



FORUM FOR
ENERGY ANALYSIS

CAPACITY MARKET ARRANGEMENTS IN GREAT BRITAIN

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Forum for Energy Analysis

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The aim of the Forum for Energy Analysis is to conduct a dialogue focused on the power sector that is open to the diverse opinions of all stakeholders in Poland, based on analysis-orientated strategic thinking about the upcoming key challenges in the sector.

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1. KEY MESSAGES

GB capacity market background

- The GB capacity market was introduced as a part of bigger power market reform in order to solve the problem of falling capacity margins (4%), lack of investments in electricity generation and predicted capacity shortage between 2018 - 2019.
- Another part of the power market reform is contract for difference scheme which rewards low-carbon projects in line with energy mix strategy (and EU obligations).
- The GB capacity market is relevant because it is the first capacity market case approved by the European Commission according to the new state aid rules, and because lessons can be learnt from the first T4 auction that took place in December 2014.

Results of the first capacity auction:

- Capacity contracts awarded will impose a cost of £980 million on consumers in 2018/19.
- The T-4 auction held in December 2014 for capacity to be delivered in 2018/19 was significantly over-subscribed, with 65 GW of capacity bidding for a notional required procurement of 48.6 GW. This suggests that the capacity market in GB was introduced prematurely.
- The auction clearing price was £19.4/KW-year, considerably below the auction cap of £75/kW-year.
- One major gas-fired project received a 15 year contract – all existing capacity clearing the first auction received either 1 or 3 year contracts.
- Due in part to the design of the capacity market, only a small amount of DSR capacity cleared the first auction.

Lessons learnt from first UK capacity market

- In assessing resource adequacy, it is important to properly take into account all available resources – demand-side, cross-border interconnections, plant availability. This is important both for determining need, lowering the costs and for securing European Commission state aid approval.
- Before introducing a capacity mechanism, it is critical to identify the problem and select measures that can solve it at lowest cost to consumers and the economy.
- Timing is essential. As the GB experience shows, introducing a capacity mechanism prematurely may be counter-productive, and represent a cost to consumers with little benefit.
- If a capacity mechanism is needed, DSR should be treated on equal footing with generation capacity. DSR has been shown to significantly reduce system costs, and can introduce new technologies and increased competition to the market.
- A capacity mechanism can adversely affect cross-border flows of energy by depressing energy prices during times of system stress, leading to a less inflows of energy and – conversely – incentivising greater outflow of energy.

2. BACKGROUND OF THE STUDY

Capacity mechanisms have recently gained the attention of policy makers in Europe. The discussion in Member States is driven by various concerns, including: resource adequacy constraints, the missing money issues raised by power utilities, and attempts to limit peak demand. The Forum for Energy Analysis has chosen to present the British case. The Capacity Remuneration Mechanism (CRM) adopted by Great Britain is the first case of a capacity mechanism notified by the European Commission after the new state aid guidelines were approved in the middle of 2014.¹ Lessons learnt from this case are particularly relevant for Poland as the country debates the possible introduction of a capacity remuneration mechanism.

This paper briefly describes the electricity market in Great Britain and measures that are currently being put in place to encourage investment in the power sector. In describing these measures, the intention is not to suggest they be adopted by Poland. Indeed, the paper refers to various concerns about their design and implementation. However, the issues faced by both countries are similar. Both countries are emerging from a period of over-capacity and depressed or declining peak demand, both markets will experience significant plant closures as older capacity becomes uneconomic, while there is concern that energy prices alone will be insufficient to sustain the required investment in replacement capacity. In addition, both systems are exposed to the impact of the increased deployment of intermittent renewable sources such as wind, which may ultimately restrict the utilisation of existing conventional capacity, adding to investor's concerns.

Table 1. Overview of the Polish and British energy system

	Poland (2012)	UK (2014)
Capacity	38 GW	82 GW
Peak demand	25 GW	56 GW
Capacity margin	13%	6%
Yearly production	164 TWh	357 TWh
Yearly consumption	163 TWh	374 TWh
Energy mix	Coal & lignate — 85% Gas & oil — 5% Hydro — 1% Other RES — 9%	Nuclear 19% Hydro 2% RES 10% Gas 27% Coal 37% Other 5%

These common challenges suggest that Great Britain's response in terms of power market reform and the introduction of mechanisms to support investment in new capacity may be of some interest to Poland in identifying the most appropriate way forward. There is also a European dimension to be considered with similar concerns arising in a number of Member States, while the increasing integration of both energy and balancing markets suggests that a purely national response to issues of resource adequacy and profitability may no longer be entirely adequate.

¹ EC Guidelines on State aid for environmental protection and energy 2014-2020, 2014/C 200/01.

3. CONTENT OF THE PAPER

This paper begins with an overview of the GB power market, followed by a description of the reasons for power market reform. It then describes the capacity market being introduced by Great Britain, some transitional arrangements, and reform of the balancing market. Lastly, the paper turns to a critique of some elements of the GB CRM and provides a brief summary of the European Commission's state aid decision. The analysis is enriched by results of the first auction, which was held in December 2014.

4. OVERVIEW OF THE POWER MARKET IN GREAT BRITAIN

4.1 POWER MARKET DESIGN

Similar to Poland Great Britain currently operates an "energy only" wholesale electricity market (EOM) with no explicit reward for conventional generation capacity other than for some ancillary and balancing services. Additional support is also currently available for renewable generation through a "Renewables Obligation" (RO), which places an obligation on suppliers to supply a proportion of their demand from renewable sources.

In terms of energy, market participants buy and sell to meet their contractual positions on a bilateral basis using over-the-counter contracts and brokers in the forwards timescales, or anonymously via power exchanges at the day ahead and intra-day timescales. The energy market closes one hour before real time. At that point, a Balancing Mechanism is introduced to allow the System Operator (National Grid) to ensure both a final energy balance and the resolution of any transmission system constraints, using bids and offers made by generators and other balancing service providers.

Competition in supply is well established in Great Britain, although the concentration of generation resource and supply within six large vertically integrated utilities has raised concern over the real level of competition in both the wholesale and retail markets. This concern has led to the retail market being referred to the Competition and Markets Authority (CMA), a move that has increased regulatory uncertainty and arguably discouraged large utilities from investing in new capacity in the short-term.

Peak demand occurs in the winter period, either immediately before Christmas or in the middle two weeks of January. Restricted peak demand² has declined to its current level of approximately 56 GW during the recession and, despite a return to economic growth, present trends suggest it will remain at or even slightly below this level in the near future. By comparison, peak demand in Poland is around 25 GW and increasing.

To meet this peak demand, Great Britain has an installed (nameplate) generation capacity of approximately 82 GW, including almost 10 GW nuclear, 21 GW coal, 34 GW gas, 10 GW renewables (mostly wind) and 7 GW pumped storage/other. There are also 4.2 GW of HVDC interconnection

² Suppliers and large customers are charged on the basis of their averaged demand during three winter peak periods nominated by the System Operator – the "triad" demand peaks. Suppliers and large customers use demand response to reduce demand during these periods and the associated transmission network use of system (TNUoS) charges. This demand reduction is taken into account when forecasting the actual "restricted" peak demand to be met.

capacity with neighbouring Member States, with the prospect that this capacity could possibly double by the middle of the next decade.

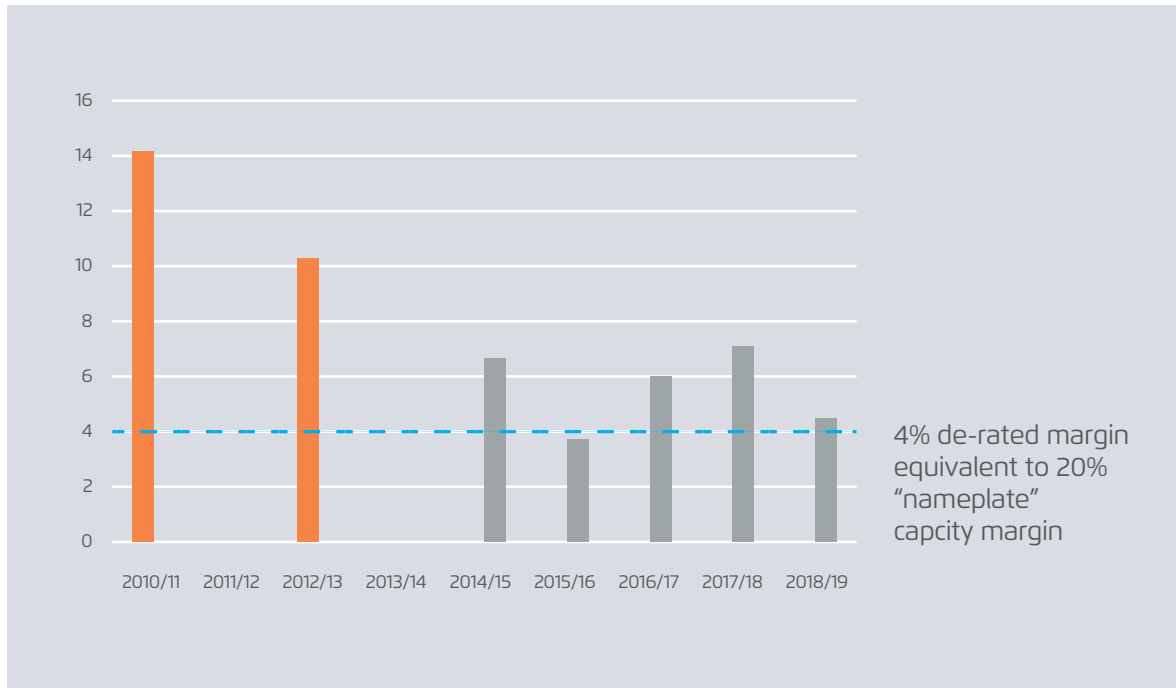
In comparison Poland has an installed (nameplate) generation capacity of approximately 38.4 GW, consisting of: 22.3 GW coal, 9.4 GW lignite, 0.9 GW gas, 3.5 GW wind, 2.3 GW water and pumped storage. There is also 4.8 GW of interconnection capacity available for imports from neighbouring countries.

4.2 CONCERNS OVER RESOURCE ADEQUACY

Due to plant decommissioning and low levels of compensating investment in new capacity, plant margins in Great Britain have declined in recent years and are expected to decline further before recovering somewhat post 2015, as illustrated in Figure 1. Plant decommissioning largely reflects the increasing cost of meeting environmental standards and the fact that some plant is reaching the end of its economic life. The lack of investment in replacement capacity is probably due to a combination of circumstances, including low power prices driven by a period of over-capacity and depressed demands, short-term regulatory and political risk faced by the major vertically-integrated utilities and also the prospect of increasing intermittent renewable generation deployment, which could impact plant utilisation and increase price volatility.

While these factors are causing generation capacity to decline, the margin of available capacity over demand is also impacted by assumptions made about interconnection contribution, plant availability and demand side participation. These issues are discussed in more detail later, however it is worth noting at this point that the rather conservative assumptions adopted by Great Britain have arguably resulted in a pessimistic view of the capacity likely to be available to meet demand in the years ahead. Based on these assumptions, de-rated plant margins are forecast to fall to below 4% level (broadly equivalent to a 20% nameplate capacity margin) for winter 2015/16 which, in the absence of any formal reliability standard, has traditionally been taken as the threshold below which margins should not fall. It is worth noting that the reserve margin in Poland is 13% and around 2016 when some power plant will be switched off reserve margin will fall to 9% - still much higher than in the UK.³

³ De-rated plant margins in the UK and Poland are calculated using the same general methodology, i.e. looking at historical availability of resources at peaks and reducing nameplate capacity by a factor, which is specific for a given technology. See footnote 4.

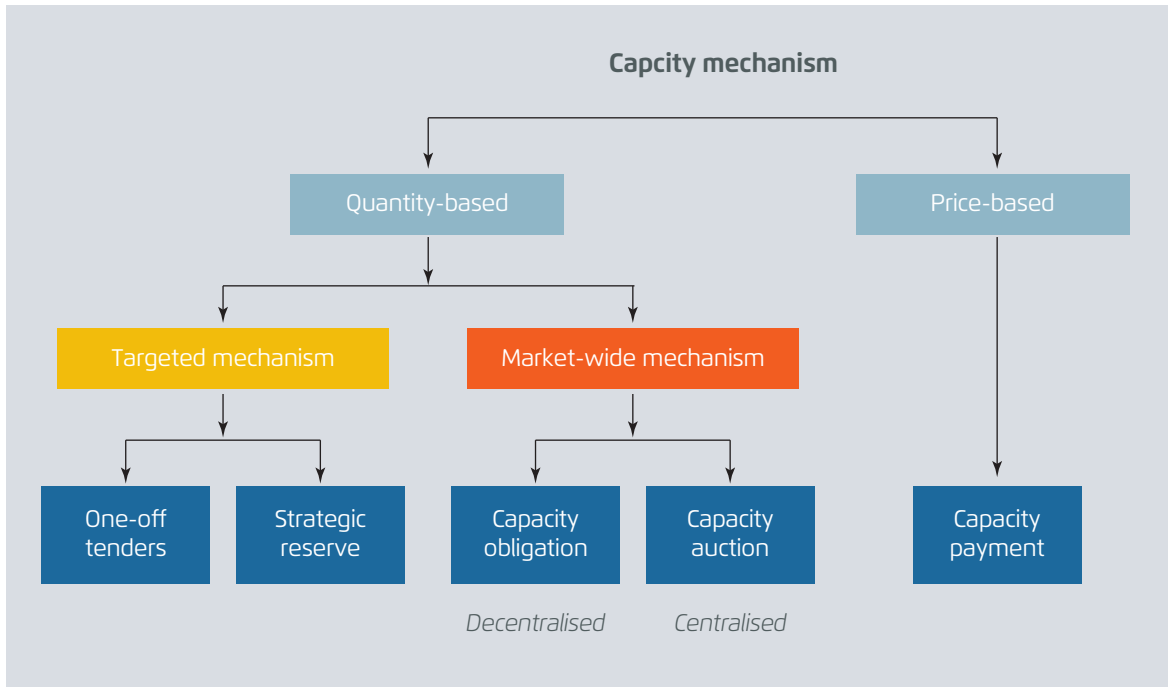
Figure 1. De-rated capacity margins to 2018/19⁴

5. CRM OPTIONS CONSIDERED

The prospect of declining plant margins has prompted the UK Government to introduce measures to support investment. However, before describing the particular arrangements being introduced, it may be useful to place these in the general taxonomy of CRM options. This is particularly relevant to the European context, as various EU Member States are considering different capacity market designs than that chosen by the UK.

The term “capacity mechanisms” broadly encompasses a wide range of mechanisms that make payments for the availability of capacity on the power system. The range of mechanisms is illustrated in Figure 2.

⁴ The de-rated plant margin takes account of the expected availability of various generation technologies over winter peak. Conventional and renewable plant commissioning together with peak demand forecast follow National Grid’s “Slow Progress” scenario, which currently appears to most accurately reflect actual trends.

Figure 2. Taxonomy of CRM options⁵

As Figure 2 shows, CRMs can either be quantity or price based. Quantity-based arrangements define the quantity of capacity required, for example to satisfy a specific reliability standard, and the market then sets the price. With price-based arrangements, a mechanism such as value of lost load (VOLL)⁶ or loss of load expectancy (LOLE)⁷ is used to set a price signal and the market then brings forward capacity in response to that signal. An example of a price-based CRM would be the old England & Wales Electricity Pool, where a capacity price was set using a combination of both VOLL and LOLE.

Quantity-based CRMs can either be targeted or market-wide arrangements. Targeted arrangements can take the form of tendered contracts to individual generators to remain available or a “strategic reserve”, where a portfolio of generation is removed from the energy market and only re-introduced in “scarcity” situations when the only remaining option to maintain an energy balance is to reduce demand via voltage reduction or load shedding. Examples of a strategic reserve CRM, which generally leave power prices unaffected other than in extreme scarcity situations, can be found in Sweden, Finland, The Netherlands and in Poland (as cold reserve implemented in 2013 and 2014).

⁵ Source, Capacity Mechanisms in Individual Markets within the IEM. Report to the European commission by THEMA & COWI, June 2013

⁶ VOLL is the estimated maximum price that customers would be willing to pay in order to avoid a loss of supply. The value of VOLL will vary for each class of consumer, industrial, commercial, domestic, and for individual consumers within those broad classes. Alighting on a single value of VOLL is therefore rather subjective, however the average VOLL for consumers in Great Britain is often taken to be around £18,000/MWhr.

⁷ LOLE represents the number of hours or days per annum in which, measured over the long term, it is statistically expected that supply will not meet demand. When expressed in days/annum, LOLE is comparing daily peak demand and available generation; when expressed in hrs/annum, VOLL is comparing hourly load to available generation. When expressed as a probability, LOLE is referred to as “loss of load probability” or LOLP.

Market-wide CRMs can either be obligation or auction-based. As the name suggests, obligation-based CRMs place an obligation on suppliers to contract for a specific amount of capacity related to their energy demand and are generally regarded as “decentralised” mechanisms. Auction-based CRMs, again as the name suggests, procure capacity to meet some specified target via market-wide auctions and are generally regarded as “centralised” mechanisms. An example of an obligation-based CRM is that proposed for introduction in France, while auction-based arrangements can be seen in a number of US regional markets, Ireland, Italy and, from this year, in Great Britain.

6. CAPACITY SUPPORT OPTIONS ADOPTED IN GREAT BRITAIN

Having considered the range of options outlined above, together with some other possibilities, the UK government opted for a package of measures designed to support new investment in capacity and maintain adequate levels of resource adequacy. In parallel, measures are also being introduced to support investment in low-carbon generation.

The package of measures to support investment in conventional capacity consists of the:

- Creation of a reliability standard, against which resource adequacy can be assessed.
- Introduction of a market-wide CRM, with the first auction held in December 2014 to deliver capacity from winter 2018/19.
- Reform of the Balancing Mechanism to encourage parties to make more use of the short-term and forward markets to balance their positions, rather than relying on System Operator action post market closure.
- Introduction of two new balancing mechanisms as a transitional arrangement to ensure system reliability prior to winter 2018/19.

Each of these measures is described below, with a more detailed description given in Appendix 2.

6.1 THE RELIABILITY STANDARD

Since privatisation of the electricity supply industry in 1990, Great Britain has not had a specific reliability standard, but has relied on the energy market to bring forward an appropriate level of capacity to ensure that “all reasonable demands for electricity can be met”. However, as the introduction of an organised capacity mechanism requires some means of assessing the need for capacity, a reliability standard has been established. This requires that the annual loss of load expectation (LOLE) should not exceed 3 hours/year and has been arrived at by comparing the estimated cost of new entry (CONE) with the assumed average value that customers place on supply, i.e. the assumed value of lost load (VOLL). The reliability standard is therefore a trade-off between reliability and the cost of providing that reliability.

6.2 CAPACITY MARKET

The CRM being implemented in Great Britain is a market-wide mechanism, although it is worth noting that the UK Government’s original preference was for a “strategic reserve”. The market closely follows designs seen in the US and consists of a number of stages, including the assessment of the capacity necessary to meet the reliability standard, a pre-qualification stage to identify total capacity and determine what capacity is eligible to participate in the capacity

auctions, the auctions themselves through which capacity contracts are awarded, delivery and finally settlement.

Two auctions are held for each delivery year. The first (T-4) auction is held four years ahead to allow the participation of new capacity, with all but 2.5GW of required capacity being procured. A second (T-1) auction takes place at the year-ahead stage at which the remaining capacity is procured, taking advantage of updated and more accurate demand forecasts.

Existing resources are able to secure 1 or 3 year contracts (apart from DSR, which can only obtain 1 year contracts), while new supply is eligible for 15-year contracts.

6.3 BALANCING MECHANISM REFORM

The Balancing Mechanism is the vehicle used by the System Operator to achieve a final balance between supply and demand in real time. In reforming the Balancing Mechanism, the aim was to encourage trading parties to balance their contractual positions in advance of market closure, by making imbalance cash-out prices reflect the marginal rather than average cost of balancing actions taken by the System Operator. The consequence of reform will be that cash-out or imbalance prices become more volatile and reflect the true scarcity value of capacity. These effects should feed into energy market prices as parties make more use of both short-term and forward markets to balance their trading positions prior to market closure, ultimately providing increased incentives to invest. A particular benefit of this approach is that investment in flexible resources, including DSR, should be preferred over investment in inflexible resources.

6.4 TRANSITIONAL ARRANGEMENTS

In order to ensure supply reliability is maintained during the period prior to the first CRM delivery year 2018/19, two new transitional balancing services are being tendered. These will allow large consumers who have the ability to flex their demand and generation that would otherwise not be available during the winter period to participate in meeting peak demand when capacity is scarce. These two balancing services will be “out of market” in that they will only be utilised as a last resort in order to avoid involuntary demand reduction. The services will be priced so as to reflect resource scarcity and VOLL and have been designed to ensure that marginal generation is not deprived of energy market revenues. Taken together with the reform of the Balancing Mechanism, Great Britain is therefore effectively implementing a “strategic reserve” ahead of the market-wide CRM that will deliver capacity from 2018/19 onwards.

6.5 LOW-CARBON SUPPORT

While not the subject of this paper, it should be noted that a parallel package of measures has been introduced to encourage investment in low carbon generation. This includes a contract for difference (CfD) feed-in tariff, a carbon support mechanism to account for the difference between the EU ETS carbon price and an administratively set carbon floor price (CPF) and an Emissions Performance Standard (EPS) that limits the carbon emissions from new conventional generating plant. The CfD feed-in tariff will ultimately replace the existing Renewable Obligations (RO) arrangements for renewable generation and create an investment support mechanism for all forms of low-carbon resources, including nuclear.

7. A CRITIQUE OF THE UK'S MARKET REFORM

The UK Government has introduced a CRM and reform of the Balancing Market to enhance investment in new capacity and therefore address the forecast decline in plant margins and associated risks to security of supply. However, there are a number of features that bring into doubt the effectiveness of the tools chosen, as well as the necessity of a capacity market at this moment in time.

7.1 THE UNDERLYING ANALYSIS

In assessing future security of supply and providing advice to Government on the amount of capacity to be procured, National Grid made what appear to be some conservative assumptions - particularly regarding generation availability and the contribution to be made by both interconnection and DSR. While a conservative approach to resource adequacy can to some extent be justified, the approach adopted by the UK Government and National Grid could potentially lead to an over-procurement of capacity and the imposition of unnecessary costs on consumers.

7.1.1 GENERATION AVAILABILITY

The assumed availability of both coal and gas fired generation over winter peak periods generally underestimates actual availabilities seen during recent winters. The assumed availabilities are also significantly lower than those achieved historically or those achieved internationally in well incentivised electricity markets.

One reason for these low estimates is that they reflect average availability seen over the winter periods rather than actual availability achieved at the time of peak demand, when wholesale energy prices will be maximised. More generally, the overcapacity and relatively low energy prices seen over recent years have also reduced the incentives for generation to maximise capacity over the winter period. However, declining plant margins together with the impact of Balancing Market reform should result in higher peak energy prices going forward, thereby encouraging higher plant availability. It seems likely, therefore, that plant operators in Great Britain should in the future be capable of achieving winter peak availabilities comparable to those seen elsewhere. On this basis, winter peak generation availability could be assumed to increase by at least 2 GW.

7.1.2 INTERCONNECTION CONTRIBUTION

Although the detailed assessment carried out by National Grid recognised that interconnection would likely contribute to security at times of peak demand, the amount of generation capacity to be procured for delivery in 2018/19 is based on the assumption of a zero net contribution from neighbouring systems. This seems at odds with the standard probabilistic approach to security of supply and it is clear that some interconnection contribution should be assumed, particularly in situations where capacity is tight and Balancing Market reform can be expected to boost wholesale energy prices. In fact analysis commissioned by both the UK Government and Ofgem Office of Gas and Electricity Markets⁸ suggest that an interconnector contribution of around 60% of installed capacity should be assumed over winter peak demand, equivalent to an additional capacity injection of around 2.5 GW.

⁸ See Analysis of the correlation of stress periods in the electricity markets in GB and its interconnected systems A report to Ofgem by Poyry, March 2013. <https://www.ofgem.gov.uk/ofgem-publications/75231/poyry-analysis-correlation-tight-periods-electricity-markets-gb-and-its-interconnected-systems.pdf>

7.1.3 DEMAND SIDE RESPONSE (DSR) CONTRIBUTION

In assessing the capacity to be procured in this year's auction, National Grid have assumed an eventual DSR contribution of 2.5 GW⁹. This is broadly equivalent to the demand response currently deployed by suppliers and large customers to reduce transmission charges, but seems to underestimate the potential 2018/19 DSR contribution, particularly as the transitional arrangements are designed to enhance DSR capacity. There is also a concern that the inherent design of the capacity market, which incentivises DSR to participate in the T-1 rather than T-4 auction, could restrict the eventual contribution to a significant extent.

Experience of DSR participation in other CRMs (such as that operated by PJM in the United States) suggests that a demand side participation of around 10% is feasible which, if applied to Great Britain, would suggest a DSR contribution of some 5-6 GW, roughly twice the current assumption.

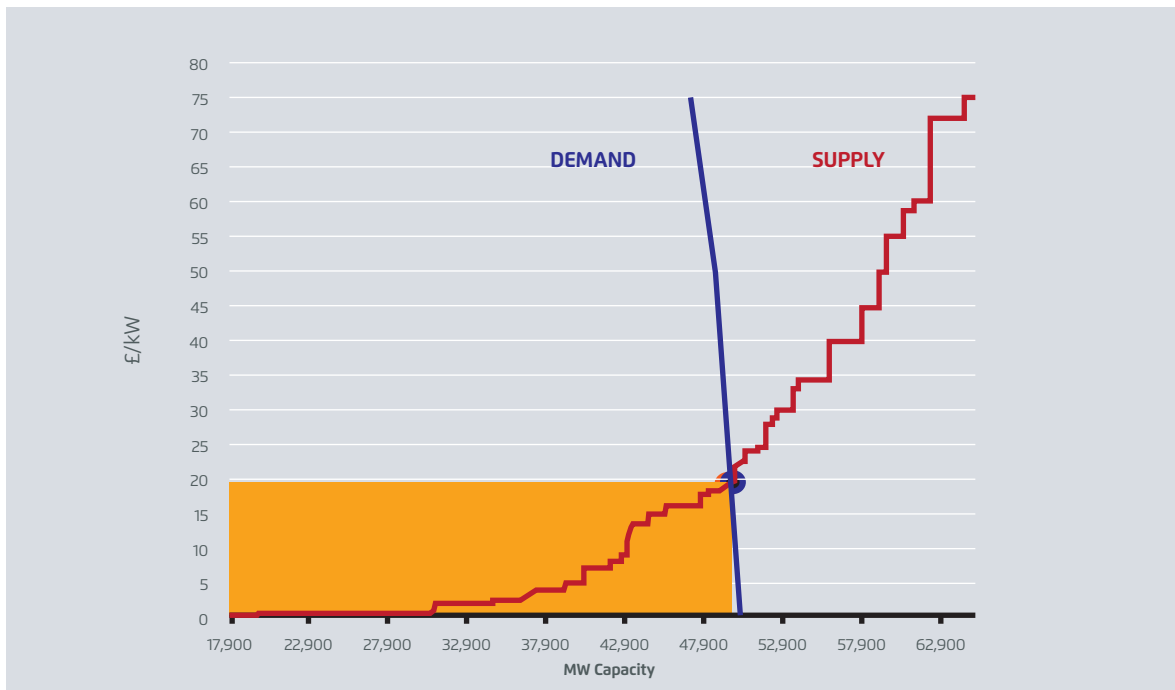
7.2 OUTCOME OF THE 2014 T-4 AUCTION AND IMPACT OF NATIONAL GRID'S CAUTIOUS APPROACH

7.2.1 AUCTION OUTCOME

The T-4 auction held in December 2014 for capacity to be delivered in 2018/19 was significantly over-subscribed, with 65 GW of capacity bidding for a notional required procurement of 48.6 GW. This over-subscription, which reinforces concerns about the need for a capacity auction at this point in time, resulted in the auction clearing at £19.4/kW-year, considerably below the auction cap of £75/kW-year. This lower than expected clearing price will impose a cost of £980 million on consumers in 2018/19, with total costs amounting to £1.7 billion taking into account the addition capacity payments to be made in subsequent years due to some three and fifteen year contract having been awarded. The supply curve for the first auction is shown in figure 3, and it can be seen that some 30 GW of capacity submitted a near-zero bid. Despite being prepared to offer capacity for virtually nothing and depend on energy market revenues alone, this plant will now receive capacity payments of £19.4/kW-year.

⁹ In fact, only 174 MW of DSR cleared the 2014 T-4 auction, of which only 8 MW was existing capacity. This is not altogether surprising as the arrangements appear to be designed to encourage DSR to participate in the T-1 rather than the T-4 auction

Figure 3. GB capacity auction supply curve



As shown in table 2, of the 49.3 GW¹⁰ of capacity clearing the auction, 33.6 GW of existing capacity received one-year contracts just covering the delivery year, 12.9 GW of refurbishing generation received three-year contracts and 2.6 GW of new generation capacity, including one major CCGT project, received 15 year contracts.

Table 2. Outcome of first GB capacity auction

	Capacity (GW)	Capacity (%)	Number of generating units
Existing generation	33.6	68.2	185
Refurbishing generation	12.9	26.2	29
New build capacity	2.6	5.2	77 ¹¹
Demand side response (DSR)	0.2	0.3	15

The limited amount of DSR capacity to clear the auction is of note. As existing DSR capacity could either participate in the T-4 auction or the transitional arrangements, but not both, it is clear that the prospect of immediate income from the transitional arrangements proved more attractive. For new DSR capacity, the low clearing price resulted in a number of potential schemes not clearing the auction.

¹⁰ The notional capacity requirement of 48.6 GW assumed a clearing price of £45/kW-year. As the actual clearing price was £19.4/kW-year, slightly more capacity was contracted. See Appendix 1 for a description of the relationship between clearing price and capacity to be procured.

¹¹ Most of the new build consists of small gas or diesel projects, with only one major CCGT project clearing the auction.

7.2.2 IMPACT OF OVER-CAUTIOUS ASSUMPTIONS

Although the cost of contracts awarded via the 2014 auction is lower than originally feared, the use of arguably overly-cautious plant availability, interconnection and DSR contribution assumptions appear to have inflated the capacity procured by as much as 7 GW, unnecessarily increasing the costs imposed on consumers. In fact, inspection of the auction supply curve suggests that, had more reasonable assumptions been made, a clearing price of around £9/kW-year could have been expected, potentially halving overall costs.

An additional concern is that, should more reasonable availability, interconnection and DSR assumptions eventually be adopted prior to the T-1 auction to be held in 2017, the consequent increase in notional capacity could result in the T-1 auction being truncated or even cancelled. As the CRM design incentivises DSR to participate in the T-1 rather than T-4 auction, the use of pessimistic assumptions that are later revised could therefore effectively prevent DSR from contributing to 2018/19 capacity requirements in any meaningful fashion. Given the benefits of DSR participation in terms of reducing overall CRM costs seen by consumers, this would be a particularly unfortunate outcome.¹²

7.2.3 REPLACEMENT OF EXISTING CAPACITY WITH NEW

A major concern prior to the 2014 auction was that new capacity, having the considerable advantage of being able to bid for fifteen rather than one-year contracts, would be able to out-bid and replace existing resource, thereby imposing on consumers the cost of funding these contracts ahead of need. In the event, this concern was somewhat misplaced, with only one major gas-fired project clearing the auction (alongside several small-scale projects). Additionally, some 8.5 GW of existing coal and gas-fired generation withdrew from the auction, effectively refusing to commit to being available in the delivery year at a capacity price of £19.4/kW-year. Presumably, this plant will now either attempt to clear the 2015 T-4 auction at a higher price or close. However, with the participation of interconnection in the 2015 auction together with the possibility of plant availability assumptions being revised upwards, the likelihood is that the 2015 auction will clear below £19.4/kW-year. This, together with the prospect of capacity payments reducing energy prices during periods of scarcity to below those that would otherwise apply¹³, implies an increased risk of plant closures in the coming years.

If this comes to pass, it would be somewhat ironic that a measure introduced at a considerable cost to consumers to increase security of supply may actually make the security situation worse, forcing the replacement of older generation capacity with new. While, in itself, this may be no bad thing, the forced closure of generating capacity ahead of need will impose additional costs on consumers.

¹² The potential of DSR to reduce the overall cost of implementing a CRM is considerable. For example, the participation of demand side measures in the PJM Reliability Pricing Model (RPM) 2012/13 capacity auction is credited for reducing the clearing price from \$179/MW-day to \$16.5/MW-day, a 90 % decrease – see [http://www.roadmap2050.eu/attachments/files/PolicyBriefMay2010RM2050\[4\].pdf](http://www.roadmap2050.eu/attachments/files/PolicyBriefMay2010RM2050[4].pdf)

¹³ The introduction of a market-wide CRM, which should ensure sufficient capacity is always available to meet demands, is likely to attenuate energy prices when capacity would otherwise be scarce.

8. EUROPEAN COMMISSION STATE AID APPROVAL

As the market-wide CRM confers an economic advantage to certain parties (ie the participants) that would not exist under normal market conditions, the measure is classified as “state aid” and therefore requires approval by the European Commission.

8.1 THE NEED FOR A MARKET-WIDE CRM IN GREAT BRITAIN

In seeking that approval, the UK Government cited two principle energy market failures, the problem of reliability being a public good and the “missing money” problem. These market failures were sub-divided into four individual issues:

- individual consumers cannot indicate their desired level of supply reliability and are unable to respond to energy market price signals
- energy prices do not reflect true scarcity value
- Government may prevent energy prices rising to appropriate levels for political reasons
- the development of intermittent technologies will prevent prices from rising and reduce opportunities for conventional generation to operate

Although an in-depth analysis of these issues cannot be attempted here, the following points are worthy of note.

Firstly, in relation to a), it is true that the majority of consumers and demand are not exposed to temporal price signals. However, larger industrial and commercial demand is exposed to wholesale prices to some extent and a degree of price elasticity does exist. This is likely to increase with time with the growth of price-related or dynamic tariffs made possible by the roll out of smart meters across the domestic and smaller commercial sectors.

Secondly, in relation to b), energy prices can be expected to more fully reflect scarcity value with the introduction of Balancing Market reform. Market failure b) will therefore be removed well before the first CRM delivery year and cannot reasonably be used to justify its introduction. Concerns that political considerations will not allow energy prices to rise to the appropriate levels, ie market failure c), are entirely within the Government’s gift to resolve.

The impact of the continuing deployment of variable output renewable generation on energy prices and conventional plant utilisation referred to in d) may be a more genuine concern. However, a clear commitment by Government that energy prices will be allowed to rise to adequately reflect scarcity value, together with Balancing Market reform which should quickly provide evidence that this will in fact be the case, and may well provide the necessary comfort to investors. Furthermore, the existence of a strategic reserve would allow security of supply to be maintained should the energy market fail to deliver.

8.2 THE COMMISSION’S DECISION

Despite representations by a number of interested parties, the Commission decided not to object to the introduction of a market-wide CRM in Great Britain. In reaching its decision, the Commission did, however, express concern over issues discussed in this paper, namely overly-conservative assumptions about the contribution to be made by both interconnection and DSR together with unduly pessimistic plant availability assumptions.

In order to allay these concerns and gain state aid approval, the UK Government and National Grid undertook to allow external generation to participate in the capacity market from 2015 and to carry out analysis that should allow more realistic assumptions to be made in assessing the capacity to be procured via future auctions. This is to be welcomed, however it comes too late to address concerns over the first T-4 and T-1 auctions.

The Commission's decision not to object to the CRM being implemented by Great Britain is now the subject of a legal challenge by Tempus Energy in the European General Court.

9. LESSONS FOR POLAND

9.1 ASSESSING RESOURCE ADEQUACY

In assessing resource adequacy, it is important to take into account all available resources. This means fully accounting for demand-side resources, cross-border interconnections, and both historical and projected plant availability. It is important both for accurately determining system needs and in securing European Commission State Aid approval.

9.2 IDENTIFYING THE MOST EFFECTIVE SOLUTION

Before introducing a capacity mechanism, it is critical to identify the problem and select measures that can solve it at lowest cost to consumers and the economy. It may well happen that the problem can be tackled through reform of existing mechanisms. In the UK, it would have been possible to fix the Balancing Mechanism first, and observed the results of this limited reform before introducing the full-fledged capacity mechanism.

9.3 TIMING MATTERS, A LOT

The first auction in the UK shows that introducing a capacity market mechanism too early is counter-productive as was over-subscribed, depressing the price of capacity. As the UK experience shows, this could conceivably lead to early decommissioning of plant that failed to obtain contracts as well as prices too low to stimulate investment in new capacity, all at a cost to consumers. Additional costs for the UK is around £1 billion. Given the lack of effectiveness of the capacity mechanism in securing reliability through existing or new plant, this cost comes as nothing more than a windfall to existing power facilities.

9.4 EQUAL FOOTING FOR DEMAND-SIDE RESOURCES

If a capacity mechanism is needed, DSR should be treated on equal footing with generation capacity, which was not the case in the first GB capacity auction. DSR has been proven elsewhere to significantly reduce system costs – and therefore the cost to consumers. Moreover, DSR brings new technologies to the market and increases competition in providing services to the system. Should the UK government have applied this principle, it could have saved up to £0.5 billion a year of electricity consumers' money.

9.5 INFLUENCE ON CROSS-BORDER FLOWS OF ENERGY

Introduction of a capacity mechanism can depress energy prices during times of system stress, potentially increasing outward flows of energy, thereby further endangering system reliability and cross-subsidising customers in neighbouring countries. Moreover, depressing domestic wholesale prices reduces the financial incentive for suppliers from neighbouring countries to provide electricity during stress events – the loss of an existing benefit. Any market reform needs to take into account the effects on scarcity pricing and cross-border interactions, and ensure that negative effects are minimized.

10. SUMMARY & DISCUSSION

This policy paper has provided a brief overview of the electricity market reform in Great Britain and the initiatives being taken to ensure adequate levels of investment and future security of supply. These initiatives are not promoted as solutions for Poland, in fact the paper raises a number of concerns about their design and implementation. However, the issues facing the two countries seem similar in many respects and an understanding of the response by Great Britain to these issues will hopefully assist in identifying the most appropriate way forward for Poland.

The case for capacity support in Great Britain reflects concerns over declining plant margins and associated risks to security of supply, driven by plant closures and insufficient investment in replacement capacity. Plant closures largely reflect the increasing cost of meeting environmental standards and the fact that some plant is reaching the end of its economic life. The lack of investment is probably due to a combination of circumstances, including low power prices driven by a period of over-capacity and depressed demands, the unfavourable economics of gas plant and short-term regulatory risk. The possibility of increasing intermittent renewable generation deployment decreasing conventional plant utilisation and increasing price volatility in the future may also be an issue. However the solutions which have been currently proposed and applied in the first auction in December 2014 proves that the major purpose of the capacity market will not be met and some further regulatory changes should be implemented.

11. APPENDIX 1.

DEFINITIONS

Capacity Remuneration Mechanisms (CRM) – Mechanisms that provide payments to generators or other capacity providers for being available and providing capacity, in addition to revenues obtained directly from the energy market. As described in the paper, CRMs can take various forms.

Contracts for difference (CfD) – A contract between a buyer and seller of a commodity, where the buyer agrees to pay the seller the difference between a previously agreed “strike” price for commodity and the value of that commodity as defined by the actual price in the event. In the context of the new GB low-carbon support mechanism, low-carbon generators will receive difference payments if the wholesale energy price falls below an agreed strike price and will pay the difference if the actual wholesale price in the event is higher than the strike price.

Cost of new entry (CONE) – CONE is the estimated annuitised cost of commissioning and operating new generation capacity. It includes capital costs annuitised over the expected lifetime of the generating plant and also fixed operating costs such as rates, maintenance, insurance and the cost of connecting to and utilising the electricity grid. Net CONE is CONE minus estimated revenues from energy ancillary service markets.

Net CONE is used to set the reliability standard for Great Britain (by comparing the cost of unsupplied energy with the cost of avoiding that unsupplied energy by building new generating capacity) and also to establish a target capacity to meet that reliability standard.

Demand Side Balancing Reserve – An additional balancing product introduced by National Grid to provide capacity relief in the years prior to the first CRM delivery year of 2018/19. DBSR can be provided by customers who are prepared to reduce demand or increase output from embedded generation when required to do so.

High Voltage Direct Current (HVDC) – HVDC transmission circuits connect transmission systems asynchronously, rather than synchronously. In other words, the connected transmission systems can operate at different frequencies. The GB transmission system is connected to continental Europe by HVDC circuits.

HVDC transmission has another advantage in that circuit flows can be controlled directly, with no need for devices such as “phase shifters” or “quad boosters” as is the case with ac transmission.

Imbalance cash-out prices – These are the prices charged or paid for any imbalance between a trading party’s contractual position at market closure (1 hr before real time) and actual outturn. If a generator is “short”, ie outturn is less than its contractual position at gate closure, it is charged; if it is “long”, ie outturn is greater than its contractual position, he is paid. The reverse is true for demand.

To date, Great Britain has deployed a “dual price” cash-out regime. If a trading party’s imbalance is adding to the aggregate system imbalance, a cash-out price that reflects the last 500 MWhr of System Operator actions applies. If a party’s imbalance reduces the aggregate system imbalance, a price that reflects the average wholesale energy price applies. Dual price cash-out prices will be replaced by a single, marginal, cash-out price during 2015.

Loss of load expectation (LOLE) – LOLE represents the number of hours or days per annum in which, measured over the long term, it is statistically expected that supply will not meet demand. When expressed in days/annum, LOLE is comparing daily peak demand and available generation; when expressed in hrs/annum, VOLL is comparing hourly load to available generation. When expressed as a probability, LOLE is referred to as “loss of load probability” or LOLP.

Scarcity value – When generation or resource capacity is plentiful, then a competitive energy market should drive clearing prices down to the variable cost of the most expensive generator operating. However, when generation capacity is scarce, market clearing prices should reflect the price that the lowest priced demand is prepared to pay. This price may exceed the variable cost of the most expensive resource operating and the difference between the two prices is referred to the scarcity price of capacity. In the long-run, the expected future scarcity revenues should just be sufficient to fund an “economic” level of resource adequacy. With a market-wide CRM however, scarcity pricing will either partially or fully replaced by capacity payments and, in scarcity situations, market clearing prices will be less than would be the case with an energy-only market.

Value of lost load (VOLL) – VOLL is the estimated maximum price that customers would be willing to pay in order to avoid a loss of supply. The value of VOLL will vary for each class of consumer, industrial, commercial, domestic, and for individual consumers within those broad classes. Alighting on a single value of VOLL is therefore rather subjective, however the average VOLL for consumers in Great Britain is often taken to be around £18,000/MWhr.

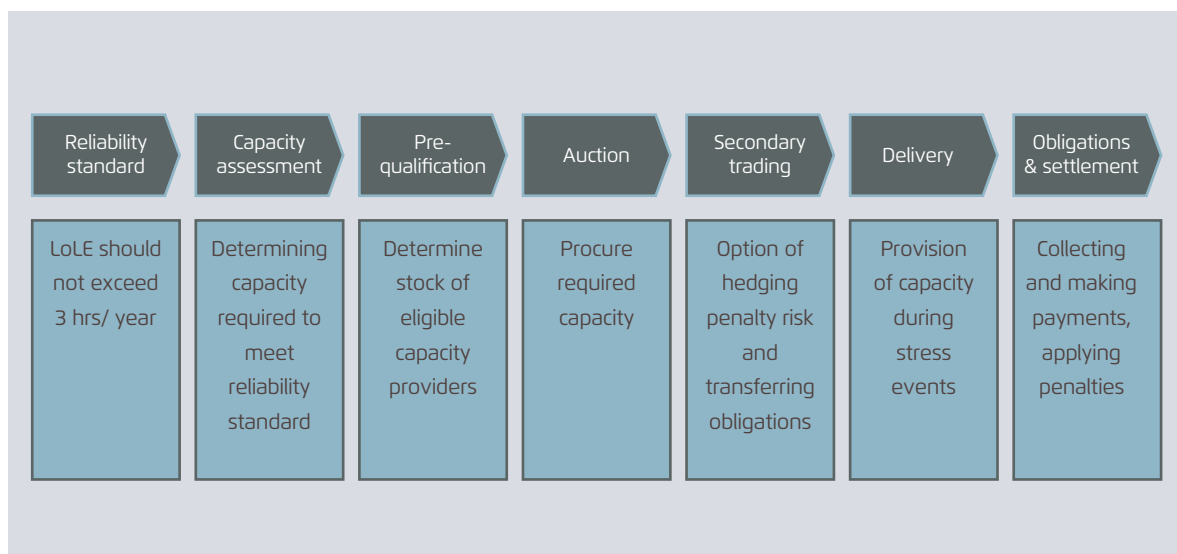
12. APPENDIX 2

A more detailed description of the CRM and energy market reform being introduced in Great Britain

A2.1 THE CRM ARRANGEMENTS BEING IMPLEMENTED IN GREAT BRITAIN¹⁴

The CRM being implemented in Great Britain is a market-wide mechanism, closely following designs seen in the US. As illustrated in figure A2.1, the market consists of a number of individual stages or processes, including the establishment of a reliability standard, assessment of the capacity necessary to meet that standard, pre-qualification and the concept of price takers and price makers, the capacity auctions themselves, secondary trading, delivery and obligations. These processes are described briefly in the following paragraphs.

Figure A2.1 The CRM process adopted by Great Britain



The reliability standard. Since privatisation of the electricity supply industry in 1990, Great Britain has not had a specific reliability standard, but rather has relied on the electricity market to bring forward an appropriate level of capacity to ensure that “all reasonable demands for electricity can be met”. To date, this has generally resulted in an over-supply of capacity, punctuated with occasional periods when capacity margins were somewhat reduced. However, as described in

¹⁴ A more detailed description of the arrangements being adopted by Great Britain is given by DECC report “Implementing Electricity Market Reform” at https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/324176/Implementing_Electricity_Market_Reform.pdf

the main text, impending plant decommissioning together with a lack of new investment has raised concerns about future capacity margins and led to the introduction of a reliability standard against which generation adequacy can be assessed. This standard requires that the annual loss of energy expectation (LOLE) should not exceed 3 hours/year and has been arrived at by comparing the estimated cost of new entry (CONE), minus expected profits from the energy market, with the assumed average value that customers place on supply, i.e. the assumed value of lost load (VOLL). The reliability standard is therefore a trade-off between reliability and the cost of providing that reliability. In comparison with practice adopted by Great Britain's near neighbours, the standard is the same as that adopted by France, but more rigorous than the 8 hours/year adopted by Ireland.

Capacity assessment. As System Operator and CRM Delivery Body, National Grid will perform an annual capacity assessment to establish the capacity required to satisfy the Reliability Standard in the delivery year. This assessment is provided to the Secretary of State for Energy, who makes the final decision on the capacity to be procured via the capacity auction. For the first auction that was held in December 2014, the target capacity to be procured for delivery in 2018/19 was 48.6 GW, a discounted figure which takes account of capacity not eligible to take part in the auction and 2.5 GW which is provisionally reserved for auction in the year prior to the delivery year.

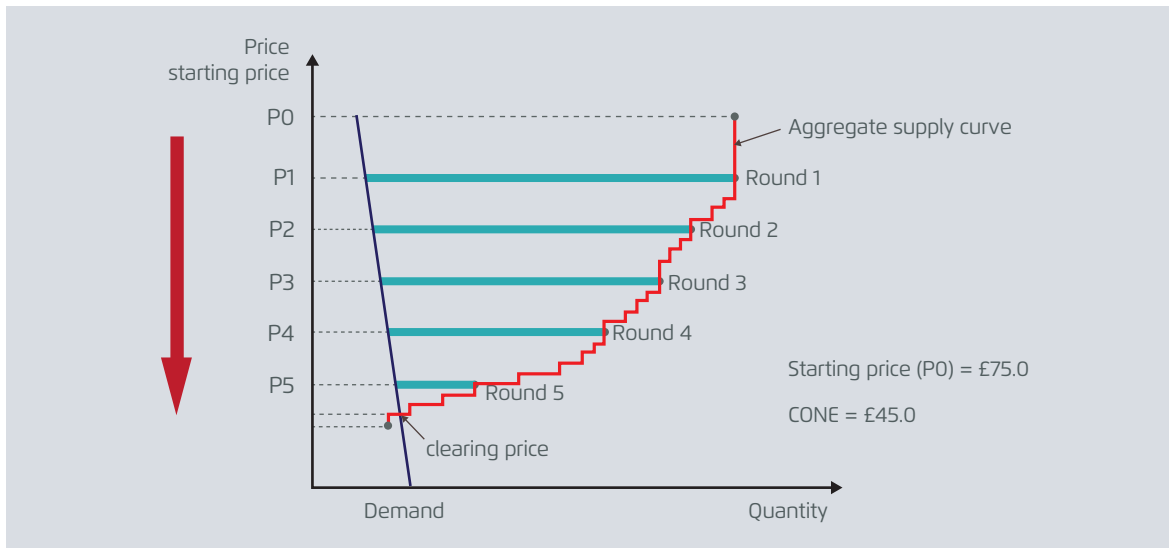
Eligibility and pre-qualification. All existing and new capacity, other than that in receipt of support through the various renewable, low-carbon and operational reserve incentive schemes operating in parallel with the CRM, are eligible to compete in the capacity auctions. This includes existing nuclear, CHP, storage and demand side response (DSR) with a capacity above a de-minimus threshold of 2 MW. A controversial feature of the initial auction is that neither generation located outside Great Britain resource nor any interconnector operator can participate.

While participation in the auction process is voluntary, all generation capacity must participate in the pre-qualification process. Pre-qualification is necessary to establish the total capacity of potential providers and to enable the Delivery Body to adjust the capacity to be procured taking into account resource that will be operational but not participating in the auction process. Pre-qualification occurs on an annual basis, four months before the annual auction. The outcome of the first pre-qualification held in 2014 was that 71 GW of capacity qualified to take part in the first auction, including 7.5 GW of new plant.

Auction format and design. For each delivery year, an auction is held four years before the delivery year (the T-4 auction), supplemented by a second auction in the year prior to delivery (the T-1 auction). This two-stage process is designed to encourage the participation of new build generation, while allowing capacity procurement to be refined by taking account of up-to-date-demand forecasts at the year-ahead stage.

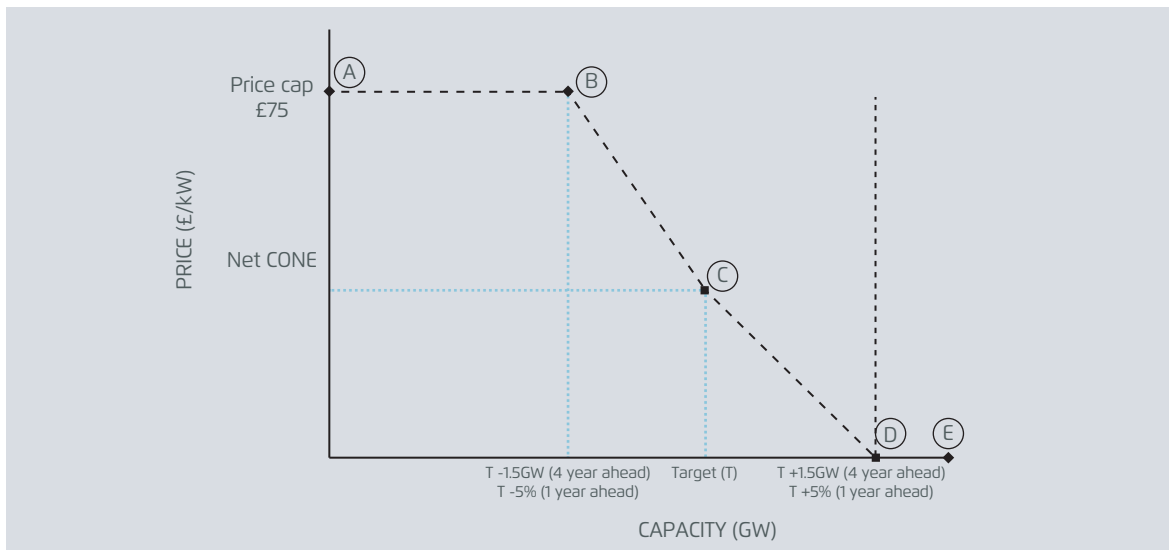
A "descending clock" or "Dutch" auction format is adopted, where providers indicate in the first auction round what capacity would be provided at an initial, high, price. Subsequent rounds are then held at reducing prices, with offered capacity also reducing until the required capacity is just met. All capacity clearing this final round will be offered capacity contracts at the clearing price. The auction format is illustrated in Figure A2.2.

Figure A2.2. Descending clock auction format



The precise amount of capacity to be procured will be influenced by the progress of the auction. If the auction clearing price equates to the net CONE of CCGT plant, then the target level of capacity (48.6 GW for the 2014 T-4 auction) would be procured. However, the capacity procured will vary by ± 1.5 GW depending on the actual clearing price, as illustrated in Figure A2.3¹⁵. This relationship between auction clearing price and capacity procured is designed to provide a reasonable trade-off between reliability and cost while at the same time giving consumers some protection against the exercise of market power.

Figure A2.3 Relationship between capacity procured and auction clearing price



¹⁵ If the clearing price rises above net CONE, then less capacity will be procured. A price cap of £75 will apply and target capacity minus 1.5 GW will be procured should the auction clear at the capped price. If the market clears at below net CONE, more capacity will be procured with a limit of target capacity plus 1.5 GW being procured should the clearing price fall to zero.

While being administrative in nature, the price cap of £75 for the 2014 T-4 auction was pitched at a level that allowed innovative technologies to participate, but at the same time protected consumers in the event of unforeseen problems such as a lack of competition or the exercise of market power.

Price takers and makers and contract length. At pre-qualification, resource wishing to participate in the auction process is categorised as a price taker or price maker. Price takers can only bid up to an administered threshold price, however resource able to demonstrate that they are justified in bidding above this threshold will be categorised as a price maker. The aim is to mitigate the abuse of market power.

Price takers that bid below the market clearing price will be awarded contracts of one year duration. Longer term contracts are available for prospective new build (15 years) or plant being refurbished (3 years). Eligibility for longer term contracts will be based on expenditure/kW thresholds. A controversial feature of the eligibility criteria is that prospective DSR cannot access longer-term contracts.

Only 1-year contracts will be available at the T-1 auction, which otherwise follows the same format as the T-4 auction. It should be noted however that, in the event of an over-procurement of capacity at the T-4 stage, the full reserve of capacity allocated to the T-1 auction may not be procured. Furthermore, in the event of falling demand or revised interconnector/plant availability assumptions reducing year-ahead capacity requirements below that procured at the T-4 stage, the Secretary of State reserves the right not to hold a T-1 auction.

Secondary trading. Capacity providers that clear either the T-4 or T-1 capacity auctions have the option to physically trade their obligations from a year ahead of the delivery year. Financial trades to hedge penalty risk are permitted at any point in time. Physical trades can only utilise capacity that has pre-qualified, for example spare capacity or capacity that has failed to obtain a contract via the auction process.

Delivery and obligations. Resource successfully clearing either the T-4 or T-1 auctions will receive annual payments in return for being available during notified "stress events" in the delivery year. Stress events are defined as situations where an energy balance can only otherwise be achieved by shedding demand and will be announced by the System Operator at least four hours in advance. Failure to deliver contracted capacity during a declared stress event will lead to a penalty being imposed. Penalties are capped at 200% of monthly revenue, with an overarching cap of 100% of annual capacity revenue.

Capacity payments made to resource clearing the auction will be funded by an obligation on suppliers. The payments to be made by individual suppliers will reflect their average market share during peak demand periods over the winter period. Payments are collected from suppliers by a Government-owned Settlement body, which also makes payments to contracted capacity providers.

A2.2 TRANSITIONAL ARRANGEMENTS FOR THE INTERIM BEFORE CAPACITY DELIVERY IN 2018

In order to ensure supply reliability is maintained during the period prior to the first CRM delivery year 2018/19 and encourage further development of DSR, National Grid have tendered for two new balancing services to complement a number of existing services.

- Large consumers or small embedded generators who have the ability to flex their demand/output may participate in a new Demand Side Balancing Reserve (DSBR) service.
- Larger generation that would otherwise not be available during the winter period can participate in a Supplemental Balancing Reserve (SBR) service.

These two Balancing services will be “out of market” in that they will only be utilised as a last resort in order to avoid involuntary demand reduction. The services will be priced so as to reflect resource scarcity and VOLL (see Reform of the Balancing Market below), and have been designed to ensure that marginal generation is not deprived of energy market revenues. Great Britain is therefore effectively implementing a “strategic reserve” ahead of the market-wide capacity market that will deliver capacity from 2018/19 onwards.

A controversial feature of the transitional arrangements is that DSR participating in the T-4 auction cannot participate in the transitional DSBR arrangements. As capacity payments are received in the delivery year, DSR is therefore required to choose between participation in the T-4 auction and not receiving income until 2018/19, or not participating in the T-4 auction and seeking DSBR income in the three preceding years. At first sight, the DSBR option seems rather more appealing and this could mean that DSR participation in the T-4 auction is low.

A2.3 REFORM OF THE BALANCING MECHANISM¹⁶

In parallel with the implementation of a CRM, Ofgem has directed that the existing Balancing Mechanism should be radically reformed. The Balancing Mechanism is the vehicle used by the System Operator to achieve a final balance between supply and demand in real time, and also to resolve any transmission constraints thrown up by the unconstrained trading process.¹⁷ In balancing the system, the System Operator has access to bids and offers made by trading parties and various other commercial balancing or reserve services that are contracted for in advance.

In reforming the Balancing Mechanism, the aim is to encourage trading parties to balance their contractual positions in advance of market closure, by making imbalance cash-out prices reflect the marginal rather than the average cost of balancing actions taken by the System Operator.

Summarising, Ofgem’s headline reforms include:

- Setting imbalance cash-out prices to reflect the most expensive 1 MW of System Operator balancing action (to be achieved in stages) rather than an average level as at present.
- Pricing in the cost of involuntary demand reduction, i.e. voltage reduction or load shedding. Such actions will be priced at VOLL, taken to be £6000.00 MW/hr¹⁸.

¹⁶ A more detailed description of Balancing mechanism reform in Great Britain is given by Ofgem document “Electricity Balancing Significant Code Review: Final Policy Decision” at <https://www.ofgem.gov.uk/publications-and-updates/electricity-balancing-significant-code-review-draft-policy-decision>.

¹⁷ All energy trading is “unconstrained”. In other words energy trades do not have to take account of the physical capabilities of the electricity grid, a “commercially infinite” electricity grid is assumed.

¹⁸ Although Ofgem’s documentation refers to pricing operational measures at VoLL, the use of a figure of £6000/MWhr rather than the generally accepted value of VOLL of £18,000/MWhr, this effectively represents a price cap.

- Improving the pricing of balancing and reserve services such as DSBR and SBR so as to reflect the level of scarcity. Reserves will be deployed at a price related to VOLL multiplied by the prevailing LOLP.
- Moving from dual imbalance prices to a single cash out price.

The consequence of Balancing Market reform will be that cash-out prices become more volatile and reflect the marginal cost of System Operator actions, i.e. the true scarcity value of capacity. The consequence should be that parties make more use of both short-term and forward markets to ensure that their trading positions are balanced at market closure, rather than relying on System Operator action in the Balancing Mechanism. The marginal nature of the single imbalance price should therefore feed into energy market prices and ultimately provide increased incentives to invest. A particular benefit of this approach is that investment in flexible resources, including DSR, should be preferred over inflexible resources.

