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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

# 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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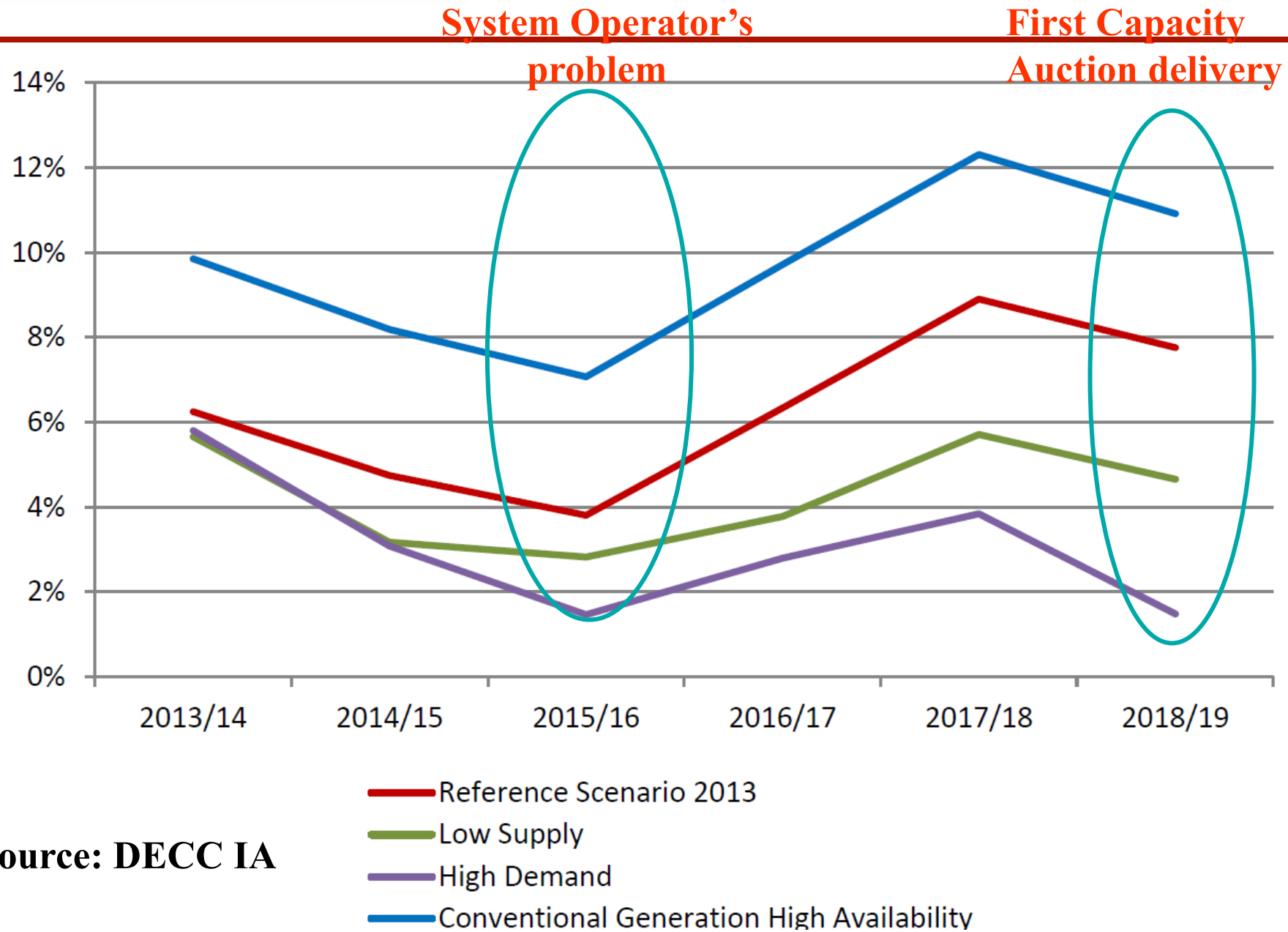
# When is the problem?

## Ofgem's derated capacity margin




**Source: DECC IA**

# Measuring SoS

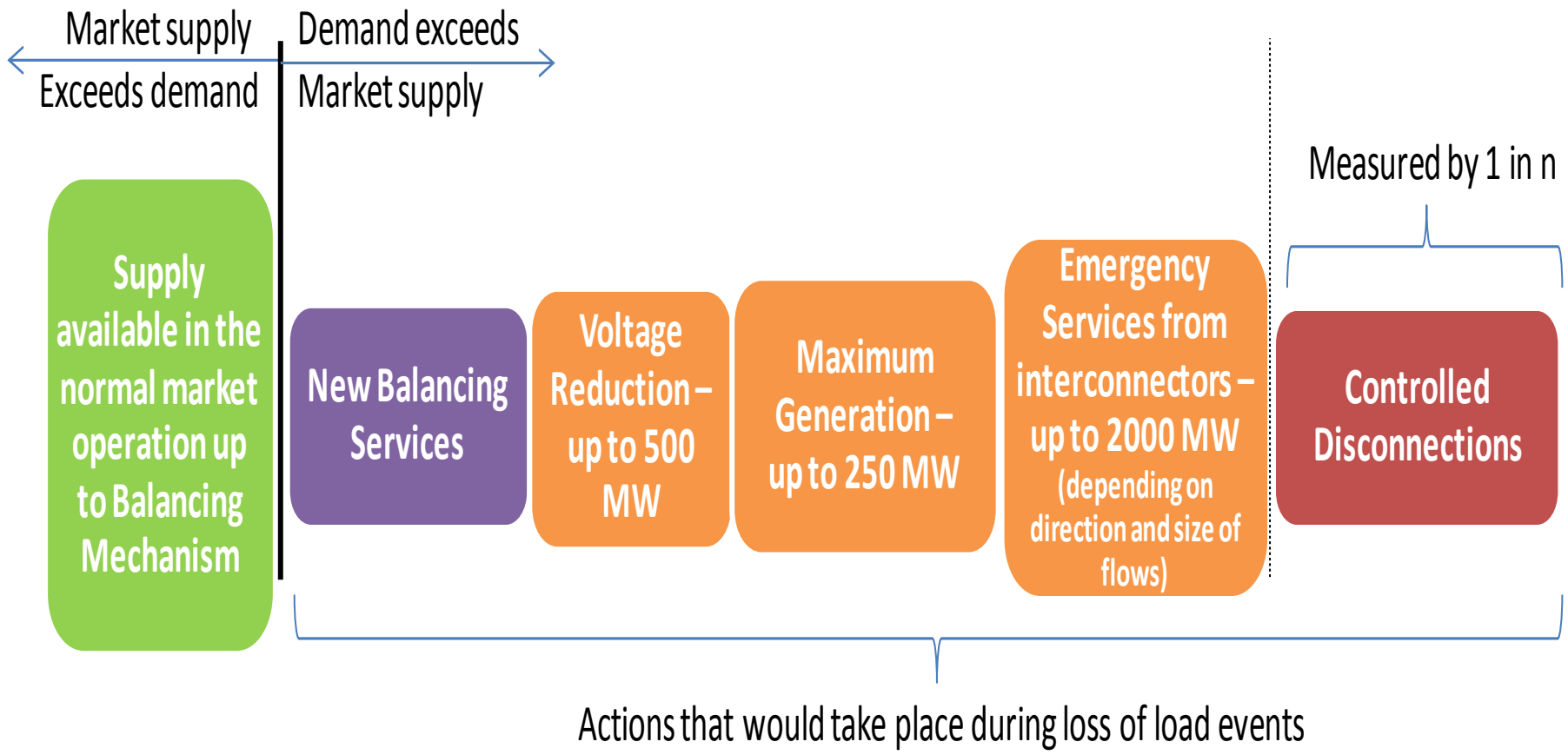
- SoS Measured by Loss of Load Expectation, LoLE
  - 3 hours per year => Value of Lost Load = £17/kWh
- But spot and balancing prices capped
  - Balancing actions costs will increase to £6/kWh
- Missing money = (£17-£6/kWh) x 3 hrs/yr =£33/kW yr

⇒ Auction to pay for missing money

***But what does a "Loss of Load" mean?***

***Demand exceeds offered market supply***

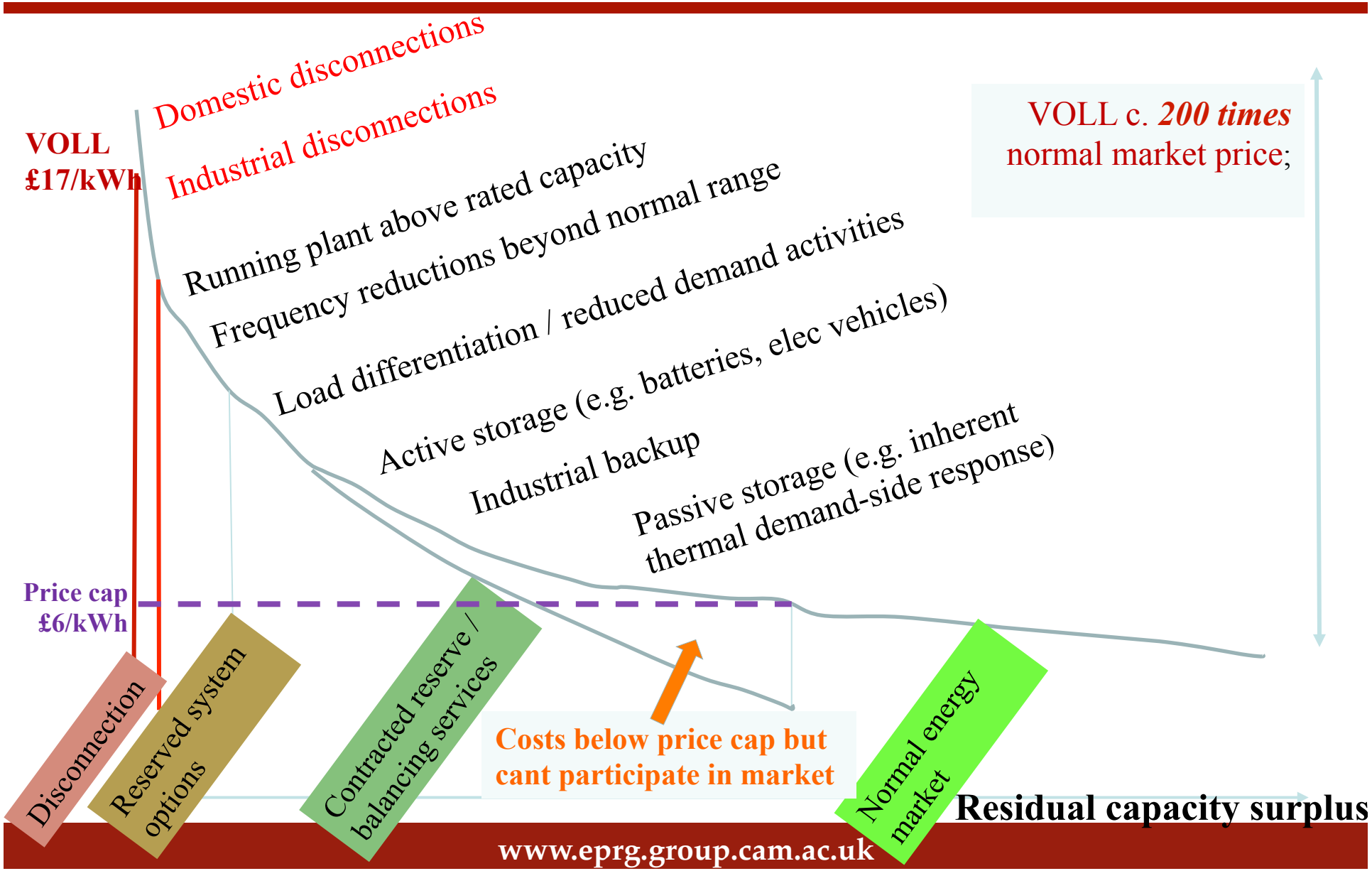
# What does "Loss of Load" mean?




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

Source: Ofgem (2014) *Capacity Assessment 2014*

# Supply curve of options

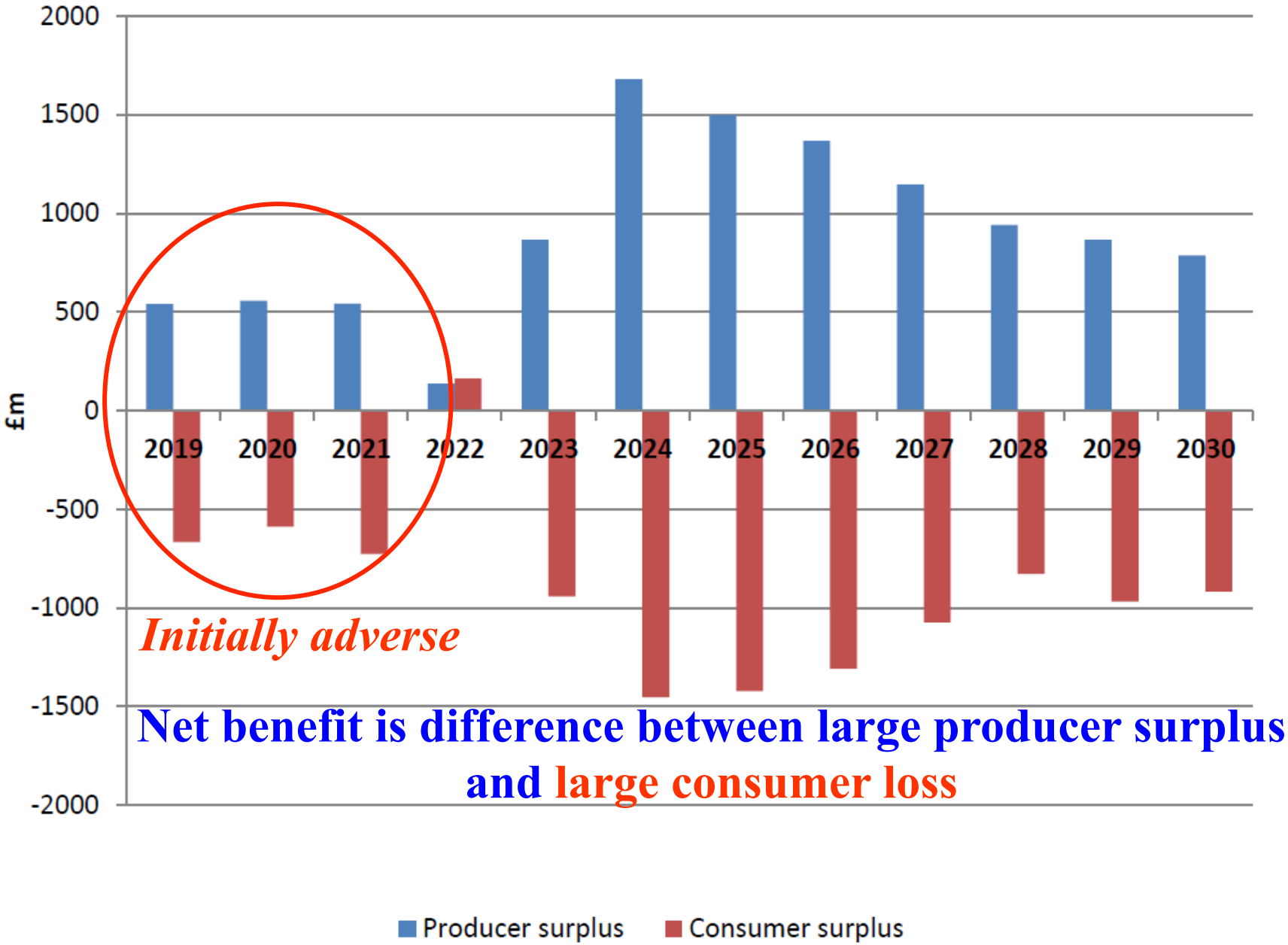


# Capacity auction

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

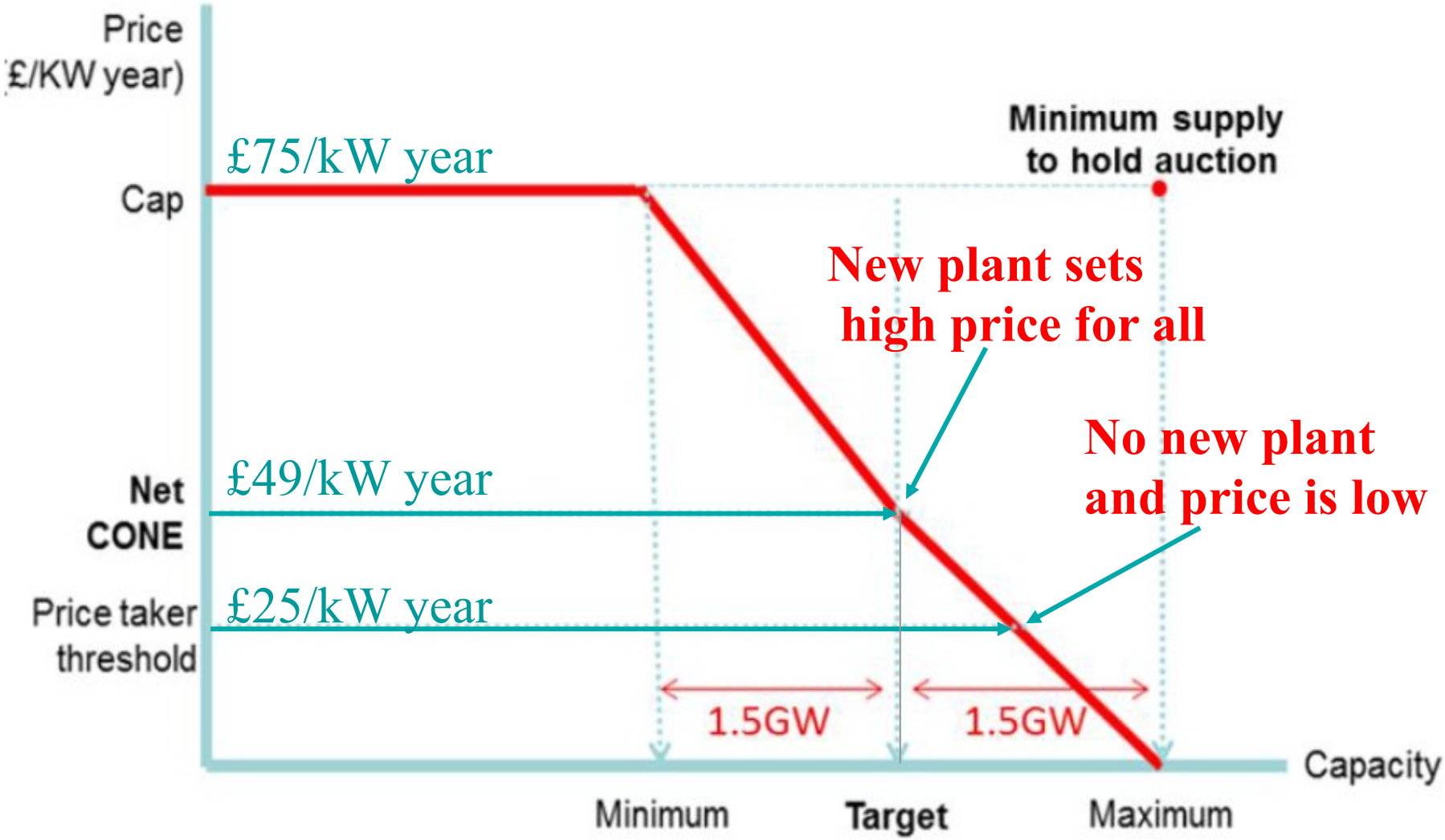
Table 3: **Estimated costs and benefits of a Capacity Market**

| 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

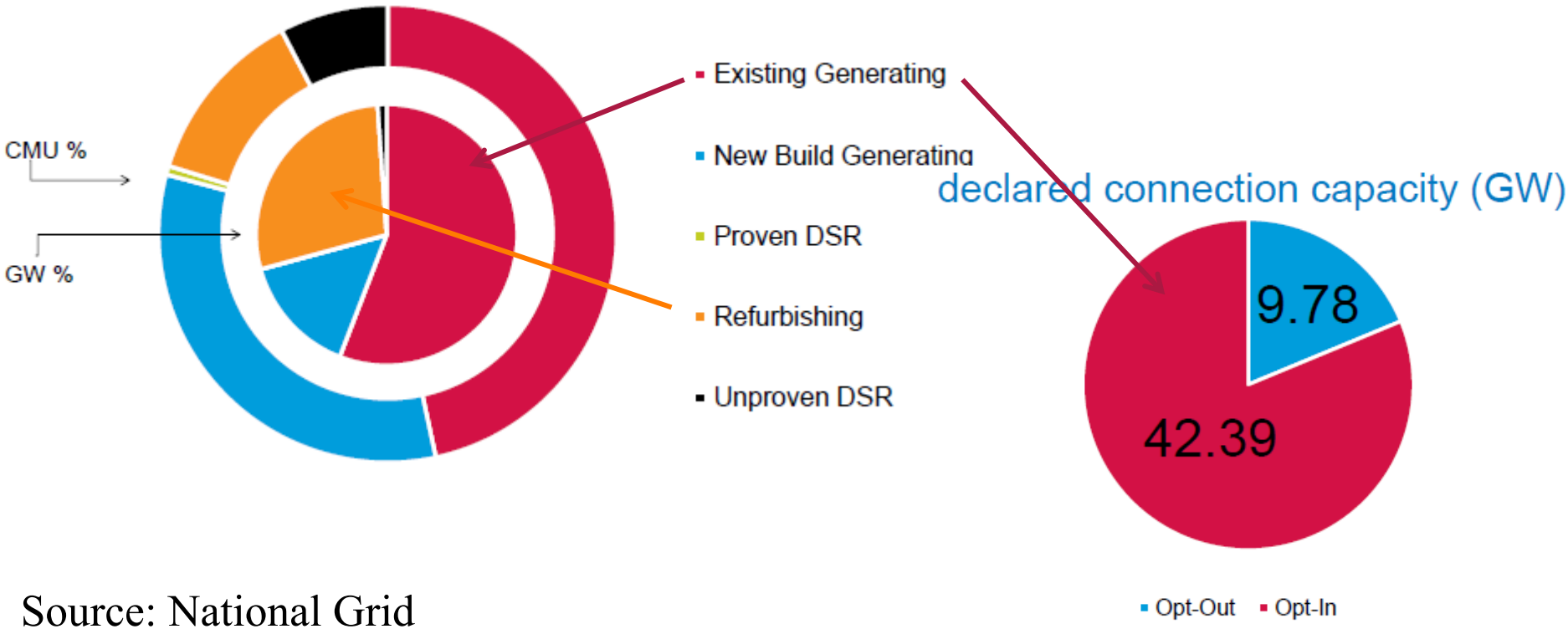
# Illustrative auction demand curve




Source: DECC IA

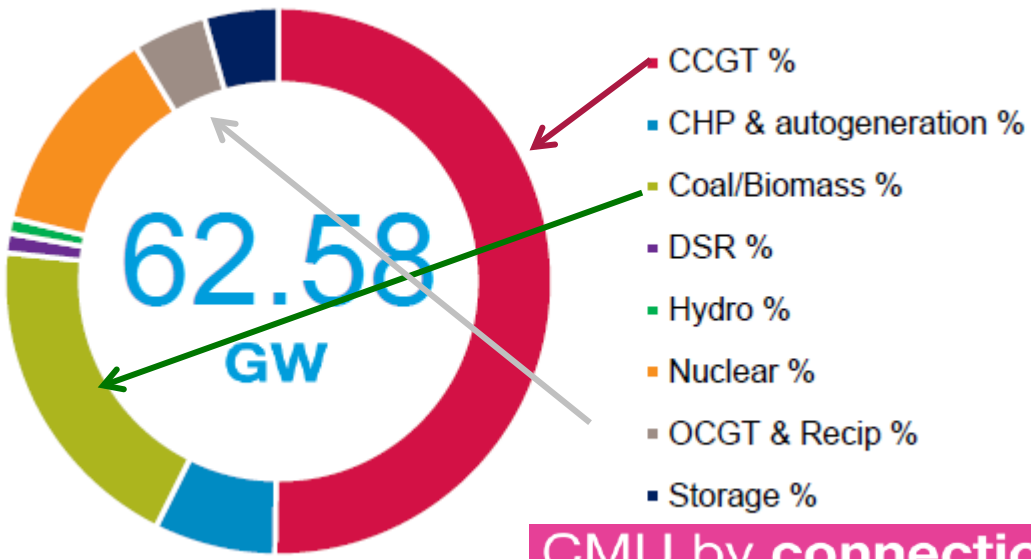
# Results of prequalification

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

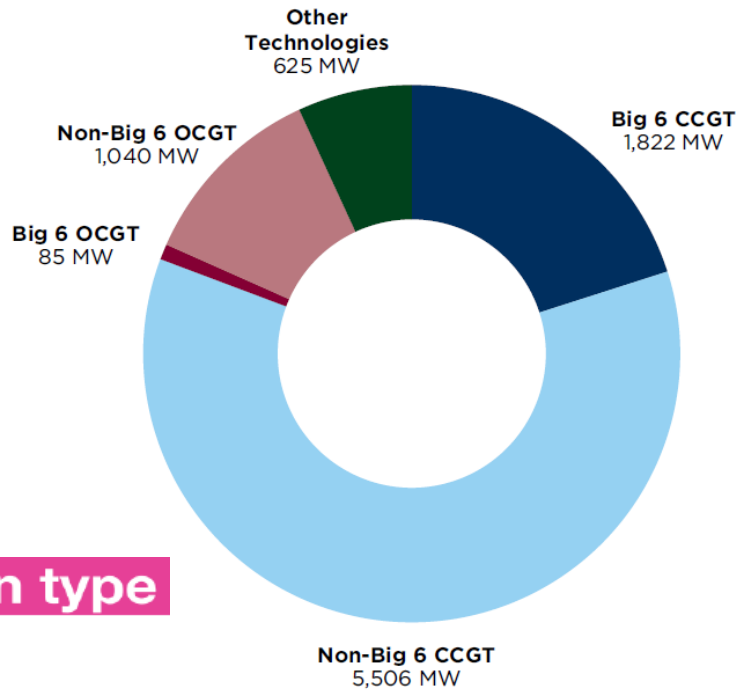


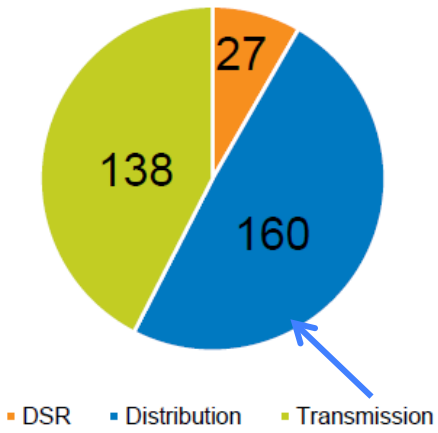

Source: National Grid

# Derated capacity by type



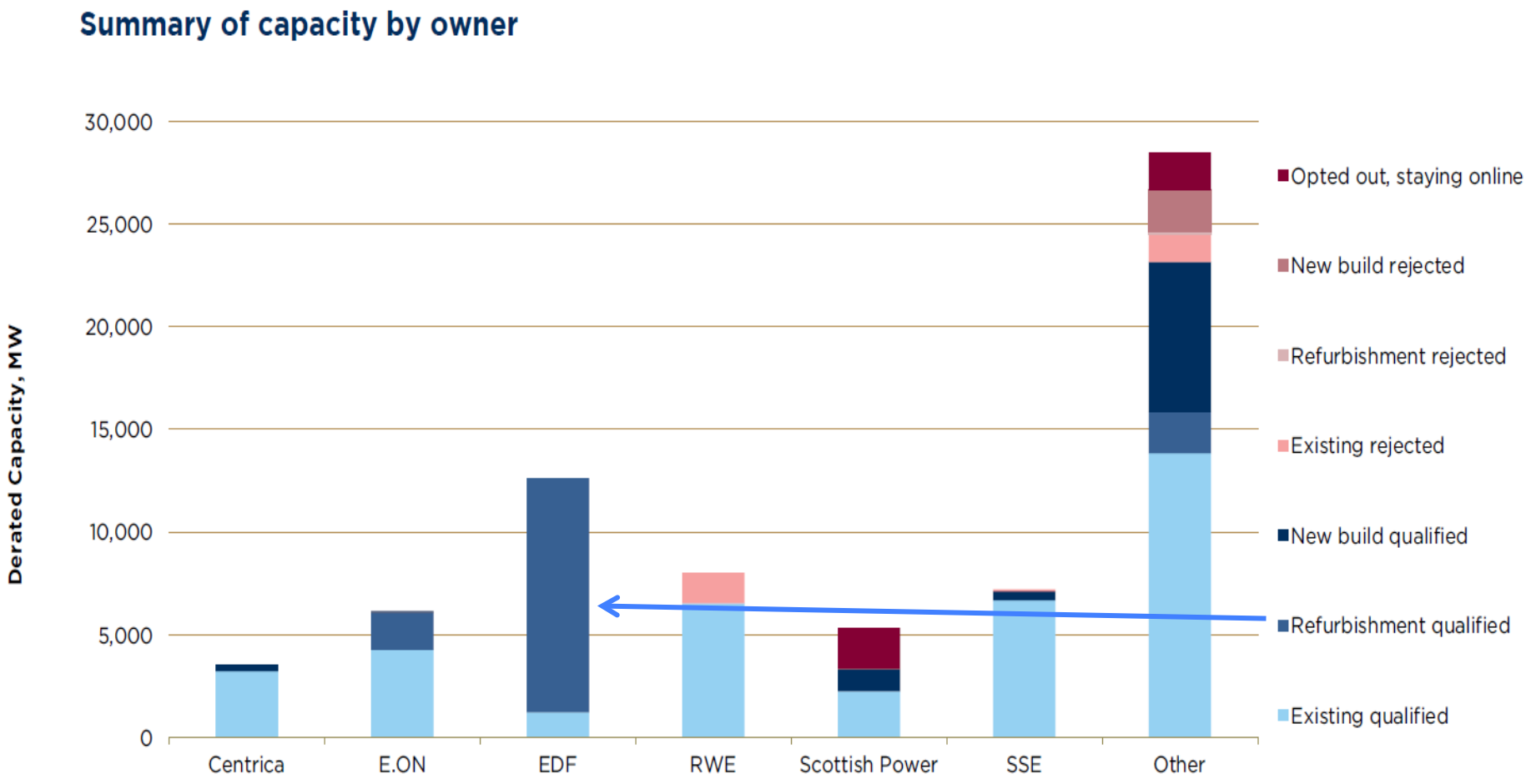

CMU by **connection type**




Source: National Grid

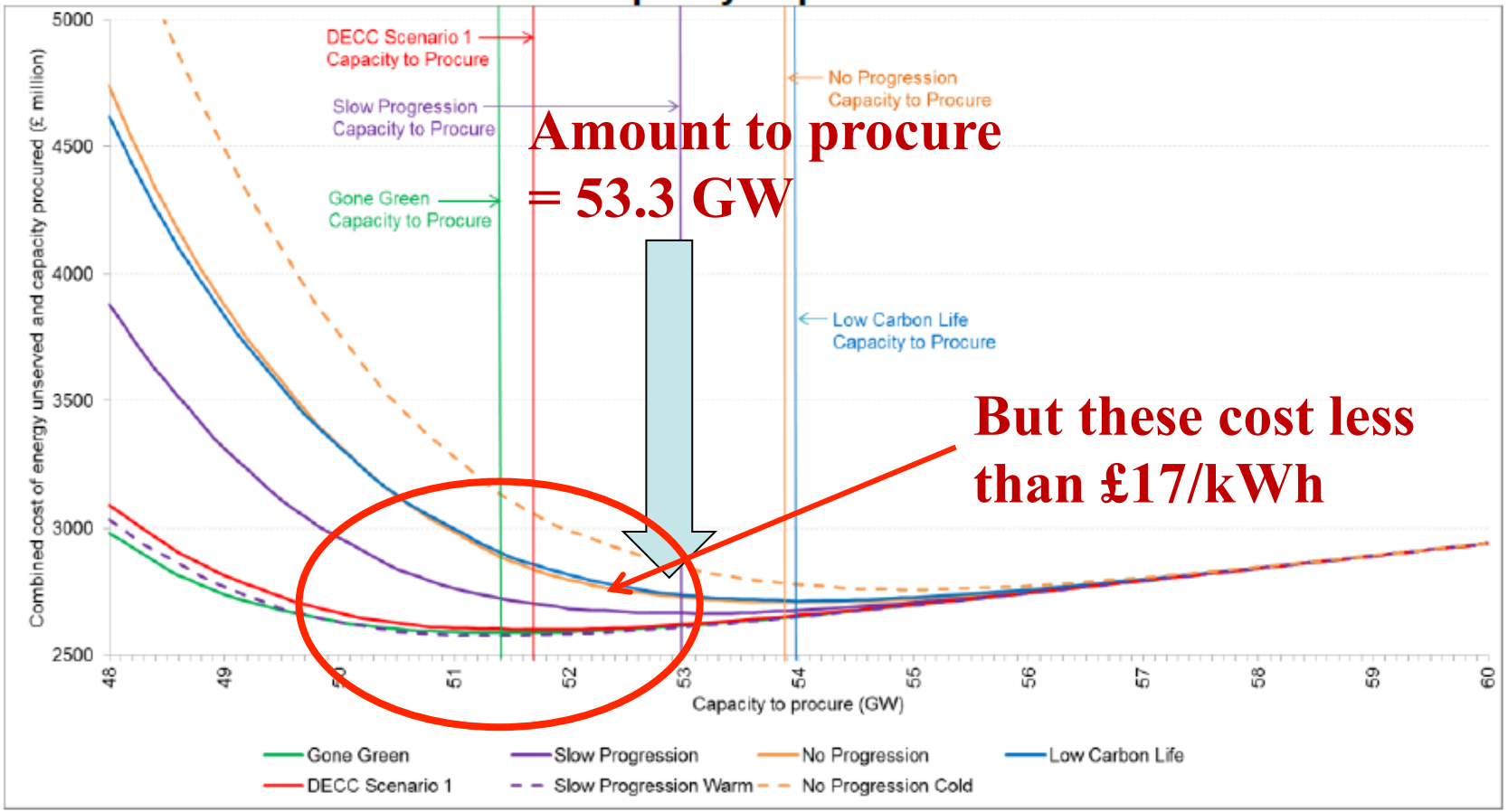
# Most nuclear refurbishes




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***

# 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

# 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

# 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

# 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?***

# 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?***

# 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

# 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***

?

# Energy-only markets

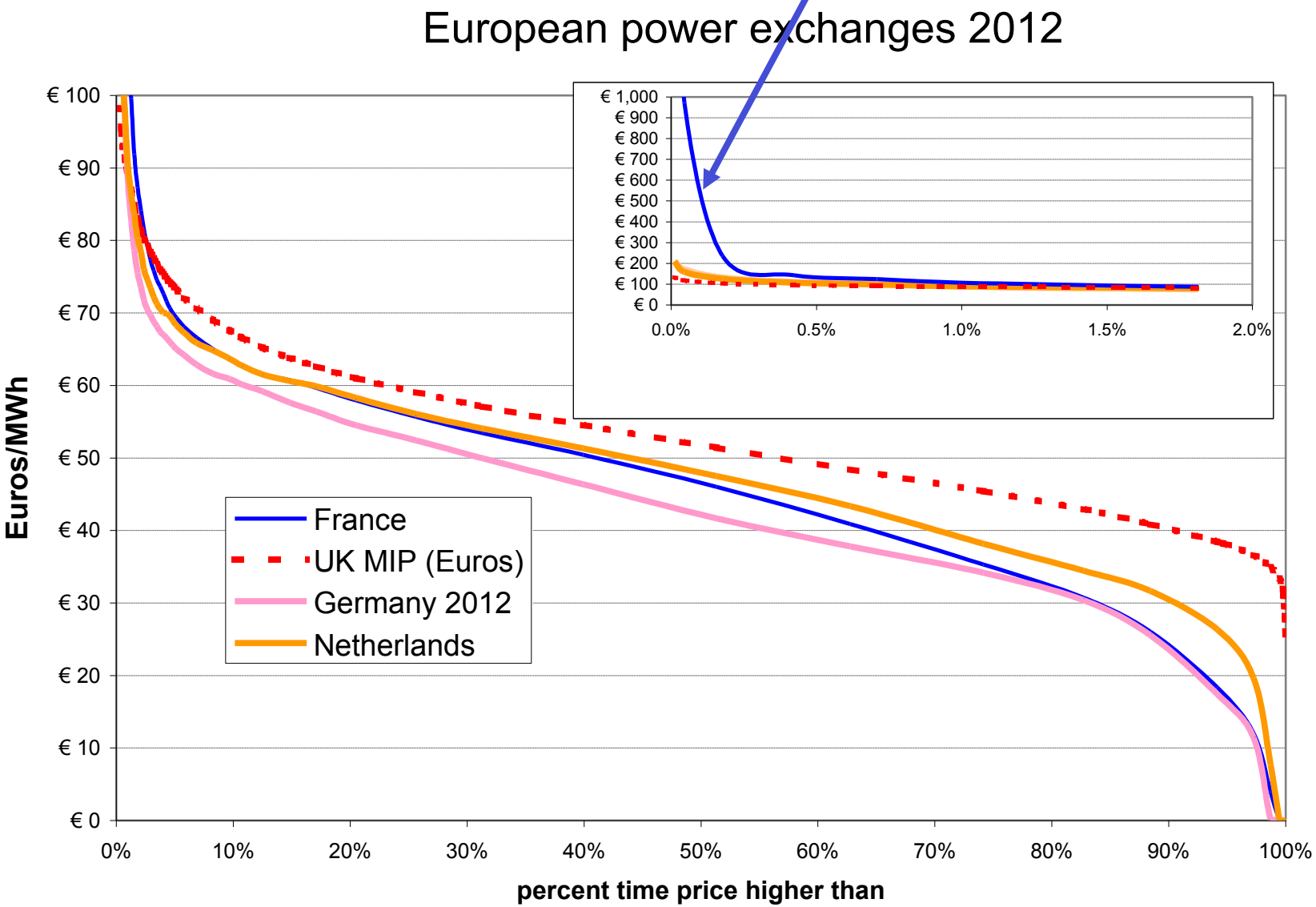
- If generators can (and are allowed to) bid scarcity prices no problem?
  - France (*de facto* monopoly) bids high peak prices
  - GB has adequate capacity and flat prices
- Wind, PV, cheap coal, low C prices drive clean spark spreads negative (in Germany especially)
  - electricity prices affected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

***=> policy uncertainty undermines peaking investments needed***

***So policy clarity on carbon price may help***

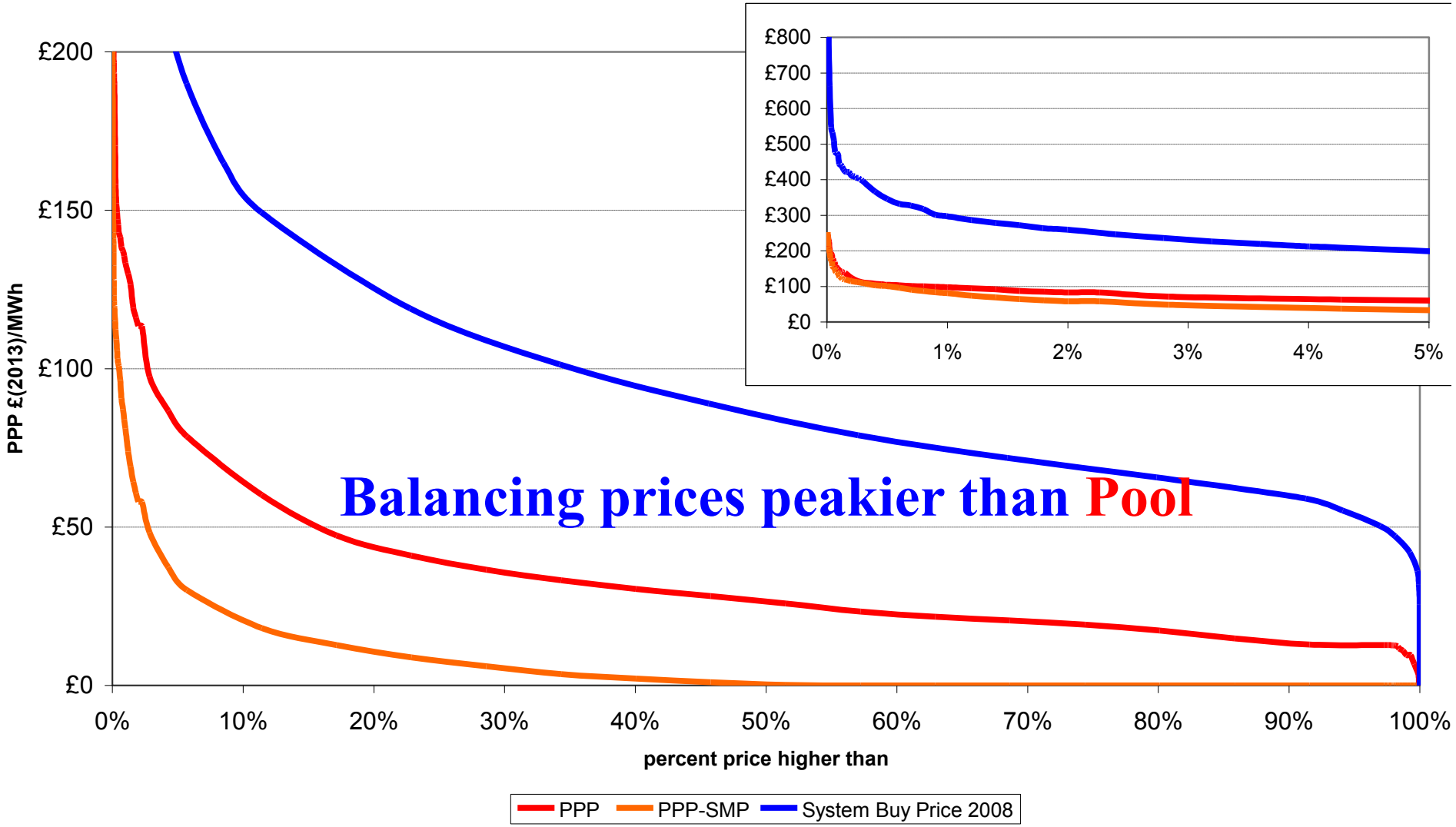
***But long-term contracts backed by state needed?***

# France much peakier than GB

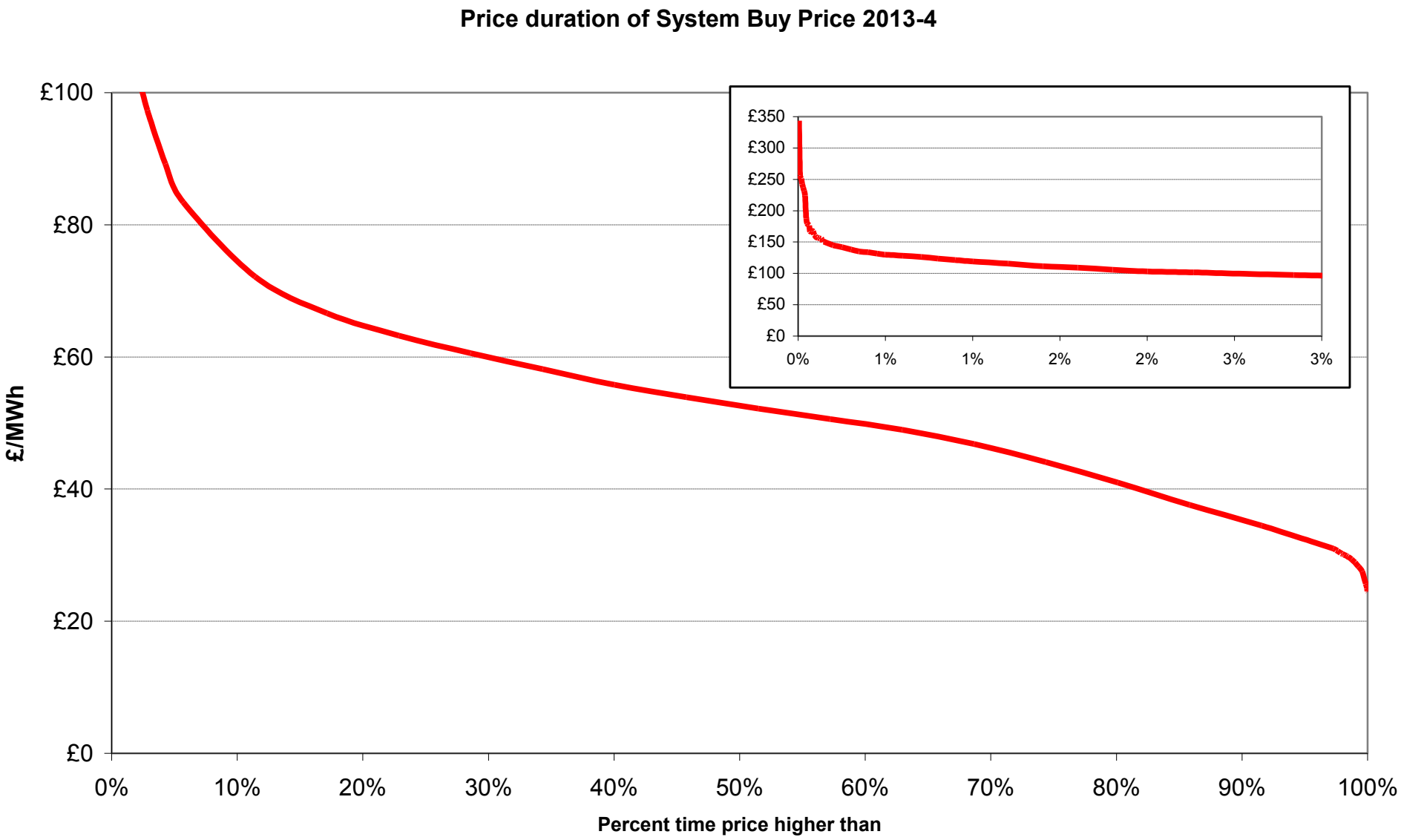


# Pool prices 1998-9 and System Buy Price 2008

**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