
- Lower prices => higher payments for CfDs => LCF exhausted, **reduces** finance for **renewables**
- Auction bid price for capacity set by Net Cost of New Entry
- Net CONE is total fixed cost *less* (revenue – opex)
- More capacity => fewer running hours => less revenue
- Lower price => lower revenue => higher net CONE
- Higher CONE sets price for all plant => paid by consumers
- Consumers not happy, not persuaded future wholesale price will reduce their bills
- Select Committees, NAO => big fuss

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Belated response

- June 2014 PTE published *Final Report on National Grid's Electricity Capacity Report*
  - Criticizes National Grid for assuming no net IC capacity contribution
  - Could have left room for IC contribution in 2018?
- Nov 2014 DECC consults on IC eligibility for capacity payment
  - 2nd Dec 2014 Treasury's *National Infrastructure Plan* confirms IC to be included in 2015 T- 4 auction

=> estimated unpaid 2018 IC displaces T-1?

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Assessment

- Unstable policy environment and uncommercial low-carbon generation make investment risky
- Capacity markets can reduce investment risk
- GB capacity auction seems a good design
- Except that nervous politicians decide quantity

=> Amount procured seems excessive

  - Influenced by bogy of “Loss of Load”?
  - Ignores interconnectors and optionality of waiting

Problem

- National Grid is System Operator
  - Charged with security of supply

and advises on capacity volume to procure

⇒Advice to over-procure as consumers pay?

⇒ Politicians nervous about “lights going out”

- Would an ISO do better? What role for politicians?

Can we do without central capacity procurement?

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Assessment of capacity markets

- Theory of scarcity pricing clear
  - leads to CP = LoLP*(VoLL-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
  - Political choices may be expensive

Need much higher Euphemia Intraday price cap

And ways of handling stress situations

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Acronyms

CCGT	Combined cycle gas turbine
CfD	Contract for difference
CMU	Capacity market unit
CONE	Cost of New Entry
CP	Capacity Payment
D & S	Demand and Supply
DER	Distributed Energy Resources
DSR	Demand Side Response
EMR	(UK) Electricity Market Reform
EPS	Emission Performance Standard
ISO	Independent System Operator
LCF	Levy Control Framework
LoLE	Loss of Load Expectation = sum of LoLP
LoLP	Loss of Load probability
NAO	National Audit Office
NW E	North West Europe
OCGT	Open cycle gas turbine
RES	Renewable energy supply
SMC	System Marginal Cost
SWE	South West Europe
STOR	Short term operating reserve
VOLL	Value of Lost Load

Appendix

Energy-only market solutions

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Theory and reality

- Efficient pricing of electricity requires prices varying in response to supply and demand each second
  - Australia has 5 minute pricing in real-time market
  - Frequency response needed in 1-5 seconds
  - Tender auctions may be cheaper than spot markets for some services
  - Contracts needed to hedge risk and incentivise responses
- Investment needs forward prices for 15-20+ years
  - Or ability to predict confidently and hedge
- Investment needed is either capital-intensive (low-C) ***or*** has low capacity factors for balancing = risky

How to allocate risk to incentivise and reduce cost ?

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Energy-only markets

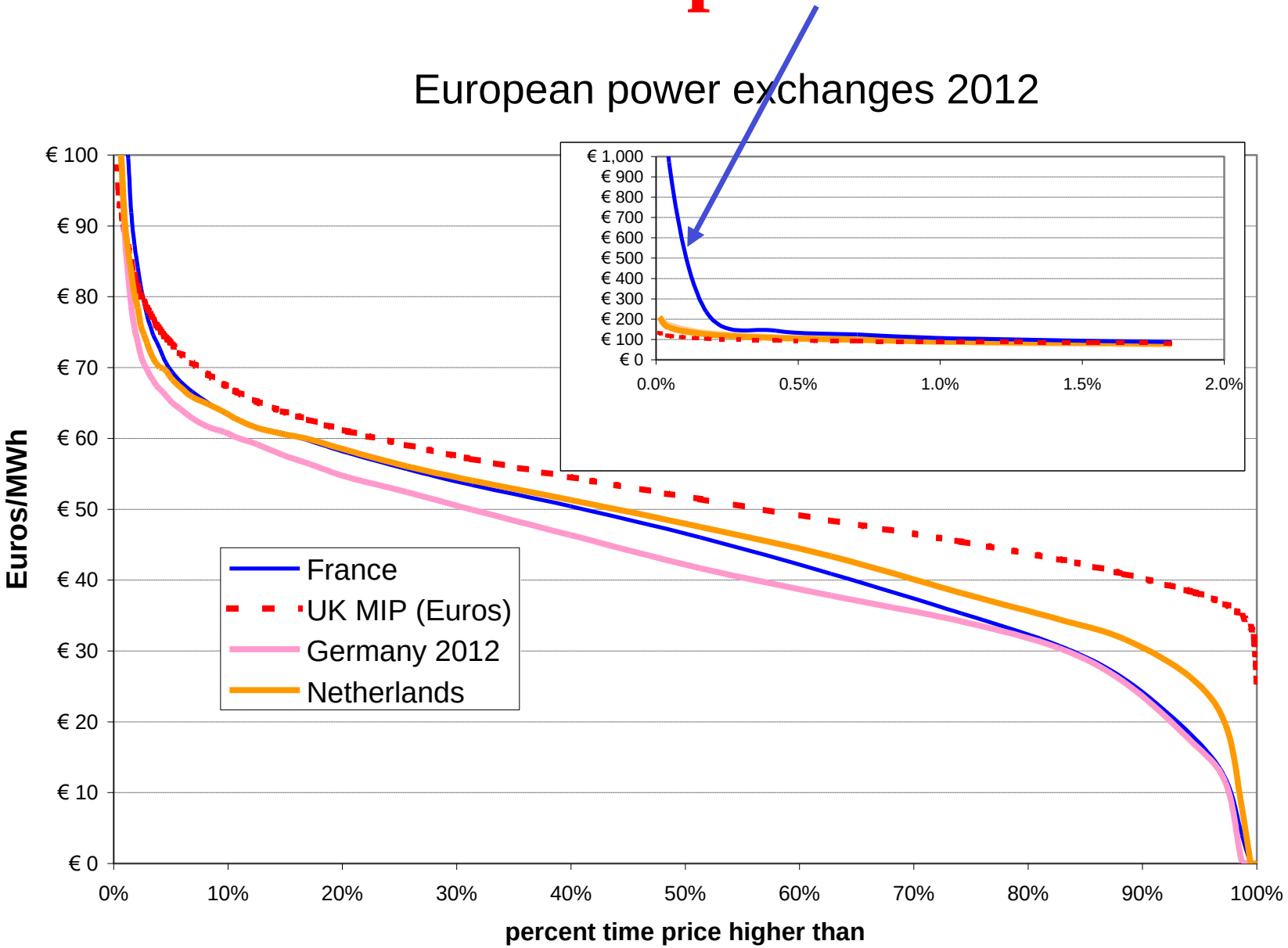
- If generators can (and are allowed to) bid scarcity prices no problem?
  - France (*de facto* monopoly) bids high peak prices
  - GB has adequate capacity and flat prices
- Wind, PV, cheap coal, low C prices drive clean spark spreads negative (in Germany especially)
  - electricity prices affected by policy

=> policy uncertainty undermines peaking investments needed

So policy clarity on carbon price may help

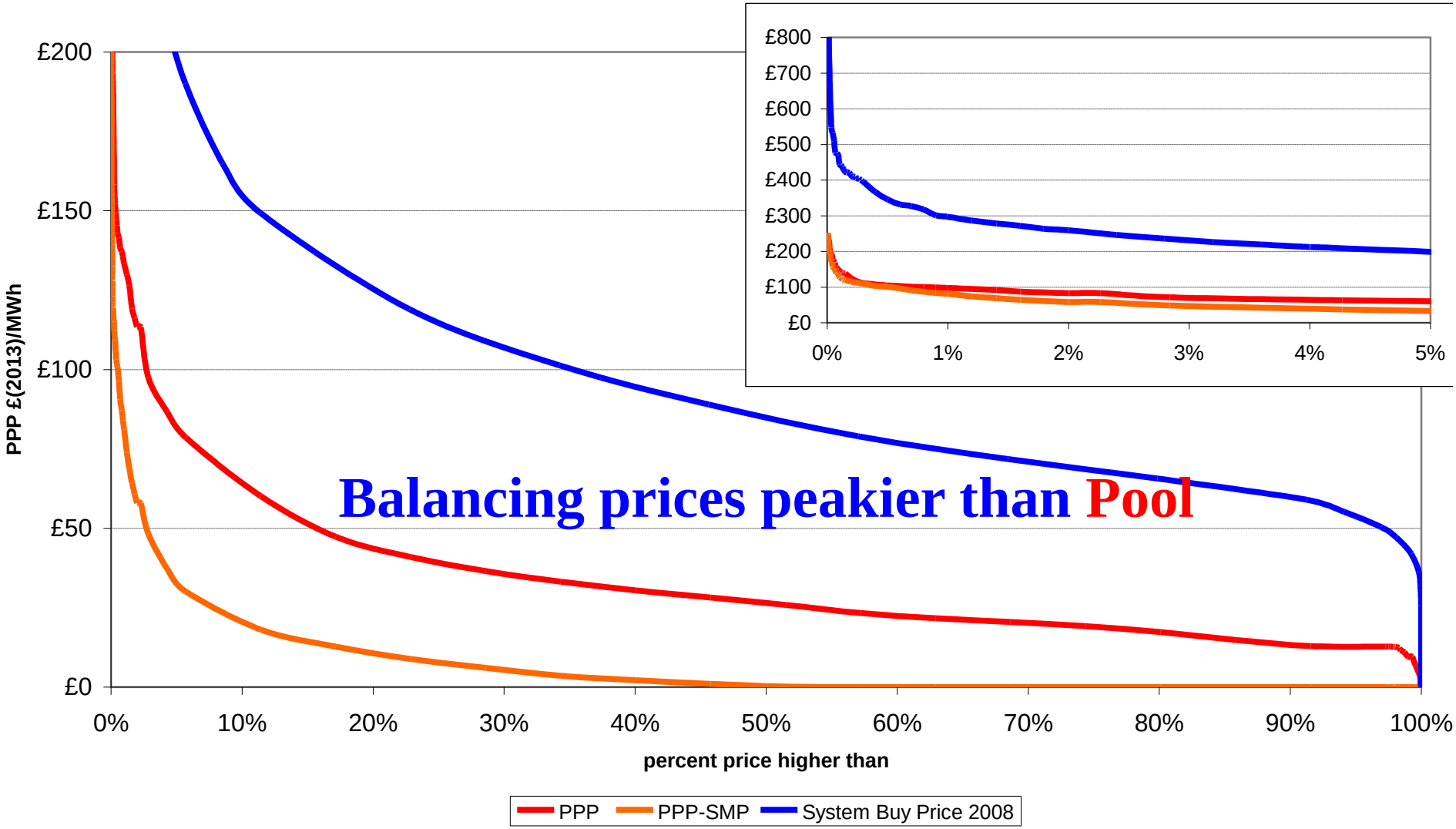
But long-term contracts backed by state needed?

France much peakier than GB

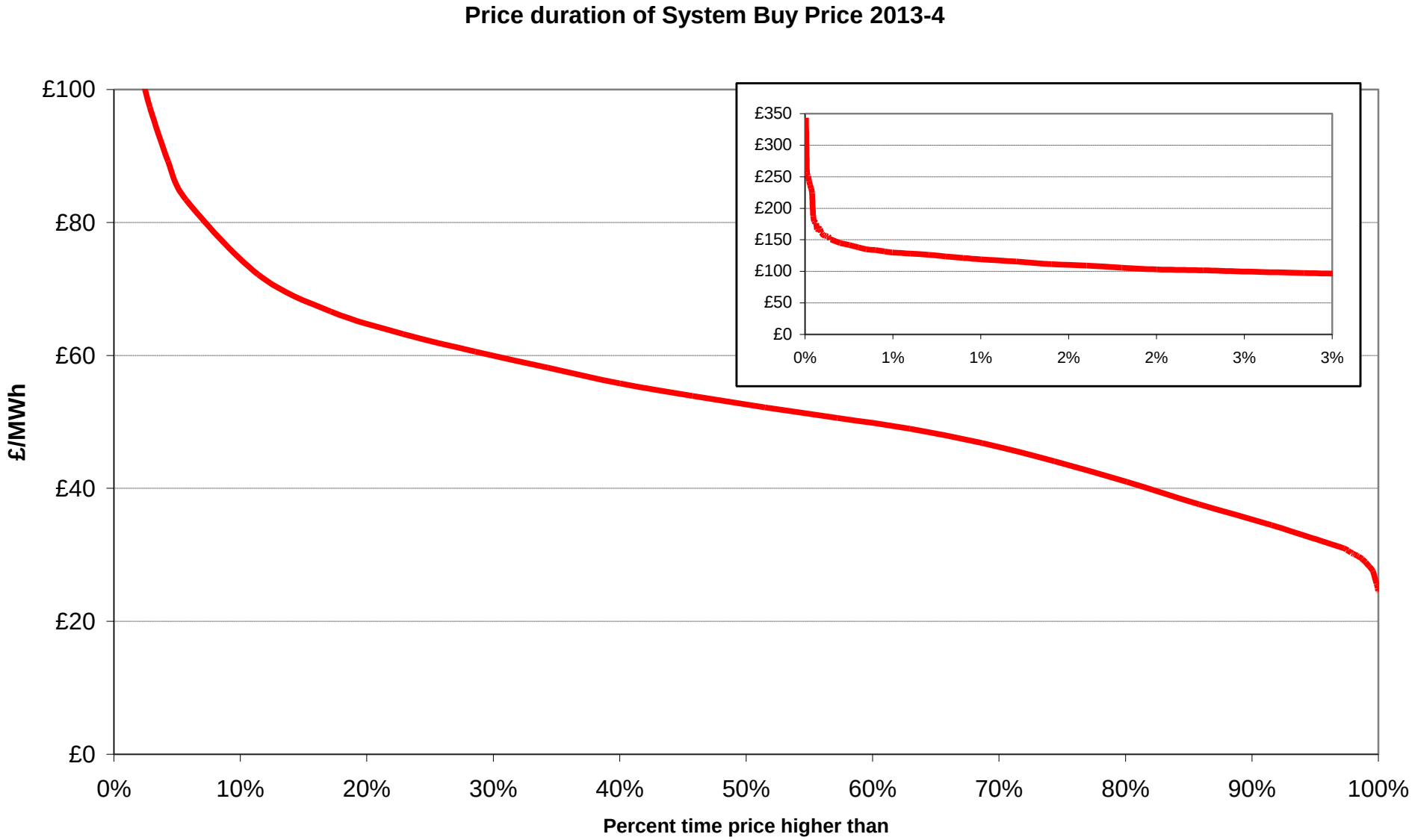


Pool prices 1998-9 and System Buy Price 2008

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



Imbalance prices not adequately marginal?



Assessment

- Energy-only market might work with no price caps, no subsidized entry and adequate credible Carbon price
- US experience suggests missing money problem is significant given fears over price caps
- Long-term PPAs have capacity element
  - Long-term contracting with central body in developed countries likely to lead to more than adequate capacity

  => low prices fail to reward capacity without CP