



Capacity mechanisms under scrutiny

Capacity mechanisms in Europe

7 December 2018

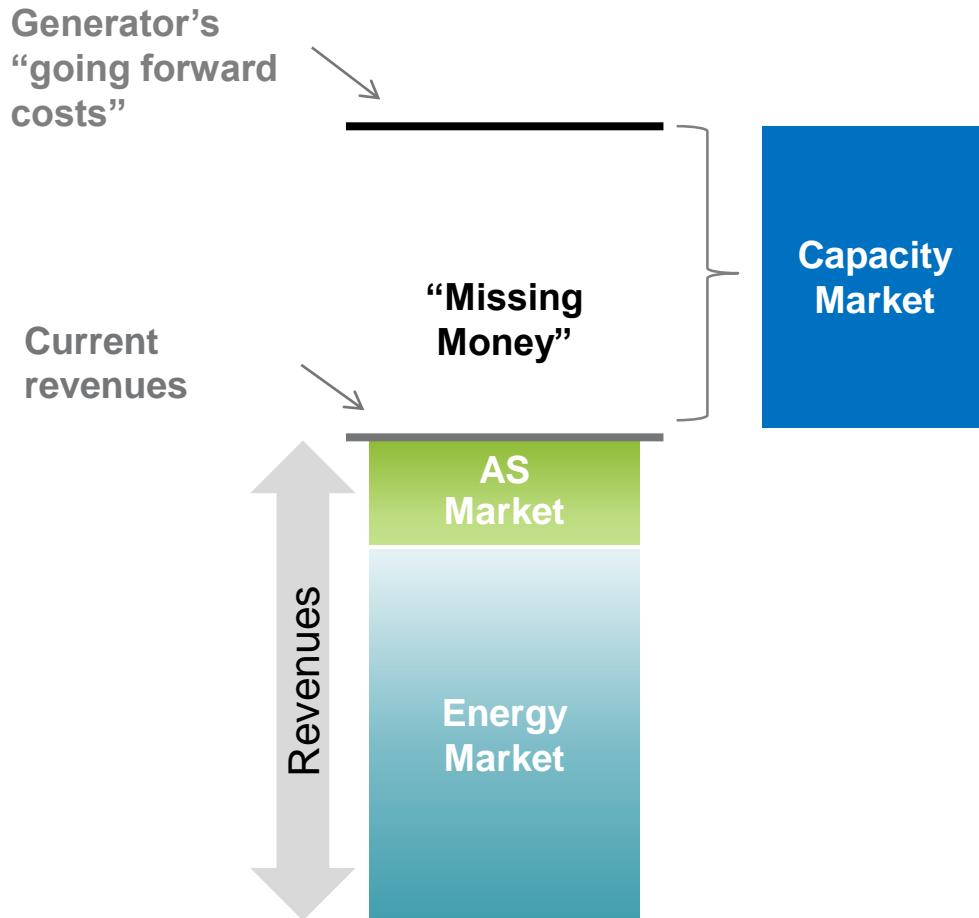
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Outline

1. Why Capacity Remuneration Mechanisms?
2. CRM design choices
3. Lessons from the US Experience
4. Lessons from the GB Experience
5. Key take-aways

Capacity Remuneration Mechanisms are seen by many jurisdictions as a necessity for system reliability



Missing Money Problem

- Prices in energy only markets don't rise high enough or often enough
 - Inadequate revenues to cover existing generator's going forward costs
 - Insufficient incentives for new capacity

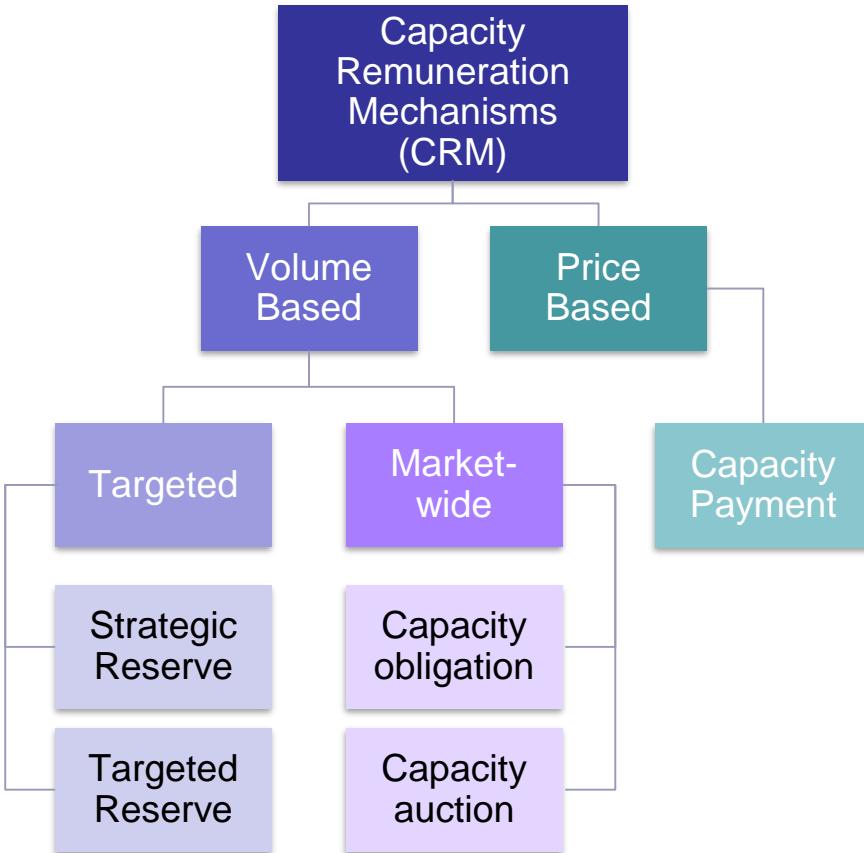
Causes

- Regulated price caps to
- Fear from market participants of perceived market manipulation
- Impact of intermittent renewables on energy prices and revenues for traditional generation

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What are the main CRM design choices?



Price-based CRM

- ‘Adder’ to an energy price
- Do not directly result in a target level of capacity
- Capacity payments can be targeted or market-wide

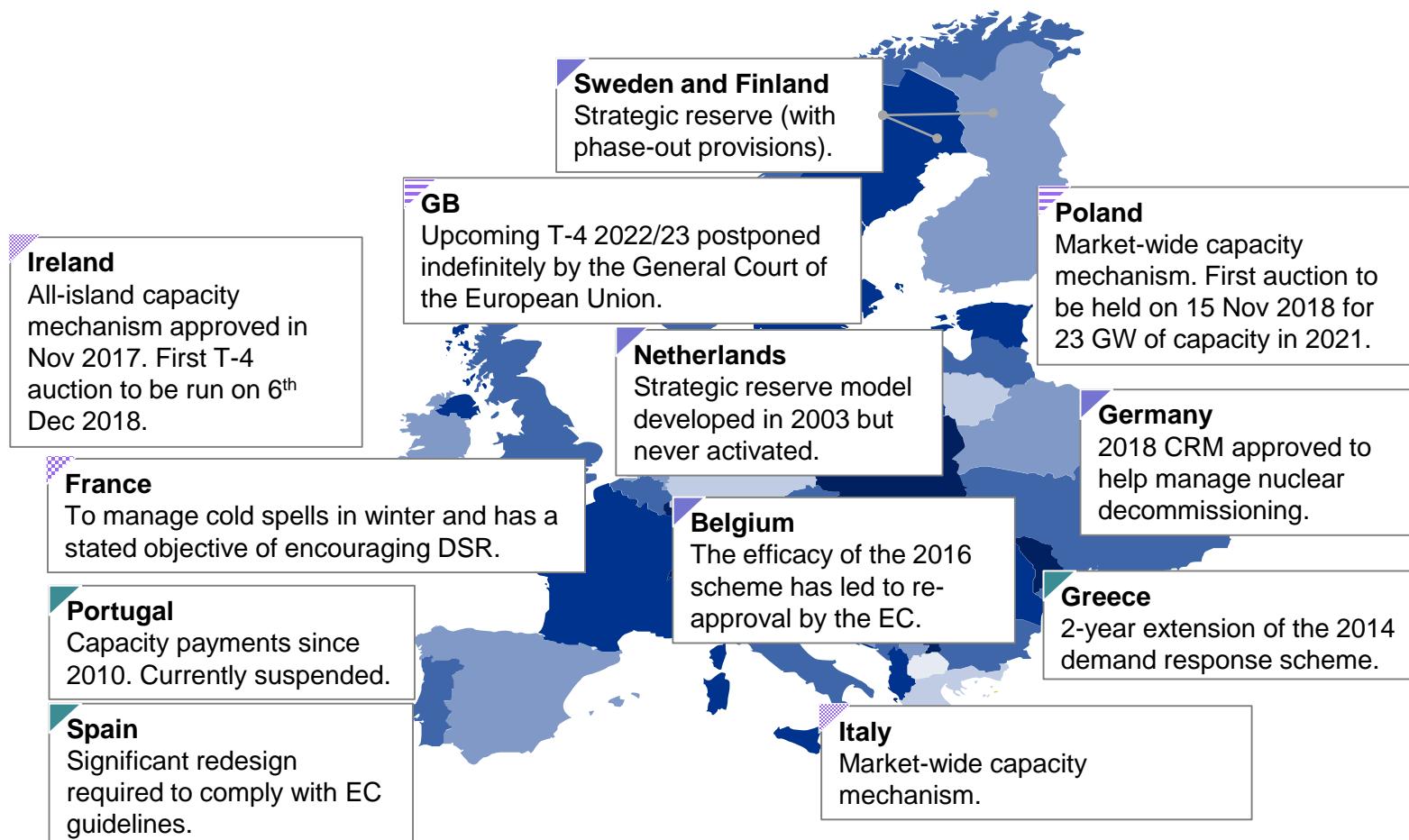
Targeted CRM

- Usually segregated from the energy market
- ‘Back-stop’ to the energy market
- Where support for all new capacity becomes necessary, segregation from the energy market is no longer possible

Market-wide

- Critical choice between:
 - Centralised auction
 - Decentralised obligation

In Europe there are a range of mechanisms in place

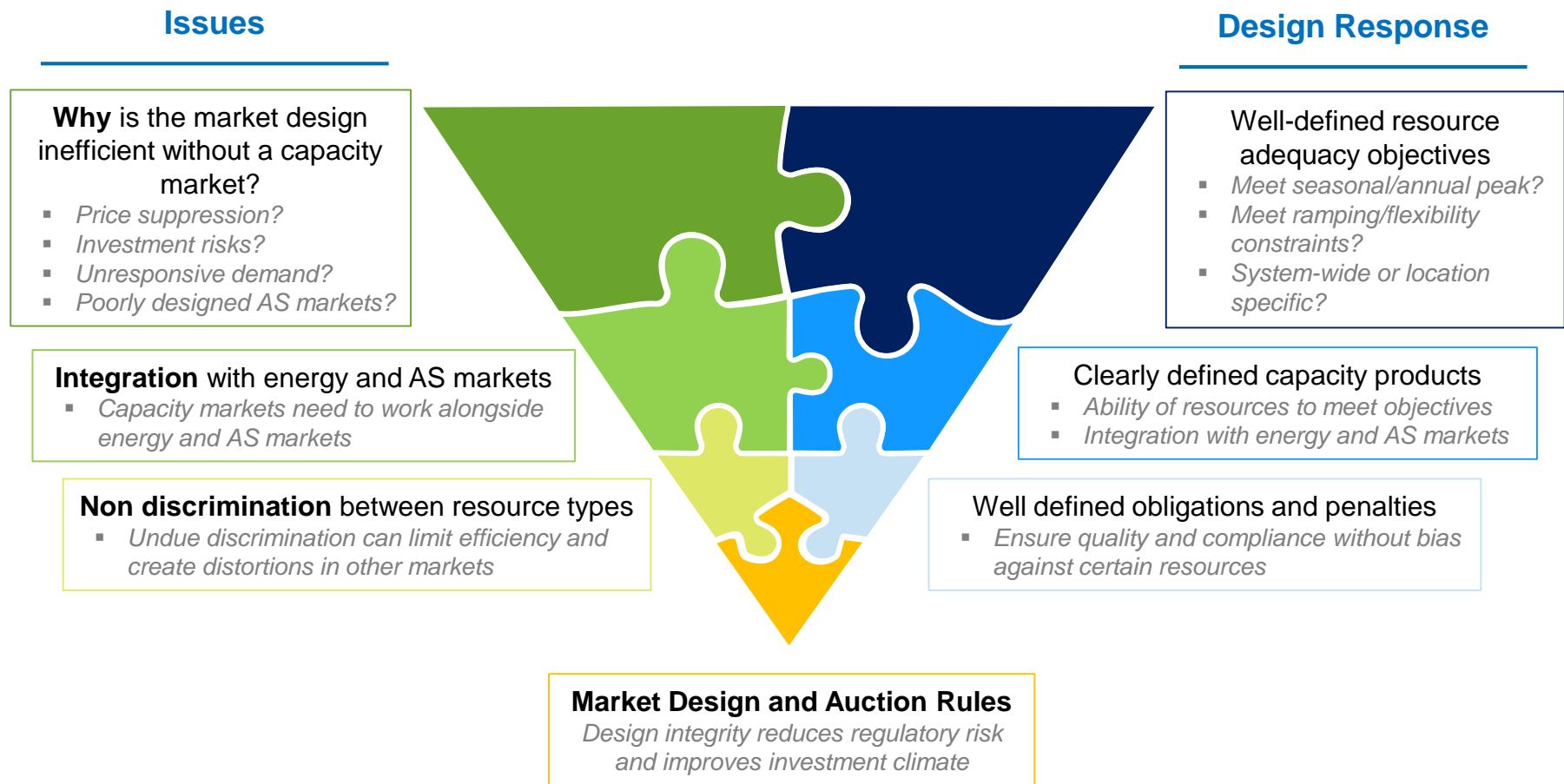


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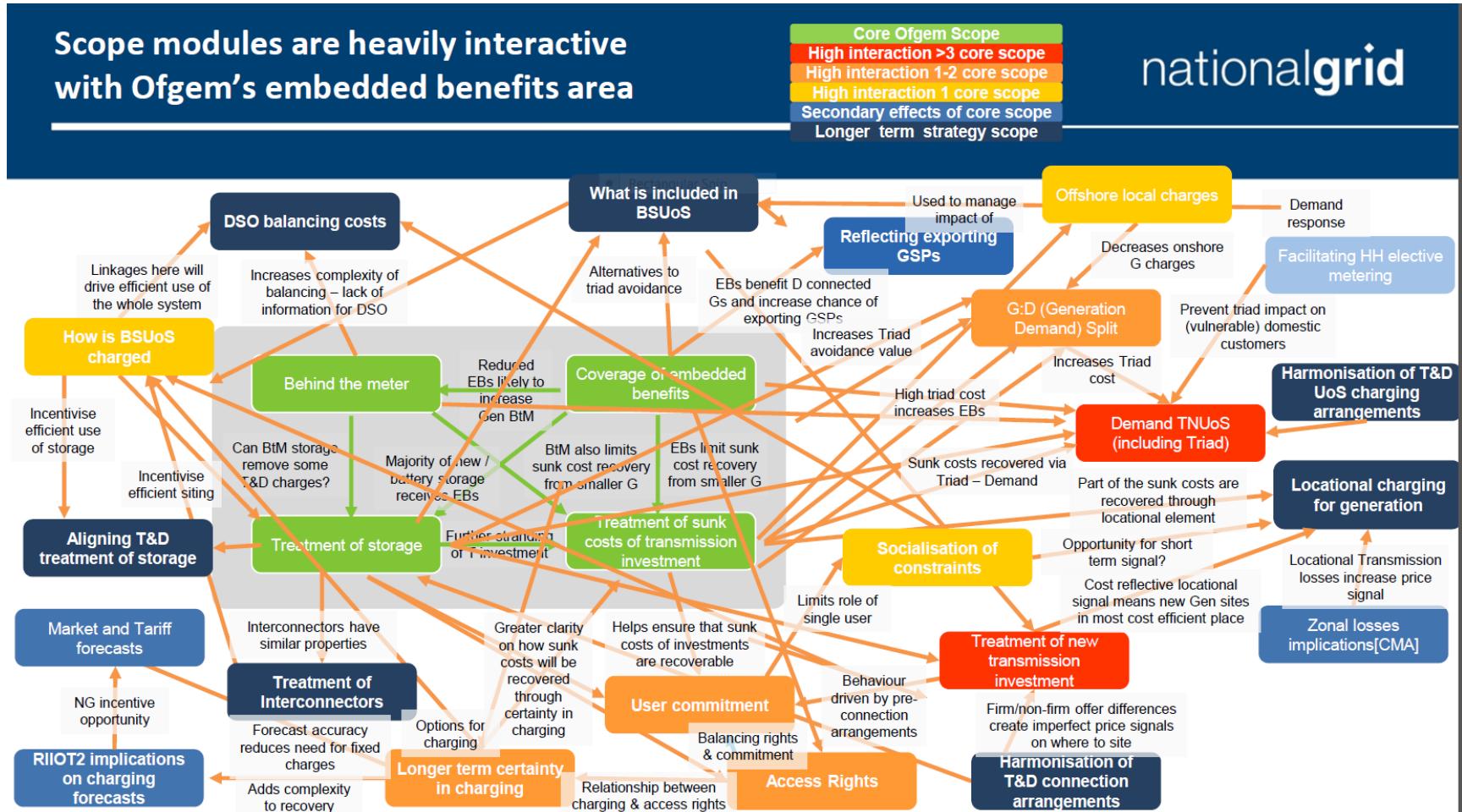
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| Capacity Payment | Strategic Reserve | Reliability option | Capacity obligation | Capacity auction |
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The choice of CRM design needs to be clearly responsive to identified issues

Well designed capacity markets start with clear objectives, comprise clearly defined products and address interactions between energy and AS markets



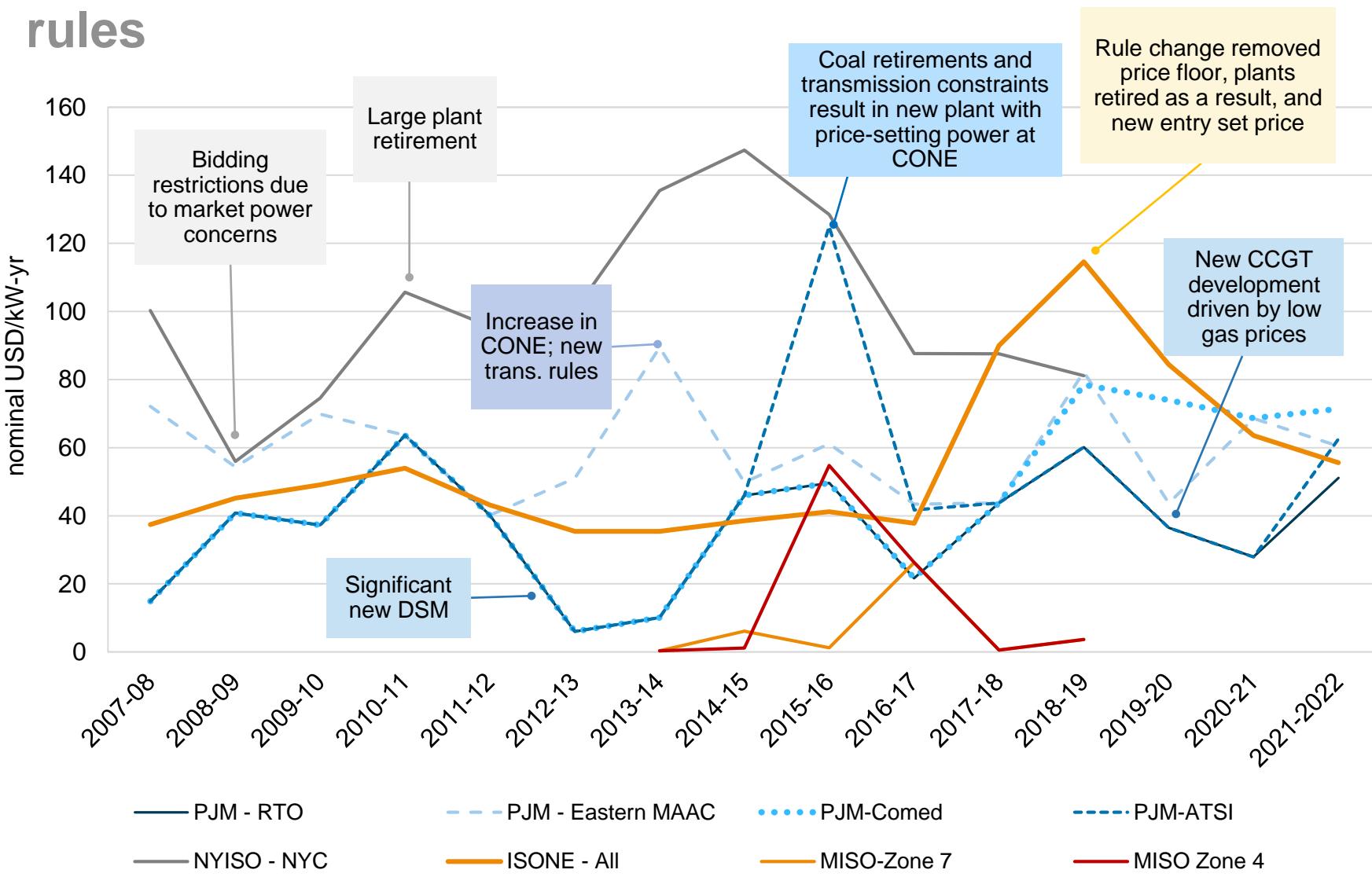
Market reform without unintended consequences is difficult given market interactions



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Capacity Markets continue to surprise participants as outcomes change with market fundamentals and new rules



There are some common themes from the performance of U.S. capacity markets over the last ten years

Rule changes can impact price volatility

- Implementation of more gently sloped demand curves
- Treatment of transmission constraints have led to significant price changes

Widespread incentives to exert market power require constant monitoring

- Need to introduce must offer requirements and offer price mitigations to avoid capacity withholding

Supply mix is responsive to price signals

- Highest quantity of new generation located in “constrained” zones
- Capacity retirements due to insufficient price incentives to support costly retrofits

Product definition can drive the mix of resources offered

- Scale of DSR participation largely driven by the existence of a tailored DSR product

Incremental auctions can reduce the effectiveness of the market

- In PJM, incremental auctions have been used as an “escape valve” for DSR to purchase back previous obligations
- Reliant on accurate load forecasts by market operators

Performance incentives continue to be a key area of review

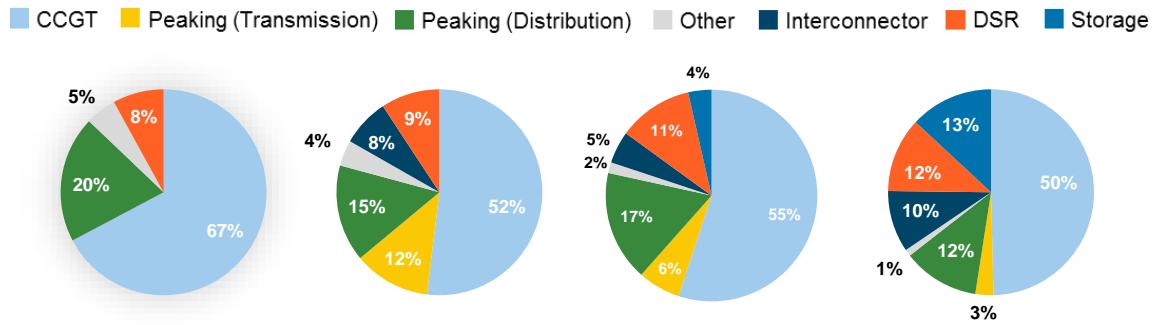
- Polar Vortex in the northeast of the U.S. provided evidence that better product definition and more stringent penalties were required

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Major trends...

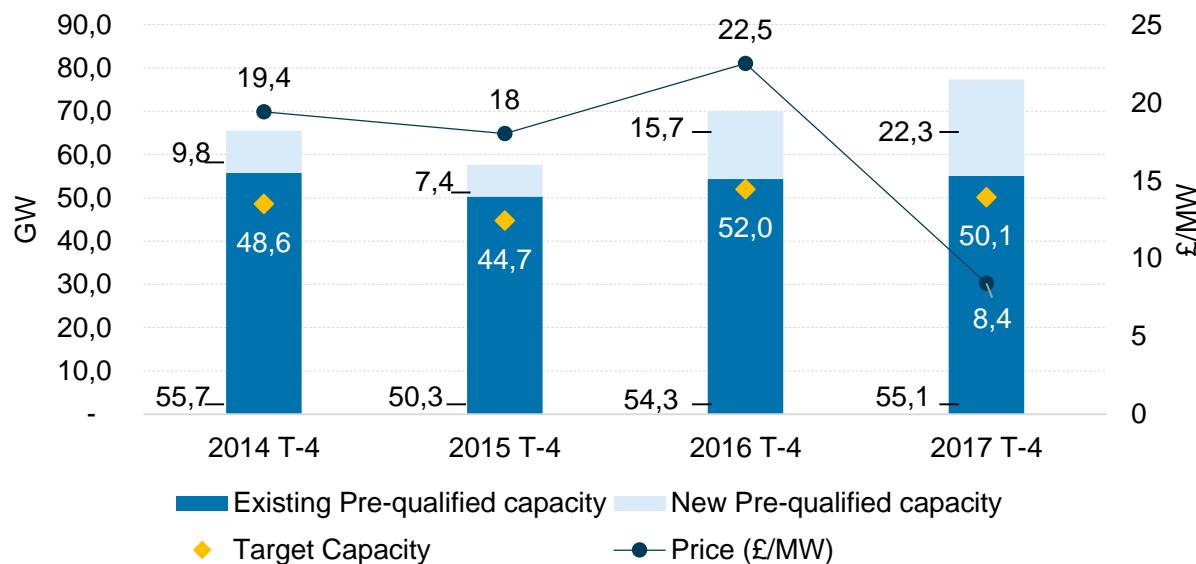
New Prequalified Technology Mix



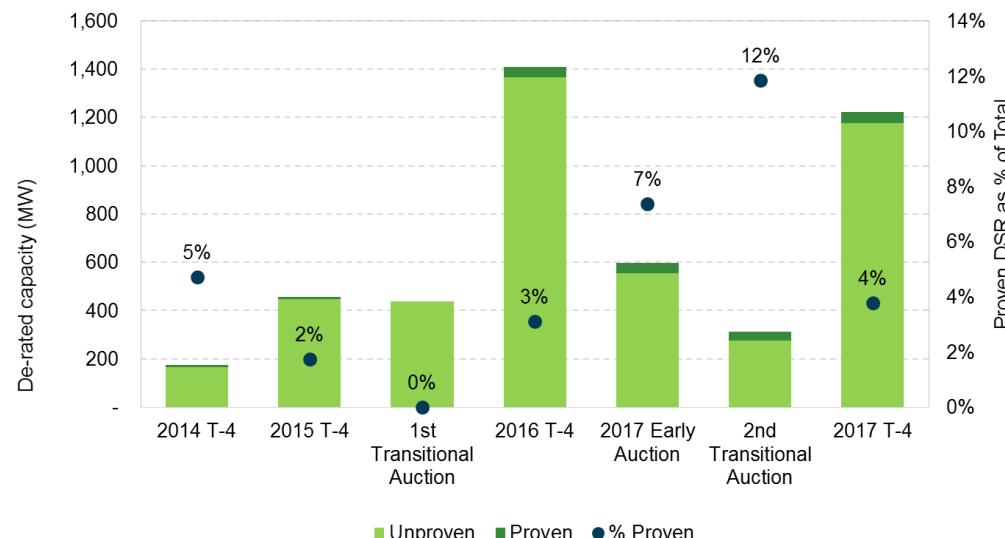
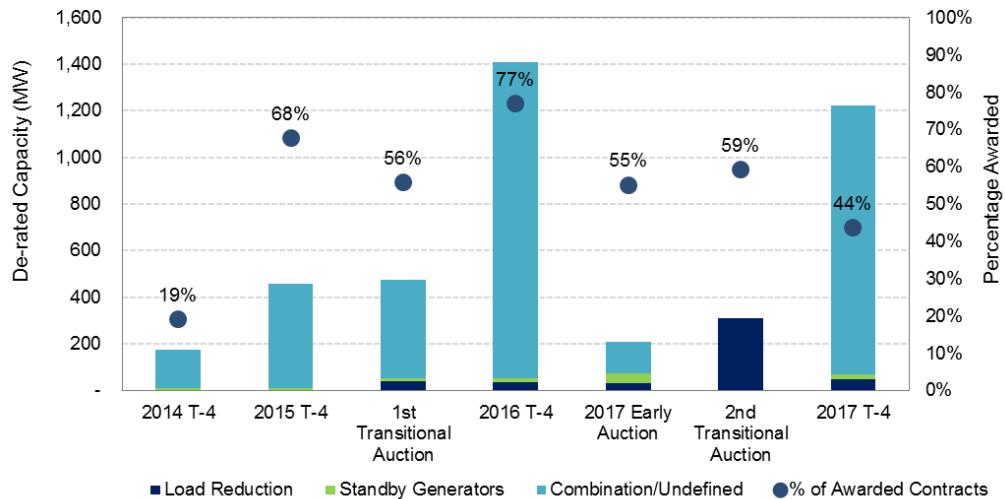
Trends

- Clearing prices remain too low to finance large-scale new gas-fired generation
- Constant stream of changes to all aspects of the CRM Rules and Regulations
- Struggle to address the “small peakers” problem
- Changing dynamics of competition in electricity markets
- Irruption of DSRs and Interconnectors in the latest auctions

Auction Results



DSR participation in the capacity market auctions has grown significantly



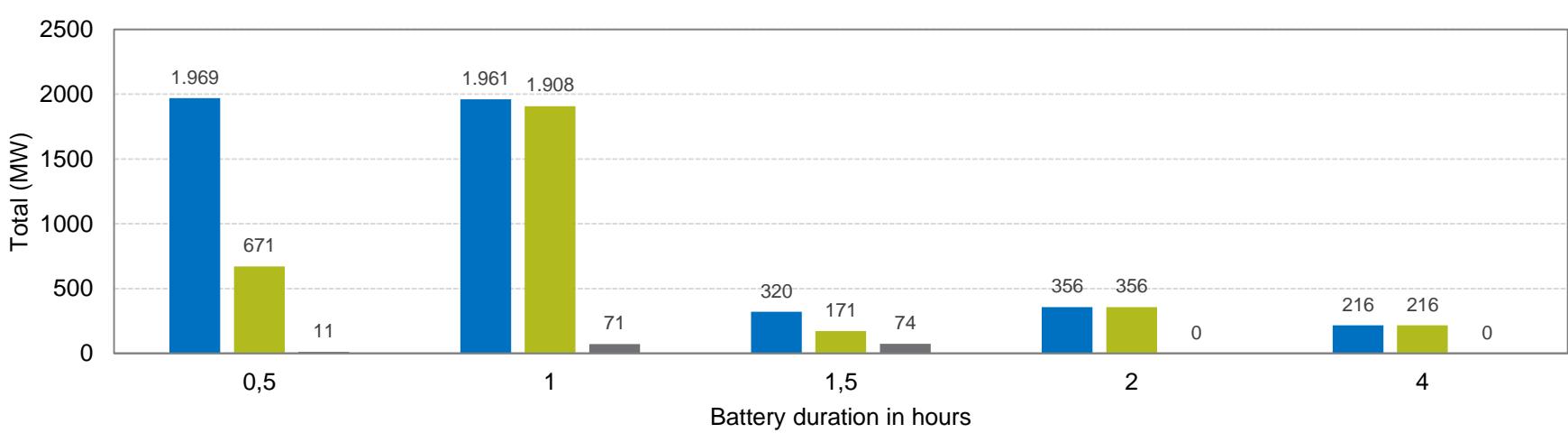
- The design of the GB Capacity Market provides incentives for the development of DSR:
 - Transitional Auctions specifically targeting DSR
 - Allows the participation of Unproven DSR
- The participation of DSR in the Capacity Market has been growing over time
 - The first T-4 auction in 2014 awarded contracts to less than 200 MW of DSR
 - The 2016 T-4 auction awarded contracts to over 1.4 GW of DSR
- Unproven DSR makes up the majority of the awarded contracts to DSR in the auctions held to date
- Barriers to further participation include:
 - Inability of DSR to access long-term contracts
 - No time limit on “dispatch” requirement during stress events

Battery derating

Battery duration (hours)	Derating Factor (% of Capacity) 2014 T-4	Derating factor (% of capacity) 2017 T-4
0.5	97.38%	17.89%
1	97.38%	36.44%
1.5	97.38%	52.28%
2	97.38%	64.79%
2.5	97.38%	75.47%
3	97.38%	82.03%
3.5	97.38%	85.74%
+4	97.38%	96.11%

- By December 2017, almost 5 GW of battery capacity had pre-qualified for the 2017 T-4 auction
- Following changes to the applicable derating factors for batteries announced in early December, over 1.5 GW of short-duration batteries opted out of the auction
- Only 150 MW were successful in the auction, compared to 500 MW in the 2016 T-4 auction

Change in Pre-qualified Battery Storage in 2017 T-4 after De-rating Changes



■ 2017 Dec conditionally prequalified ■ 2018 Jan conditionally prequalified/prequalified ■ 2018 Awarded Capacity

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Introducing new market mechanisms without distortionary effects is challenging

- Difficult to define a level-playing field if objectives for market mechanisms are outcome-oriented
- Capacity markets are designed to complement energy and ancillary services revenues, so changes in these markets will affect capacity clearing prices
- Whole system approach is required but complex as all players have:
 - multiple revenue opportunities
 - exposures to related charges
- Tension between:
 - Central planning – as per Capacity Market and central procurement model for renewables/nuclear/CCS
 - Bottom-up innovation and decentralised power markets
- Centralised auctions are complex and tend to involve multiple, successive rule changes
- Competition becomes more a matter of arguing over the rules than bidding in the auction: what are the best dispute resolution and governance arrangements?

Key areas of review expected for GB market may draw on U.S. experience

	GB Outstanding Issues	Key Learnings from the U.S.
Contract duration	<ul style="list-style-type: none"> ▪ Concern that 15-year contracts can impact the value of new generation vs. existing generation and may lead to inefficient retirements. ▪ Eligibility of DSR for 15-year contracts 	<ul style="list-style-type: none"> ▪ Maximum contract duration in U.S. markets are three years in PJM and seven years in ISO-NE. Both RTOs have successfully attracted c.40 GW of new merchant capacity since 2007.
Performance incentives (inc. completion milestones)	<ul style="list-style-type: none"> ▪ GB performance incentives have led the U.S. proposals, but other issues, like importance of fuel deliveries and capacity construction milestones are still to be tested. ▪ Majority of DSR contracted in the auction is unproven, with performance yet to be tested. 	<ul style="list-style-type: none"> ▪ Insufficient incentives for deliverability during times of system stress led to very close calls during the extreme cold weather conditions of the Polar Vortex. ▪ Under-estimated forced outage rates, lack of firm fuel delivery contracts, and inability to deploy dual fuel capability were some of the key issues cited by market monitors. ▪ Completion milestones have not been a major issue, except for DSR.
Interconnector participation	<ul style="list-style-type: none"> ▪ Interconnector-led solution in GB considered temporary. Market developments in Ireland will provide a “live” test ground to solve dichotomy between market coupling and firm delivery requirement for reliability. 	<ul style="list-style-type: none"> ▪ Compatibility with market coupling requirements not an issue in the U.S., therefore, participation of externally-located resources requires firm delivery and ability to respond directly to instructions from the RTO where capacity is sold.
DSR participation	<ul style="list-style-type: none"> ▪ DSR participation continuously growing. Penetration and performance of DSR will continue to be reviewed. 	<ul style="list-style-type: none"> ▪ Concerns about performance measurement have led to additional auditing requirements for DSR.
Locational reliability	<ul style="list-style-type: none"> ▪ Where resource adequacy has a locational requirement, the capacity market also needs to be locational. 	<ul style="list-style-type: none"> ▪ Locational requirements have been a key focus of the U.S. capacity markets. Higher clearing prices in constrained zones have led to additional generation and price convergence in selected zones.
Market power	<ul style="list-style-type: none"> ▪ Market power mitigation was an area of particular focus in the design of the GB capacity market. However, this requires constant monitoring and review. 	<ul style="list-style-type: none"> ▪ U.S. markets have continued to implement measures to mitigate market power, most of which have been adopted in some form in GB. U.S. experience highlights need for continued monitoring of misaligned incentives and exertion of market power.



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TALKING POINTS AND FIGURES

The GB capacity auction – results of 2014 auction

The 2014 T-4 auction cleared below expectations at £19.40/kW-year. Only one new CCGT secured a contract but then failed to reach financial close

2014 T-4 Auction Results

Derated MW

Technology Type	Successful		Unsuccessful	
	Existing	New	Existing	New
CCGT	22,836	1,656	4,646	4,563
Coal	7,474		4,038	
Hydro	3,334			49
Nuclear	7,876			
Other (Transmission)	69		34	486
Peaking (Transmission)	2,988		461	
DSR	8	166	20	718
Other (Distributed)	990	124	79	250
Peaking (Distributed)	896	841	13	1,060
Grand Total	46,472	2,787	9,290	7,125

- 2.8 GW of new capacity secured contracts of which nearly 1 GW was embedded generation with the remainder, Trafford Power, subsequently failing to reach financial close
- The new embedded generation was mostly small-scale diesel/gas gensets with relatively high gCO2/MWh emissions
- A substantial amount of existing CCGTs – 4.6 GW – failed to secure contracts

Incentives from transmission charges and other incentive arrangements enabled low efficiency, high emission plant to win 15 year agreements

		Unit	LV/MV Connected	EHV Connected
Levelised Capacity Cost		£/kW-Year	£40	£50
Transmission and balancing costs	Transmission Losses, TNUoS and BSUoS	£000		£5
Distribution benefits	Distribution Losses and DUoS	£000	-£7	
Transmission benefits	Transmission Losses, TNUoS, BSUoS	£000	-£45	
Revenues Needed from the Energy and Capacity Market with 50% of embedded benefits		£/kW-Year	£14	£55

- Embedded gensets benefitted from incentives to reduce transmission network demand in periods of peak system demand
- Because of their size, other benefits include exclusion from environmental legislation – the Industrial Emissions Directive. Diesel gensets have an intensity of around 0.75 tCO2/MWh.
- Under the Enterprise Investment Scheme, gensets in certain areas gain tax breaks worth up to 15% on annual rate of return

2015 T-4 auction also cleared below expectations at £18/kW-year. No CCGTs secured a contract

"In the next 10 years, it's imperative that we get new gas-fired power stations built. We need to get the right signals in the electricity market to achieve that. We are already consulting on how to improve the Capacity Market. And after this year's auction we will take stock and ensure it delivers the gas we need."

(Secretary of State for Energy, November 2015)

2015 T-4 Auction Results Derated MW

Technology Type	Successful		Unsuccessful	
	Existing	New	Existing	New
CCGT	24,106		1,961	3,739
Coal	2,410		3,072	
Hydro	3,293		87	48
Nuclear	7,575			
Interconnector	1,862			540
Other (Transmission)	20			
Peaking (Transmission)	3,604		53	865
DSR	8	448		217
Other (Distributed)	1,144	176	14	68
Peaking (Distributed)	758	950	311	351
Grand Total	44,779	1,575	5,498	5,828

- 1.1 GW of new embedded generation capacity secured contracts of which the majority is likely to be fuelled by diesel
- After the 2015 auction, Ofgem announced a review of embedded benefits and warned market participants not to rely on grandfathering; existing investments would not be spared the impact of any changes
- The Government also increased the target capacity requirement for the next auction

2016 T-4 auction cleared at £22.50/kW-year. A single new 333MW CCGT secured a contract

2016 T-4 Auction Results

Derated MW

Technology Type	Successful		Unsuccessful	
	Existing	New	Existing	New
CCGT	23,534	333	1,400	8,286
Coal	5,699		2,174	
Hydro	3,411			
Nuclear	7,878			
Interconnector	2,342			770
Other (Transmission)	2,320			
Peaking (Transmission)	984	299	1,735	716
Battery		453		105
DSR	44	1,367		424
Other (Distributed)	1,064	167	5	91
Peaking (Distributed)	1,187	1,342	556	1,356
Grand Total	48,465	3,960	5,870	35,211

- 8 GW of new CCGT exited the auction as prices fell towards £22.50/kW-year
- A new 300 MW OCGT secured a contract but a further 1.5 GW of small scale gensets secured contracts
- A total of 3.4 GW of new embedded generation have secured contracts across the three auctions – and analysts now point to a risk of non-completion with reform to embedded benefits
- Further concerns arise from
 - 1.4 GW of unproven DSR, much of which may in practice be behind-the-meter diesel gensets
 - 450 MW of batteries with a high de-rating factor but uncertain life

2017 T-4 auction (*held in January 2018*) cleared at £8.40/kW-year

2017 T-4 Auction Results

Derated MW

Technology Type	Successful		Unsuccessful	
	Existing	New	Existing	New
CCGT	24,324		591	11,055
Coal	2,565		7,724	
Hydro/ PS	3,177		74	
Nuclear	7,926			
Interconnector	2,403	2,155		
Other (Transmission)	2,366			
Peaking (Transmission)	831		70	633
Battery		182		2,757
DSR	46	1,178	96	1,487
Other (Distributed)	1,699	181	4	55
Peaking (Distributed)	975	429	213	2,245
Grand Total	46,313	4,125	8,772	18,232

- The target capacity for 2021/2022 was 49.2 GW, 2.5 GW lower than the target capacity for the 2020/2021 auction
- With 54.9 GW of existing capacity pre-qualifying for the auction, existing capacity alone exceeded the target by 12%
- Interconnectors secured contracts for 4.56 GW, compared to 2.34 GW secured in the 2020/2021 auction.
- Even though there was a lot of focus on the participation of batteries in the auction, of the 1.3GW (3.3GW connection capacity) of battery projects that prequalified for the auction, only around 150MW were successful.
- Auction results reflect:
 - Declining competitiveness of coal-fired plant
 - Change in bidding behaviour and (perhaps) the expectation of higher revenues in other markets