Integrated Single Electricity Market

(I-SEM)

Capacity Requirement and De-Rating Factor

Methodology

Detailed Design

Decision Paper

SEM-16-082

08 December 2016

EXECUTIVE SUMMARY

This decision paper adds to the complement of CRM detailed design decision papers published to date and represents the decision associated with the combined methodology for the capacity requirement and de-rating factors. The decisions within this paper follow on from the associated consultation (SEM-16-051) which closed on 5th October 2016. A stakeholder workshop was held during the consultation period on 29th September 2016 and feedback from the consultation responses and the workshop has been considered in arriving at these decisions. It is important to note the governance arrangements will be set out in the Capacity Market Code which is currently being developed by the TSOs through a Rules Working Group process involving industry input and feedback. Within the wider CRM context, a further consultation (SEM-16-073) was published on 8th November 2016 relating to the CRM parameters.

Overview of CRM Capacity Requirement & De-Rating Methodology

The capacity requirement and plant de-rating factors are key inputs to both the qualification and the auction processes. They deliver the primary driver of the volume to be auctioned and identify the volume that each potential capacity provider is able to qualify for participation in the auction. In consequence, the values are critical to the efficient operation of the I-SEM ensuring that the capacity contracted is sufficient to deliver the SEM security standard. In the near term there will likely be more existing de-rated capacity on the system than will be procured through the initial CRM auctions.

Previous CRM decisions include the use of the least worst regrets analysis when determining the capacity requirement and the use of marginal de-rating factors for groups of technologies which will also be adjusted for size (CRM Decision 1 SEM-15-103). The Regulatory Authorities (RAs) were tasked with developing a methodology to determine the de-rating factors to be applied to interconnectors (CRM Decision 2 SEM-16-022).

Existing demand forecasts (TSOs Generation Capacity Statement) are used to create various demand scenarios for each capacity year. An understanding of outage drivers and historic performance data was used to group existing and future potential capacity providers into a small number of technology classes. Historical performance data from generator units and interconnectors is used to determine the level of outages to be applied to each technology class. Capacity adequate portfolios are comprised from the existing capacity portfolio to satisfy the SEM security standard. These capacity portfolios, along with their associated outage levels and demand scenarios inputs, are then used within the multi-scenario adequacy analysis in order to derive a capacity requirement and de-rating factor curves as a function of unit size for each combination demand scenario and capacity portfolio. This approach yields a range of possible auction outcomes. Least worst regrets analysis is used to select the base demand scenario with the least combined regret cost due to both shortages of energy and over-supply of capacity. The de-rated capacity requirement and the de-rating curves for that base demand scenario are selected as the result of this methodology.

The interconnector de-rating factor is based upon the probability that capacity will be available to import from GB at times of scarcity in the I-SEM and the probability that the interconnector will be technically available at times of scarcity in the I-SEM. Historical outage data was used to determine the technical availability of the interconnectors themselves, however the probability of availability to

import to the I-SEM at times of scarcity is much more complex. A model was developed to look across all half-hourly periods in a large number of potential scenario days (500,000) where scarcity could arise. This model used historical and forecast data (where appropriate) for temperature, wind, demand, capacity, reserve and outages for both I-SEM and GB.

The interconnector methodology produces an External Market De-Rating Factor and separate forced outage and scheduled outage rates. These are then provided to the TSOs as inputs for the overall capacity requirement and de-rating model and treated in exactly the same way as conventional generator units.

Summary of Responses

24 responses were received to the CRM capacity requirement and de-rating factor methodology consultation. Most respondents supported the methodology at a high level, however there were concerns on specific aspects which some felt would benefit from being revised.

Specific concerns associated with the determination of capacity requirement were raised, relating to:

- Over-valuing the cost of excess capacity in the least-worst regrets analysis by using NetCONE; and
- uncertainty of the treatment of non-market demand, particularly wind.

Most respondents supported the inclusion of operational reserves within the capacity requirement.

There was broad support for the technology groupings. However, there was particular concern around grouping AGUs and DSUs together and also concern regarding grouping of all storage technologies together. Concerns were also raised as to the appropriate treatment of autoproducers and dual-rated units.

Responses specific to the marginal de-rating curves were mainly focused on requests for further clarity on the treatment of wind, the rationale for notional unit size and the appropriateness of random capacity adequate portfolios applied to demand scenarios. Those respondents who were particularly focused on DSUs disagreed with the application of an intrinsic forced outage rate on the basis that reliability of response is ensured by those managing the DSU portfolio. They viewed the application of a de-rating factor as effectively a second de-rating of DSU capacity.

There was particular emphasis by respondents on the interconnector de-rating factor methodology. While broadly supporting the approach at a high level they had a number of serious concerns regarding some of the assumptions being made and strongly recommended the modelling be refined to provide a much more cautious and prudent outcome for both end customers in terms of reliability and prices. They viewed the contribution from interconnectors as being overstated due to GB forecast scarcity and historical outages not being captured within the consultation assumptions.

The vast majority of respondents did not agree with the minded to position to set a zero tolerance band. Most considered tolerance bands important to reflect plant differences within the technology groupings. There was a strong view that zero tolerance bands do not reflect the intention of CRM Decision 1 (SEM-15-103) to have tolerance bands.

Summary of Key Capacity Requirement and De-Rating Methodology Decisions

At a high level, the SEM Committee has decided that:

- Operating reserve will not initially be included in the Capacity Requirement;
- The decision on inclusion of reserve within the Capacity Requirement, once the enduring combinatorial solution for the capacity auction is implemented, will await further evidence from the TSOs supporting the need for such inclusion;
- To the extent reserve is included within the Capacity Requirement, its level and justification will form part of the broader Capacity Requirement consultation;
- Outage rates for technology classes with very few units, currently storage and interconnectors, will be determined using the last 10 complete years of history, rather than the 5 years used more generally;
- The de-rated capacity of an AGU will be determined as the sum of the de-rated capacity of the Generators which make up the AGU;
- DSUs will be de-rated on the basis of the System-Wide De-rating Curve, but will be permitted a negative tolerance to qualify below this level. This level will be set based on historic DSU availability, but adjusted for the changes to the I-SEM. The qualification level will need to be evidenced in the qualification process under the Capacity Market Code (CMC);
- Any capacity already awarded a Reliability Option for a Capacity Year should be fixed in all Capacity Adequate Portfolios for that year;
- For any technology classes where outages are highly correlated between units, the de-rating factor should be set on the basis of the whole class, rather than individual units. Initially this will apply to the wind and solar classes;
- The de-rating curve for storage units for the first transitional auction will be based on a reference de-rating factor derived from existing storage capacity and a set of storage-duration curves. These curves will be determined by analysing the additional demand which can be served by storage units of a range of MW sizes and reservoir capacities. The reference de-rating factor used for new storage technologies (i.e. other than pumped storage) will use the outage characteristics of the System-wide Technology Class;
- The methodology for storage units will be consulted upon as part of the broader consultation prior to the first auction after the first transitional auction;
- Autoproducer units will be de-rated from their Maximum Export Capacity (MEC). For capacity which can only be delivered by demand reduction, autoproducer

units will be able to bid above the Existing Capacity Price Cap, subject to RA approval. Such approval will be based on evidence provided by the participant prior to qualification, in line with the rules laid out for the Unit Specific Offer Cap in the CMC;

- Dual-rated units will be de-rated on the basis of the higher of their two capacities. For capacity above the lower of the two capacities, dual-rated units will be able to bid above the Existing Capacity Price Cap, subject to RA approval. Such approval will be based on evidence provided by the participant prior to qualification in line with the rules laid out for the Unit Specific Offer Cap in the CMC;

- De-rating of interconnectors will be based on their Aggregate Import Capacity;

- Demand and wind profiles and the least-worst regrets analysis will be at the half-hourly level;

- De-rating curves should be produced for the interconnector and solar Technology Classes;

- An External Market De-rating Factor will be determined for each external market linked by an existing or proposed interconnector. This will represent the deliverability of capacity from that market to the I-SEM at times of scarcity excluding the impact of interconnector outage;

- Outage rates for interconnectors will be determined based on the most recent 10 years of historic data; and

- The determination of coincident scarcity in the I-SEM and an external market will be modelled on the basis of the demand served from both transmission and distribution connected generation for that market. The RAs will consider a broad range of scenarios for the external market when coming to a view as to the appropriate level of interconnector de-rating.

The Technology Classes for the first transitional auction are given in the table below:

Table 1: Initial Technology Classes

Technology Class	Units included
Gas turbine	All units with gas turbine as prime mover, i.e. OCGT, CCGT and GT-based CHP
Steam Turbine	All units with a steam turbine as prime mover, i.e. coal, oil and peat fired units
Hydro	All hydro units
Pumped Storage	All pumped storage units
Other storage	All other storage units, e.g. CAES, battery
Wind	All wind units
Solar	All solar units
DSU	All DSU

The SEM Committee has decided that the tolerance bands should be set to zero for the transitional auctions. This position will be reviewed for the enduring auctions once the enduring value of the Full Administered Scarcity Price (FASP) has been determined. The one exception will be for DSU where the SEM Committee has recognised the very wide variation in outage levels arising from differing aggregations of demand response providers and will allow a negative tolerance to be applied.

Of particular note since the consultation is the expected change in the interconnector de-rating factor. The initial interconnector de-rating factor published in the consultation paper (SEM-16-051) was c75%. Since then National Grid have published their latest Future Energy Scenarios (2016 FES) which shows a substantial shift from the 2015 FES, in particular, a major reduction in conventional, transmission connected generation. A refresh of the model with this updated information gives a revised initial interconnector de-rating factor of c50%.

The amended methodologies are set out in Appendices 1 and 2 to this Decision. (In the event of disagreement between the appendices and this Decision, the Decision will take priority.) Determinations made using the values arising from these methodologies will, in general, be laid out in the Capacity Market Code and will be subject to the governance arrangements of that Code.

The Regulatory Authorities may choose to adjust the capacity requirement used in the auction from the de-rated capacity requirement determined in accordance with this decision for a number of reasons, including (but not limited to) non-bidding capacity, de-rating factor tolerance bands and expected failure to deliver capacity.

The Regulatory Authorities will verify that the interconnectors de-rating inputs have been correctly incorporated into the TSOs De-Rating Methodology and that the de-rating factors have been determined in accordance with the published methodology and any associated agreed procedures.

This decision paper and appendices are focused on the enduring methodology. For each capacity auction the RAs will determine the **final** capacity requirement, technology classes, de-rating curves and interconnector External Market De-rating Factor(s) in line with the methodologies laid out in this decision. The final values/determinations will be published in advance of the first transitional capacity auction. For subsequent capacity auctions the values/determinations will be consulted upon to a timetable consistent with the qualification process set out in the Capacity Market Code.

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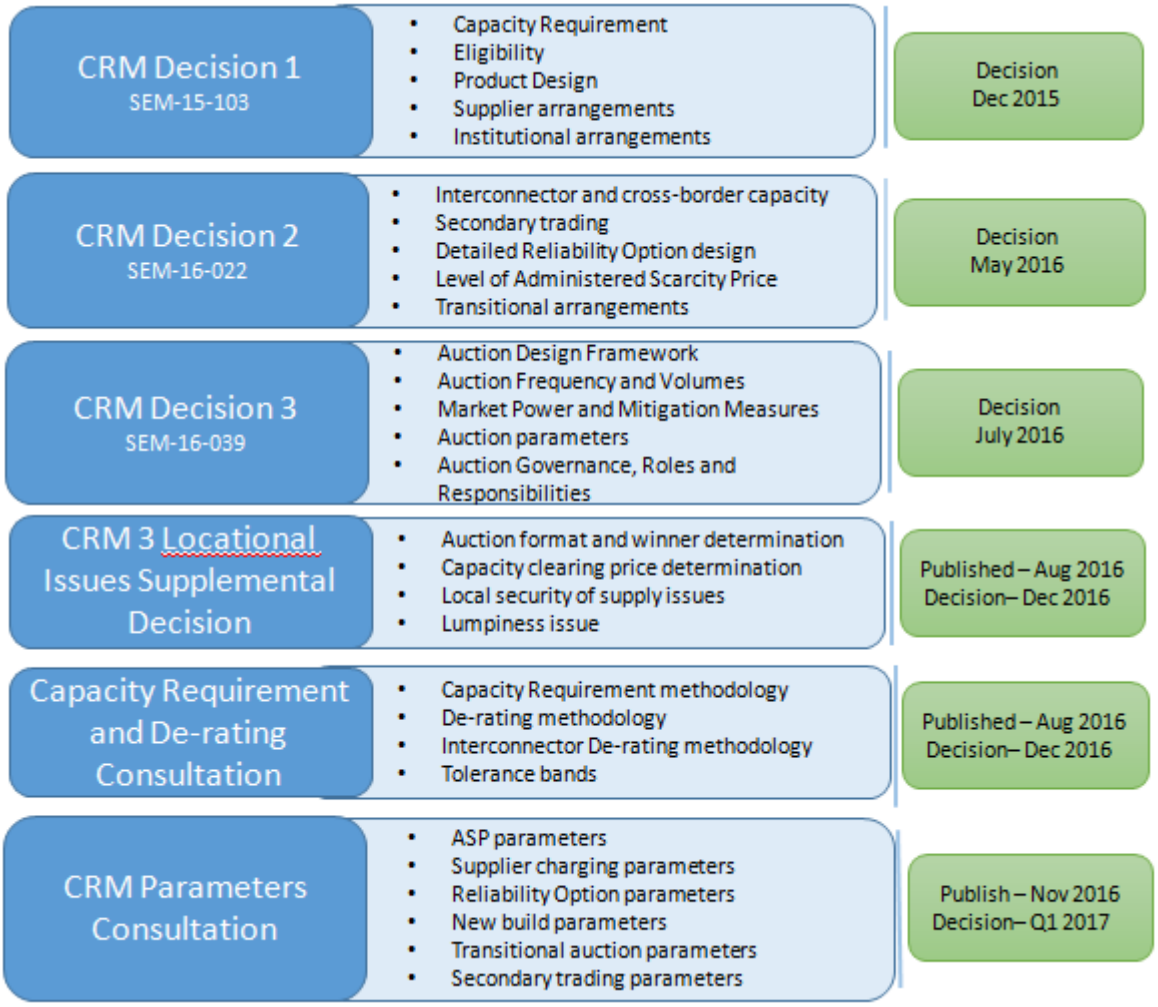
1. INTRODUCTION

1.1 BACKGROUND

1.1.1 The purpose of the CRM Detailed Design is to develop through consultation the specific design features of the new capacity mechanism. This process is illustrated in Figure 1 below.

Figure 1: Overview of CRM Policy Development



1.1.2 During November 2016 a further consultation was published relating to the CRM parameters (SEM-16-073).

1.2 PURPOSE OF THIS PAPER

1.2.1 This paper and appendices are focused on the combined methodology designed to determine the Capacity Requirement and the De-rating Factors to be applied to capacity providing units. It also sets out the decision regarding tolerance bands that will apply to the de-rated capacity of a capacity provider.

1.2.2 The Capacity Requirement is a key input to the setting of the demand curve used in the auction of Reliability Options as laid out in CRM Decision 3 and is elaborated upon in the CRM Parameters Consultation (SEM-16-073). The De-rating Factors to be applied to capacity providers will establish the volume of capacity which can enter into the auction and which can participate via the secondary trading platform.

1.2.3 The paper includes a summary of the responses made to the consultation paper issued on 23 August 2016, SEM-16-051, and sets out the SEM Committee's response to the key points raised.

1.2.4 The introduction of the CRM will involve notifying the proposed mechanism to the European Commission (EC) in relation to State Aid, a process which will be led by the Department of Communications, Climate Action & Environment (DCCAE) and the Department for the Economy (DfE). The proposals in this paper have been developed to be consistent with guidelines published by the EC in this respect; however, the proposals are subject to the outcome of this notification process.

1.2.5 This decision paper is structured as follows:

- **Governance:** Section 2 sets out the SEM Committee's decisions on the governance of the capacity requirement and de-rating methodology;
- **Capacity Requirement and De-rating Methodology:** Section 3 discusses the details of the methodology for setting the capacity requirement and the de-rating curves and sets out the SEM Committee decisions;
- **Tolerance Bands**: Section 4 sets out the SEM Committee's view on the use of tolerance bands around a unit's de-rated capacity;
- **Appendix 1**: Detailed De-rating Factor methodology provided by the TSOs;
- **Appendix 2**: Detailed Interconnector De-rating Factor methodology provided by the Regulatory Authorities.

Each policy section sets out a summary of the issues consulted upon, provides an overview of respondent's views, sets out the SEM Committee's response to the key points raised and then specifies the SEM Committee's decision on each matter (along with next steps, as relevant).

1.3 RESPONSES TO CONSULTATION

1.3.1 This paper includes a summary of the responses made to the CRM Capacity Requirement and De-Rating Factor Methodology consultation paper (SEM-16-051) which was published on 23 August 2016.

1.3.2 A total of 24 responses to the consultation were received. These were submitted from a wide range of interested parties including Generators, Suppliers, the Transmission System Operators, Network Owners and Industry Representative Groups. Of the 24 responses, two have been marked confidential. We note that most of the arguments raised in the confidential responses were a subset of the points made in the non-confidential responses,

and the SEM Committee has not relied on any evidence presented in the confidential responses which is not available to all stakeholders. The remaining 22 are outlined below and copies can be obtained from the SEM Committee website.

- AES
- BGE
- Bord na Mona
- DRAI
- EAI
- Eirgrid Interconnector
- Electric Ireland
- Empower
- Energia
- ESB
- Gaelectric
- iPower
- IWEA
- Moyle Interconnector
- Power NI
- Power NI PPB
- PrePayPower
- RUSAL Aughinish
- SIGA Hydro
- SSE
- Tynagh
- Vayu

1.4 ROLE OF THE CAPACITY REQUIREMENT AND DE-RATING FACTORS WITHIN THE CRM PROCESS

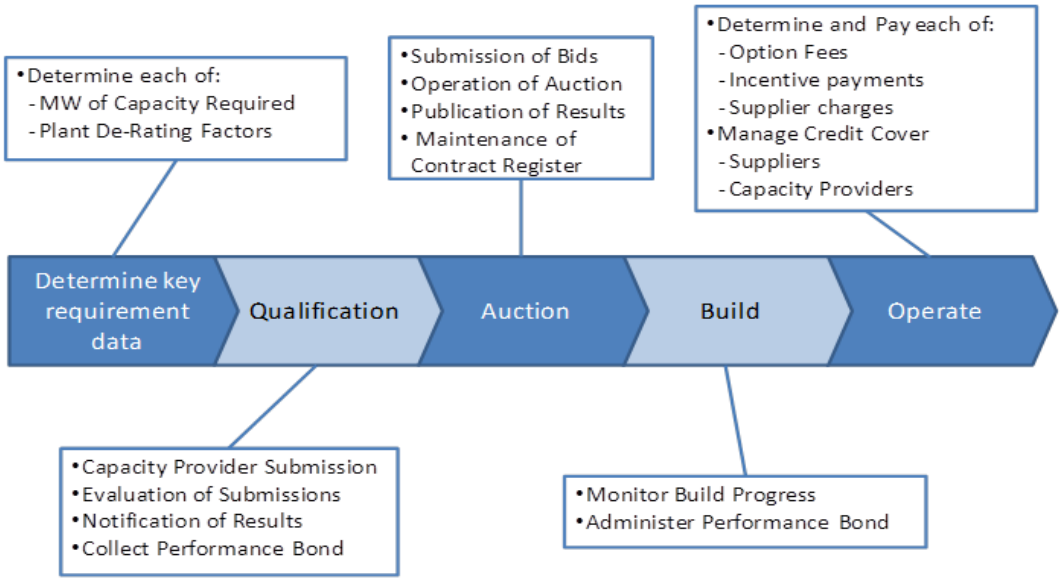
1.4.1 As can be seen in Figure 2 below, the determination of the Capacity Requirement and the De-rating Factors form part of the "determination of key data" element of the I-SEM CRM process.

1.4.2 The Capacity Requirement is the primary driver of the volume of capacity to be purchased by the market through the Reliability Option auction. The intention is that the level of capacity procured should be sufficient to maintain the agreed security standard, i.e. the 8 hour LoLE standard, in an unconstrained I-SEM. The Locational Issues Decision Paper (SEM-16-081) sets out the methodology to preserve the security standard given the key constraints which do exist, e.g. those relating to Northern Ireland and the Dublin area.

1.4.3 All providers of capacity will have an element of unreliability when they will be unavailable to perform, e.g. due to forced outages or intermittency. Such unavailability will require additional capacity to be procured to maintain the agreed security standard.

1.4.4 The De-rating Factors are used to adjust the nameplate capacity of capacity providers to reflect the contribution they can make to meeting the Capacity Requirement.

Figure 2: End to End Process for the I-SEM CRM



1.5 KEY DECISIONS FROM CRM CONSULTATIONS 1 – 3 FOR THE CAPACITY REQUIREMENT AND DE-RATING FACTOR METHODOLOGIES

Capacity Requirement

1.5.1 In CRM Decision 1 (SEM-15-103), the SEM Committee stated that the Capacity Requirement should be:

"determined based on the analysis of a number of scenarios for demand. These scenarios should provide reasonable coverage of the potential future requirement for capacity. The capacity requirement should be determined for each scenario, and the optimal scenario selected based on the least regret cost approach as outlined in the consultation paper."

1.5.2 In setting the volume of capacity to be auctioned, CRM Decision 3 (SEM-16-039) makes clear that the volume will be based on the Capacity Requirement adjusted for capacity withheld by capacity providers, capacity already purchased under previous auctions and capacity withheld by the RAs from the T-4 to the T-1 auction. The volume purchased from the auction will be on the basis of a sloping demand curve, the details of which are being consulted on as part of the CRM Parameters Consultation (SEM-16-073) which closes on 21 December 2016.

De-Rating Factors

1.5.3 Following the first CRM consultation, as part of CRM Decision 1, the SEM Committee decided that:

"the procurement of Reliability Options under the I-SEM should be based on a de-rated requirement."

and further that this de-rated requirement should be determined using de-rating factors developed as follows:

*"Central de-rating factors will be technology specific, but make allowance for the impact of plant size. [De-rating factors will] be based on **marginal contribution** to meeting the capacity requirement."*

1.5.4 That same decision stated that the De-Rating Factors should:

- *be centrally determined by the TSOs, with the TSOs determining de-rating factors for groups of technologies;*
- *be based on TSO analysis of the marginal contribution of the relevant technology to the capacity requirement. That is the extent to which a marginal increment or decrement of nameplate capacity from that technology type impacts the overall requirement for nameplate capacity; and*
- *vary for characteristics of a technology (e.g. size) that can be parameterised, and which legitimately impacts its marginal impact on the capacity requirement.*

1.5.5 Concerns were raised by stakeholders during the second CRM Consultation about the conflict of interest which could occur if the TSOs were to develop de-rating factors for the interconnectors. Responding to these concerns, the SEM Committee decided in CRM Decision 2 (SEM-16-022) that:

"RAs should develop a methodology to determine the de-rating factors to be applied to interconnectors."

1.5.6 Given the absence of historic data directly relating to the operation of the I-SEM, and changes to the GB market, and taking account of responses received to the second CRM Consultation, the SEM Committee decided that:

"the methodology [for interconnector de-rating] will be based on suitable historic and forecast data for GB and the SEM."

1.5.7 As part of CRM Decision 1, the SEM Committee decided that:

"Existing dispatchable plant will need to bid within a tolerance band of the centrally determined de-rating factor for that plant […]. This band will be tight, and will not exceed the lower of:

- *A threshold as set periodically by the SEM Committee (e.g. +x%, -y%); and*
- *Variation that, is sufficient to encompass legitimate variations in the technical characteristics of relevant plant."*

1.6 ASSESSMENT CRITERIA

1.6.1 The assessment criteria for the detailed design of the CRM (including the auction design) are based on the same principles as those applied to the I-SEM High Level Design and as agreed with the Departments in the Next Steps Decision Paper published March 2013. We have developed detailed descriptions of these criteria to focus on issues that are relevant to procuring capacity and tailored to the detailed design elements of the capacity remuneration mechanism.

1.6.2 These assessment criteria are set out below:

- **The Internal Electricity Market:** the market design should efficiently implement the EU Target Model and ensure efficient cross border trade.
- **Security of supply:** the chosen wholesale market design should facilitate the operation of the system that meets relevant security standards.
- **Competition**: the trading arrangements should promote competition between participants; incentivise appropriate investment and operation within the market; and should not inhibit efficient entry or exit, all in a transparent and objective manner.
- **Equity:** the market design should allocate the costs and benefits associated with the production, transportation and consumption of electricity in a fair and reasonable manner.
- **Environmental:** while a market cannot be designed specifically around renewable generation, the selected wholesale market design should promote renewable energy sources and facilitate government targets for renewables.
- **Adaptive**: The governance arrangements should provide an appropriate basis for the development and modification of the arrangements in a straightforward and cost effective manner.
- **Stability:** the trading arrangements should be stable and predictable throughout the lifetime of the market, for reasons of investor confidence and cost of capital considerations.
- **Efficiency:** market design should, in so far as it is practical to do so, result in the most economic overall operation of the power system.
- **Practicality/Cost**: the cost of implementing and participating in the CRM should be minimised; and the market design should lend itself to an implementation that is well defined, timely and reasonably priced.

1.6.3 Fundamental to the SEM Committee's consideration of the overall CRM design is the European Commission State Aid Guidelines, particularly in light of the EC energy sector inquiry including capacity mechanisms. Furthermore, we are actively engaged with the Departments (DCCAE and DfE) and the European Commission as we develop the capacity market design as ultimately EC State Aid approval is required for the CRM auctions to commence.

2. GOVERNANCE

2.1 INTRODUCTION

2.1.1 The key governance arrangements will be contained within the Capacity Market Code which is currently being developed by the TSOs through a Rules Working Group process which involved industry input and feedback. However, it is recognised that the Consultation Paper did not set out any specific proposals with regard to the governance of the methodology for the setting of the Capacity Requirement and Derating Factors. The RAs recognise the importance of such arrangements and provide further clarity below, consistent with the current drafting of the Capacity Market Code.

2.1.2 The RAs are mindful of the need for transparency of the input data and the models used implement the methodologies for determining both the capacity requirement and de-rating factors.

2.2 CONSULTATION SUMMARY

2.2.1 Some respondents requested the governance arrangements should set out all aspects of the capacity requirement.

2.2.2 On respondent noted that the marginal de-rating factors appear to be a function of the overall generation mix as well as individual capacity units' technical availability. The marginal de-rating factors will presumably change year on year. Consideration should therefore be given to if and how de-rating factor of any capacity provider that receives a long-term contract is adjusted each year.

2.2.3 A number of respondents reiterated their concerns regarding the SEM Committee's decision for an 8 hour security standard rather than a 3 hour security standard.

2.3 SEM COMMITTEE RESPONSE

2.3.1 The SEM Committee agrees that clarity is required in the governance arrangements surrounding the setting of both the capacity requirement and de-rating factors.

2.3.2 The SEM Committee intends to use similar principles regarding such governance arrangements as are currently employed for the CPM. Under the CPM, determination of the capacity requirement is made by the RAs, though with the work carried about by the TSOs, and the determination is consulted on annually. For the CRM, this consultation would be required for each capacity auction.

2.3.3 Under CRM Decision 2 (SEM-16-033), the RAs are required to determine the de-rating factors to be used for interconnectors. The RAs cannot be subject to governance under the Capacity Market Code, as they are not Party to the Code, and so this determination will be subject to

the same governance as the capacity requirement, i.e. by consultation prior to each capacity auction.

2.3.4 Given the de-rating curves are determined by an integrated methodology which also determines the capacity requirement, the determination of the de-rating curves must be subject to the same governance arrangements as the capacity requirement.

2.3.5 The RAs will determine the Capacity Requirement(s), the Technology Classes to be employed and the Derating Curves. They will also determine an External Market Derating Factor for each external market linked (or planned to be linked) to the I-SEM by an existing or proposed interconnector (see Section 3 below for more details). These determinations will be made for each Capacity Auction carried out under the terms of the Capacity Market Code for the relevant Capacity Year. All determinations will be in line with the methodologies laid out in this Decision.

2.3.6 The final values/determinations associated with this methodology will be published in advance of the first transitional capacity auction. For subsequent capacity auctions the values/determinations will be consulted upon to a timetable consistent with the qualification process set out in the Capacity Market Code. The consultation will set out the basis for the proposed determinations, including details of the inputs used. In the longer term, as the CRM moves away from transitional arrangements, it is anticipated that less frequent consultation will be needed in line with current practise for the CPM.

2.3.7 The Decision will be published to a timetable consistent with the Qualification process set out in the Capacity Market Code.

2.3.8 The determination of the derating capacity for individual units and interconnectors will be laid out in the Capacity Market Code. Changes to these determinations will be subject to the governance arrangements of that Code. The CMC is being developed by the TSOs through the Rules Working Group process with industry input provided through regular meetings and opportunities to provide feedback on the drafting. Following the completion of this process, the Code itself will then be subject to formal consultation.

2.3.9 The methodology for setting of the demand curve used in each Capacity Auction will be determined as part of the Parameters Consultation. Any specific governance arrangements will be set out in the associated Decision which is planned for Q1, 2017.

2.3.10 CRM Decision 1 (SEM-15-103) states “the quantity of Reliability Option awarded to new plant should be fixed for the life of that RO” and this decision has been implemented in the drafting of the Capacity Market Code. As Reliability Options are awarded on the basis of de-rated capacity, this means that the de-rating factor which applies at the time of the RO award will apply throughout the term of an RO. To the extent that derating factors later rise, the holder of an RO, in excess of one year, will be able (and in some circumstances, required) to offer the additional capacity now eligible into subsequent Capacity Auctions. This additional capacity would only qualify for a one year RO.

2.3.11 A new interconnector which meets the new investment threshold could be awarded a 10 year reliability option in the same way as a new generator unit. As with generator units, the contribution to capacity made by a new interconnector will vary over the term of the reliability option from that fixed at the time of award. For most capacity, the de-rating factor applying would move only gradually over time. For wind and storage this movement will have a downward trend as their contribution to capacity declines as the volume of installed capacity rises. For a new interconnector, its contribution to capacity is affected by changes in the forecast generation margin in the external market. This can change move substantially from year-to-year as the timing of new projects or capacity closure moves. As with any change in de-rating factors over time:

- if the factor rises a project can offer the additional capacity in later auctions and be awarded a one year reliability option; or
- if the factor falls then the consumer will be left paying for a hedge which can no longer be delivered.

This is part of a broader range of issues associated with the awarding of long-term reliability options which includes consumers being exposed to exchange rate risk and out-of-merit capacity. Such issues were explicitly recognised in CRM Decision 2 (SEM-16-022) when seeking a balance between such risks to consumers and the need to make new capacity financeable.

2.3.12 The SEM Committee recognise that the decisions in this paper are being made in advance of any Capacity Auctions taking place and with no history of operation of the I-SEM. As a consequence, the RAs will monitor the operation of the CRM and the impact of the decisions in this paper. If this monitoring indicates that any of these decisions needs to be reviewed then the RAs will launch a new consultation at that time.

2.4 SEM COMMITTEE DECISIONS

2.4.1 The RAs will determine the Capacity Requirement(s), Technology Classes and their associated De-rating Curves and the External Market De-rating Factors using the methodologies laid out in this Decision. The determination of Technology Classes should enable existing and new units to clearly identify which Technology Class they belong to.

2.4.2 The final values/determinations associated with this methodology will be published in advance of the first transitional capacity auction. For subsequent capacity auctions the values/determinations will be consulted upon to a timetable consistent with the qualification process set out in the Capacity Market Code. In the longer term, it is anticipated that some of the CRM parameters/values can move to less frequent consultation in line with current practise in the CPM.

2.4.3 Determinations set out in the Capacity Market Code, e.g. of unit level de-rated capacity and the demand curve, will be subject to the governance arrangements laid out in that Code.

3. CAPACITY REQUIREMENT AND DE-RATING FACTOR METHODOLOGY

3.1 INTRODUCTION

3.1.1 The requirement for De-Rating Factors to represent the marginal contribution to meeting the Capacity Requirement means that a combined methodology for the determination of both the Capacity Requirement and unit De-rating Factors is needed.

3.1.2 As set out in CRM Decision 1, the TSOs have developed a methodology for the determination of the Capacity Requirement and the unit De-rating Factors. As required by earlier SEM Committee decisions this methodology:

- Determines a Capacity Requirement on the basis of a representative range of future demand scenarios and uses a least-worst regrets approach to determine the Capacity Requirement; and
- Determines De-rating Factors for groups of technologies and then adjust these based on the marginal contribution to Capacity Requirement made by each unit.

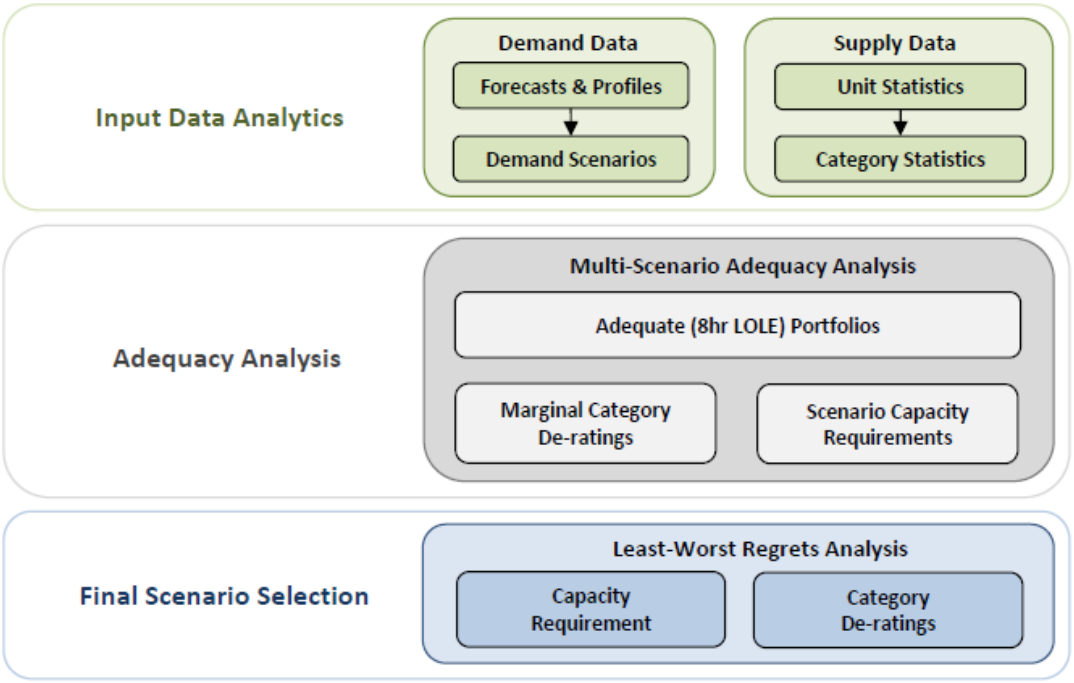
3.2 CONSULTATION SUMMARY

3.2.1 The TSOs detailed proposed methodology was appended to the consultation paper. In addition to setting out the proposed methodology, the TSOs paper also provides indicative values for the following:

- the Capacity Requirement;
- the technology groupings used in the determination of De-rating Factors;
- technology group level De-rating Factors;
- marginal de-rating curves; and
- unit level De-rating Factors.

3.2.2 The steps taken by the TSOs in developing the proposed methodology are outlined in Figure 3 below.

Figure 3: Overview of the Methodology



3.2.3 To determine the capacity required to serve demand a range of demand scenarios for each capacity year was used. These differ based on annual demand growth and how demand is profiled across the year. Relevant demand information was sourced from the EirGrid and SONI 2016 – 2025 Generation Capacity Statement (GCS).

3.2.4 Using demand forecasts for years 2017 through to 2020 the TSOs adjusted this downwards for small-scale non-market demand and increased the forecasts for the inclusion of reserves. The inclusion of reserves within the capacity requirement methodology represents a change to the current treatment within the current Capacity Payment Mechanism (CPM). Given this has a significant impact on the end result the Regulatory Authorities encouraged feedback on this proposal.

3.2.5 Table 2 below details the components of the demand forecasts and provides indicative capacity requirements based on Least-Worst Regrets analysis. The TSOs considered these values as representing the forecasted capacity requirement to satisfy the 8hr LoLE adequacy standard for the unconstrained all-island system.

Table 2: Demand Forecast Components and Indicative Capacity Requirements for 2017/18 to 2020/21

	2017	2018	2019	2020
GCS Low TER Peak Demand	6,767	6,778	6,793	6,821
GCS Median TER Peak Demand	6,888	6,938	6,980	7,038
GCS High TER Peak Demand	6,917	6,977	7,074	7,219
Small-Scale Non-market Adjustment	242	251	263	265
Low Market Peak Demand	6,525	6,527	6,530	6,556
Median Market Peak Demand	6,646	6,687	6,717	6,773
High Market Peak Demand	6,675	6,726	6,811	6,954
Reserve Requirement	444	444	444	444
Low Market Demand + Reserve	6,969	6,971	6,974	7,000
Median Market Demand + Reserve	7,090	7,131	7,161	7,217
High Market Demand + Reserve	7,119	7,170	7,255	7,398
Indicative Capacity Requirement	7,312	7,321	7,401	7,498

Source: I-SEM CRM Industry workshop 29th September 2016 – TSO slides

3.2.6 Technology categories were derived to group similar types of units in order to determine de-rating factors by technology category rather than by individual units. The availability of the units in a technology category is a statistically more robust and reliable measure of future performance than the availability of the units in isolation. Seven technological categories were proposed and these are described in Table 3 below.

Table 3: Types of Units in each Technology Category

Technology Category	Unit types included
DSU AGU	Demand side units (including aggregated units)
Gas Turbine	CCGT, Gas and Distillate[1] OCGT, Large CHP
Hydro	Hydro
Steam Turbine	Oil, Coal, Peat
Storage	Pumped Storage[2]
Wind	Wind
System Wide	All of the above

[1] In Table 2 of the consultation document Distillate was mistakenly listed in the Steam Turbine category instead of the Gas Turbine category. However, the consultation analysis had correctly included Distillate within the Gas Turbine category.

[2] In the future this could include compressed air, battery and other grid powered storage technologies

3.2.7 Regarding new capacity to the system it was proposed that new capacity that conforms to one of the existing technology categories would take on the values associated with that technology category therefore no data is required for such a unit. New capacity that does not conform to the existing categories would be given values associated with the system wide average initially. Over time as actual performance data becomes available the value can be reviewed.

3.2.8 The TSOs based availability statistics on historical data for existing units. Historical data informed the level of forced, scheduled and ambient (e.g. temperature dependent) outages for the individual capacity market units upon which an average was derived for each technology category. Averaging serves to make the data more consistent, smoothing out random variability within a technology category, and making the data more stable between auctions.

3.2.9 The Multi-Scenario Adequacy Analysis was applied to derive de-rating factor curves as a function of the size of a unit. First, capacity adequate portfolios, comprising a set of capacity market units that together satisfy the 8 hour LoLE standard for demand scenarios were produced. For each demand scenario five randomly selected capacity adequate portfolios were simulated to provide a range of possible auction outcomes. The least worst analysis was used to select the base demand scenario with the least combined regret cost due to both shortages of energy and over-supply of capacity. The de-rated capacity requirement for this demand scenario is selected as the result of this analysis. The de-rating factor curves for each technology category associated with this base demand scenario are applied to the registered capacity for the capacity market units when determining their de-rated capacity.

Interconnector De-Rating Factor Methodology

3.2.10 In accordance with CRM Decision 2, the Regulatory Authorities developed a methodology for determination of the De-Rating Factor to be applied to the interconnectors. The details of this methodology and indicative results were appended to the consultation paper.

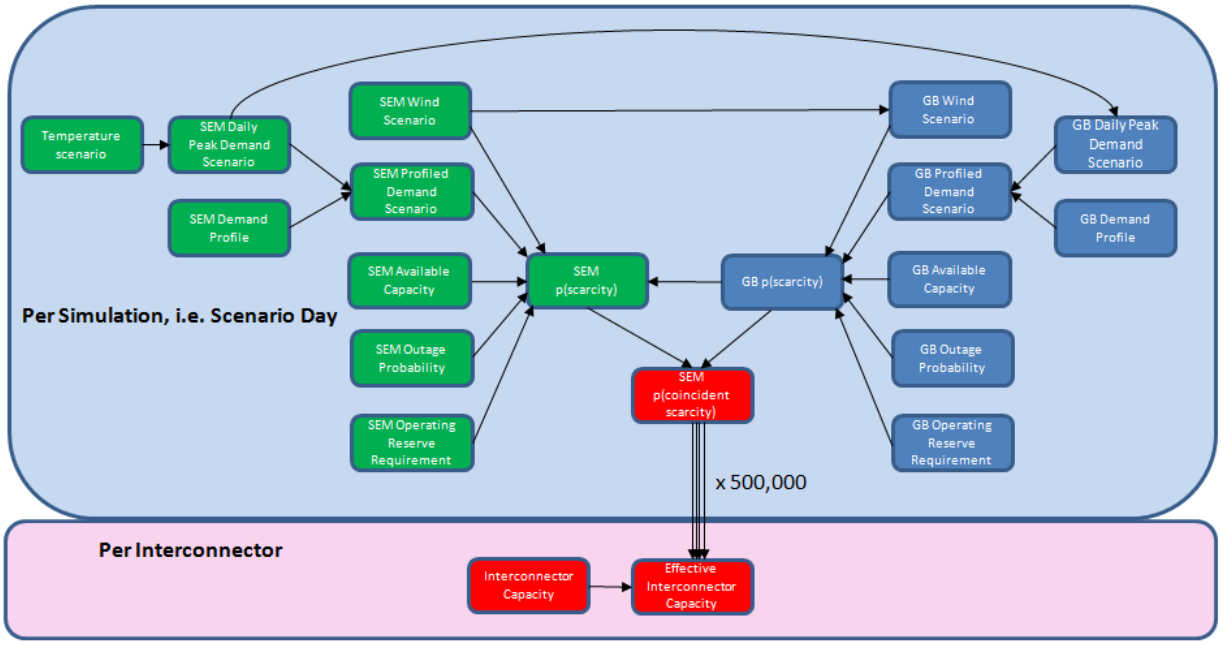
3.2.11 In determining the de-rating factor for an interconnector consideration has to be given to the probability that capacity will be able to import from GB at times of scarcity in the I-SEM and the probability that the interconnector will be technically available at times of scarcity in the I-SEM.

3.2.12 Determining the effective capacity of an interconnector i.e. probability of availability to import to the I-SEM at times of scarcity, is problematic. This is due to substantially different market design between the SEM and I-SEM, significant recent change within the GB market and very limited historical events of scarcity.

3.2.13 The GB and SEM markets were modelled to forecast whether imported capacity will be available at times of I-SEM scarcity. Historical outage data was used to determine the technical availability of the interconnectors. The small number of interconnectors (2) and the limited history, including a very long term outage on Moyle, necessitates some minor variation to the standard methodology applied to conventional generator units.

3.2.14 Figure 4 below illustrates determination of the probability of scarcity in I-SEM and in GB, taking account of the correlations between the key drivers affecting the I-SEM and GB market. This allows determination of the probability of coincident scarcity in the two markets, i.e. the I-SEM has scarcity and GB lack surplus capacity and so imports through the interconnector are not possible. By looking across all half-hourly periods in a large number of potential scenario days (500,000) where scarcity could arise, it is possible to produce an estimate of the effective capacity of an interconnector.

Figure 4: Simplified Methodology Overview



3.2.15 The base case created captures those periods in the I-SEM for which true scarcity occurs, i.e. it approximates to an average of 8 hours of scarcity per year.

3.2.16 The Regulatory Authorities supplied the TSOs with the Effective Interconnector Capacity (EIC) for each interconnector and the planned outage and forced outage rates to be applied to the interconnector technology class. These two sources of information are inputs to the TSOs De-Rating Methodology and treated in exactly the same way as conventional generator units.

3.2.17 The base case was run for each year from 2017/18 through to 2020/21. Over this period, the changes in effective interconnector capacity track broadly with the changes to the GB generation portfolio. The forced and scheduled outage rates shown would apply to all four capacity years. The indicative results are show below in Table 4.

Tables 4: Indicative results for effective interconnector capacity and forced and scheduled outage rates

Year	***2017/8***	***2018/9***	***2019/20***	***2020/21***
Effective Interconnector Capacity	89%	95%	88%	86%

Data Source	***Interconnectors***	
	FOR	***SOR***
TSO Operations data	5.6%	2.3%

3.2.18 The interconnector de-rating paper appended to the consultation paper set out in greater detail the methodology including assumptions and sensitivity analysis.

Indicative Results presented within the Consultation Paper

3.2.19 Table 5 below contains indicative de-rating factors for the different technology categories and sizes calculated using the test version of the analysis tools. Here, the size classes are divided into 100 MW divisions. The midway point in the size class was used to calculate the de-rating factor to be applied to that size class.

3.2.20 Marginal de-rating factors were calculated for the interconnectors using the indicative results of the Regulatory Authorities Interconnector de-rating methodology. These are a forced outage rate of 5.6% and a scheduled outage rate of 2.3% and Effective Interconnector Capacities of 392 MW and 435 MW for Moyle and EWIC, respectively. These are then treated the same as other technology types in the marginal de-rating process. The difference between the marginal de-rating factors for Moyle and EWIC is due to the fact that they fall into two different size classes.

Table 5: Indicative de-ratings for different technology categories and size classes within consultation paper

De-rating Factors (%)								
Size Class (MW)	Gas Turbine	Steam Turbine	Hydro	Storage	DSU	Wind	EWIC	Moyle
001-100	95.8	91.8	95.4	86.0	73.0	12.5	85.6	88.0
101-200	95.0	90.3	94.6	82.7	68.8			
200-300	94.0	88.3	93.4	74.4	64.1			
301-400	92.6	85.9	92.0	64.3	59.3			
401-500	91.1	83.1	90.3	54.2	54.4			

3.3 SUMMARY OF RESPONSES

Capacity Requirement Methodology

3.3.1 There was broad support for the capacity requirement methodology however most respondents raise some concerns or proposals regarding specific aspects of the methodology.

3.3.2 Most supported the use of the least worst regrets approach while some cautioned that while there is excess capacity on the system this approach may skew the capacity requirement and risk under-procurement. Quite a number of respondents explicitly referred to the cost of over-procurement (NetCONE) being lower than the cost of having under-procured (Value of Lost Load) and therefore supported a cautious approach to over-procurement. While it was recognised that the BNE cost is lower than VoLL, the cost of excess capacity is realistically going to be lower than BNE and therefore a lower metric should be applied. Proposals for a lower metric included an estimation of the CRM auction clearing price, 20% of NetCONE or the use of the Existing Capacity Price Cap.

3.3.3 Given the references to the TSOs Generation Capacity Statement (GCS) within the consultation a number of respondents commented that they could not reconcile the capacity requirement being proposed to the GCS and were concerned the methodology assumptions could lead to under-procurement of capacity.

3.3.4 More clarity regarding the treatment of wind within the modelling was requesting and whether low wind stress days were captured. One respondent considered it inappropriate to remove out of market wind before calculating the capacity requirement. Clarity was also sought regarding the treatment of non-market demand being netted off demand.

3.3.5 One respondent commented that the methodology should also take account of the benefit of reduced costs of capacity when security is lower than expected. Similarly, the methodology should also take account of the benefit of reduced costs of unserved energy when security is higher than expected. This is the approach taken by National Grid and described in its Electricity Capacity Report. Furthermore, the methodology does not appear to take account of the possibility that the interconnectors may be importing in thereby reducing I-SEM scarcity.

Treatment of Operational Reserves within the Capacity Requirement

3.3.6 All respondents who commented on the inclusion of operating reserves agreed with the inclusion, although one respondent did view reserves as ideally being the responsibility of the TSOs. Most of these respondents did not agree with the TSOs using the largest generator infeed of 444MW and suggested the largest single infeed should be EWIC at 500MW.

3.3.7 In general, the inclusion of reserves was viewed as being a prudent approach whilst also aligning with the approach taken in GB.

Technology Groupings

3.3.8 In the main, there was broad support for the technology groupings. One respondent disagreed with the approach while another suggested the groupings may be more appropriately separated by fuel source as well as, or rather than, their technology type. Another alternative proposed for technologies which do not naturally deliver the best fit the other forms should be considered e.g. Technical Offer Data (TOD) or no grouping at all. A number of respondents requested further analysis be provided to show the range of historical performance that exists within each group as justification for the final categories. Furthermore, transparency was requested of the other alternative technology categories which were considered, as referred to in the consultation paper.

3.3.9 Specific comments on the groupings related to the gas turbine, steam turbine, storage and DSU/AGU categories are summarised below.

3.3.10 A number of respondents commented how broad the gas turbine and steam turbine categories are, with a wide variety of technologies being captured in each relative to other categories. Again, there was a request, particularly in light of the Regulatory Authorities "minded to" position for zero tolerance bands, that the analysis of the spread of outage rates within these groups be provided as justification of the final technology categories. One

respondent considered the averaging approach to be aggressive and justified in the decision paper or alternatively a more precise set of technology groups should be applied due to the expected 0% tolerance bands.

3.3.11 The storage category includes a very broad range of storage characteristics and argues that a single de-rating factor is too simplistic to capture the technical variations of pumped storage, battery storage and compressed air storage. It was argued that compressed air has identical operational characteristics to an OCGT. The initial de-rating factors for storage was considered too low because they are based on untypical outage data and noted pumped storage has a much higher factor within GB (96%) reflecting pump storage high performance. Low and inappropriate de-rating factors for pumped storage increase the capacity requirement and risk financial resourcing of such capital-intensive projects. Some respondents mentioned the proposed treatment of storage was still to be finalised and requested the opportunity to respond to the final proposed treatment before a decision is made or before the auction qualification process begins.

3.3.12 Regarding the DSU/AGU category a number of respondents did not view this category as being consistent with the requirement for groupings to be separated by "legitimate technical variations" to reflect differing load dependency and requested they be separated. To support the separation some respondents requested the TSOs consider the spread of outage rates for DSUs and AGUs as AGUs will have reasonably high availability and therefore a separate category from DSUs would be justified.

3.3.13 One respondent requested the technology groupings should be applicable in the long term and proposed an additional category, "wind and other technologies" in order to capture wind farms with other technologies (storage or solar) which could possible guarantee capacity at times of system stress. There was also a request for a solar category as the system wide category would overestimate the contribution.

Marginal de-rating curves

3.3.14 Most respondents broadly supported the marginal de-rating curves. However, some did have reservations. Some mentioned concerns regarding the unit sizes and the lack of visibility of the rationale of unit size and the impact or sensitivity on each technology group.

3.3.15 Some respondents raised concerns that an intrinsic forced outage rate cannot be had for a DSU and argue the availability of a DSU is in no way related to the actual reliability of the unit. The amount available compared to the registered or nameplate capacity is dependent on the energy being consumed or generally available which can vary hourly. Furthermore, emphasis was placed on the DSU portfolio being managed to ensure reliability of response and argued the application of a de-rating factor by the Regulatory Authorities would effectively result in a second de-rating of DSUs and therefore double de-rating. Another respondent believed the proposed methodology underestimates the de-rating factors for DSUs as the diversity benefit of a DSU portfolio doesn't appear to be equally reflected.

3.3.16 A couple of respondents considered a lack of transparency regarding the use of five random capacity adequate portfolios for various demand scenarios and considered them unclear and

unknown. The variance of the de-rating factor when calculated for different portfolios should be specified.

3.3.17 The outcome of the treatment of wind was considered unfairly low. It was proposed that wind should be treated the same as other units of different size rather than including all wind as a large block.

3.3.18 Given the uniqueness of autoproducers and uncertainly of the intent to de-rate Trading Site Supplier Units (TSSU) a proposal was made to deduct embedded consumption from the nameplate capacity before the de-rating would be applied.

3.3.19 It was proposed that a measure of reliability should be included within the calculation to give a true reflection between those units which run often and those which don't.

Interconnector De-Rating Factor Methodology

3.3.20 This was given particular emphasis by most respondents who recognised the complexity involved. While broadly supporting the approach at a high level they had a number of serious concerns regarding simplistic assumptions being made and strongly recommended the modelling be refined to provide a much more cautious and prudent outcome for both end customers in terms of reliability and prices for the following reasons.

3.3.21 Most respondents referred to the decision that interconnectors are only required to make difference payments during technical outages. Their concern was therefore a risk that interconnector contributions would be overestimated with the knock on effect that suppliers are subject to increased hole in the hedge exposure, if realised, it ultimately increases costs to consumers.

3.3.22 Regarding the technical availability of interconnectors most respondents explicitly referred to the need for historical outages of the Moyle Interconnector to be captured together with the recent and ongoing long term outage on EWIC. It was also considered necessary to capture the longer time required to remedy such forced outages. This was also important from the perspective of the large contribution of the interconnectors relative to the system capacity and therefore the interconnectors should not be overly relied upon.

3.3.23 GB forecasts an increased likelihood of scarcity compared to historical data. This together with the evidence of the recent GB winter price spike of £1,000 MWh led the respondents to the view that the modelling needs to reflect this significant likelihood for coincident scarcity in I-SEM and GB.

3.3.24 The assumption that the available capacity is set by 100% of the possible flows from GB to I-SEM is viewed unrealistic. The flows will be dependent on, *inter alia*, GB scarcity, intra-day markets and TSO – TSO interconnector trading and therefore 100% is not viewed appropriate. One respondent considered the need to clarify the contractual relationship between National Grid and the SEM interconnectors and whether National Grid has the power to reduce the transfer capacity. If so, the de-rating factor should be lowered to reflect this.

3.3.25 Moyle requested there be further consideration of the multi-pole nature of the unit and reflect the size of the poles rather than the whole unit, resulting in a higher overall de-rating factor. Moyle raised reservations regarding the outages included in the analysis. Eirgrid interconnector considers it more appropriate, given the significant differences in the technologies used, to use the actual forced outage rate and scheduled outage rate figures for each interconnector rather than an average based on two interconnectors. They also had reservations over the use of a "class" approach and the level of influence of the larger size of EWIC relative to Moyle.

3.3.26 A small number of respondents mentioned the level of detail provided, including insufficient scenario analysis, made it difficult for market participants to appraise the results. Others referred to the lack of consideration of other methodologies being applied.

3.4 SEM COMMITTEE RESPONSE

Capacity Requirement Methodology

3.4.1 Given the imbalance between the valuation of the costs of over- and under-procurement (at NetCONE and VoLL respectively), the least-worst regrets method will always tend to err on the side of over-procurement. This can be seen in the indicative results shown in the consultation paper where the Capacity Requirement lies towards the high end of the range of demand scenarios.

3.4.2 The SEM Committee recognise that valuing over-procurement at NetCONE does not offer a perfect metric for these costs. We would note that even with an assumption of excess capacity, the Existing Capacity Price Cap may not represent the maximum expected auction clearing price, given new capacity bids and the ability for capacity to apply for a unit-specific price cap.

3.4.3 The SEM Committee also notes that the analysis performed for the Parameter Consultation paper (shown as the blue line in Figure 5) which shows the value of over-procured capacity falls off very rapidly. As a result, over-procurement at a lower price would have only a modest impact on the Capacity Requirement.

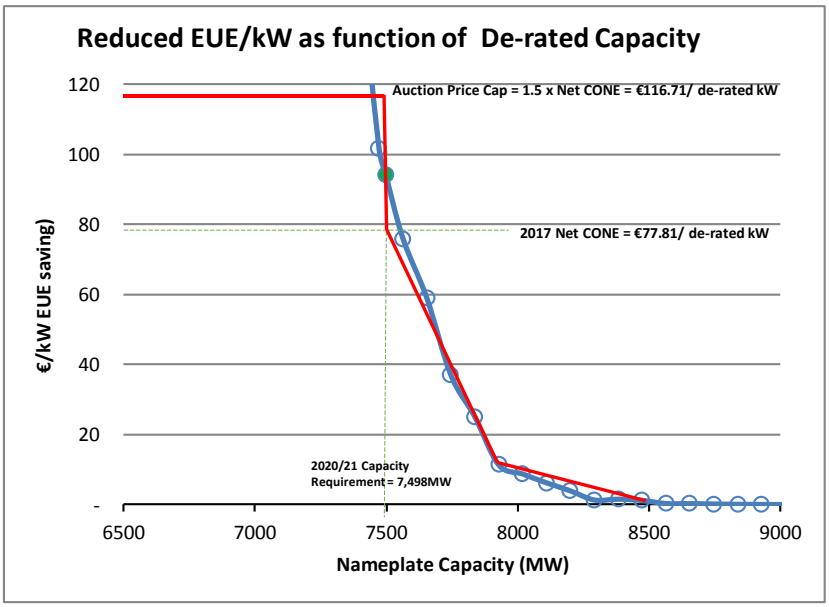


Figure 5: Saving in EUE with increasing capacity requirement

3.4.4 Given the difficulties in estimating a more reliable metric at which to cost over-procurement before any CRM auction has taken place, the SEM Committee believe that NetCONE represents a robust and objective metric. NetCONE offers a reasonable balance between the risks of over- and under-procurement and, as a consistent metric, will reduce year-on-year volatility in the Capacity Requirement.

3.4.5 CRM Decision 1 requires the Capacity Requirement to be a de-rated requirement. This de-rated requirement would vary by capacity type reflecting its typical reliability. This is reflected in the methodology through the choice of Technology Classes and the use of average historic outage rates.

3.4.6 It then follows that the capacity obligations will also be de-rated volumes and that this must be on a basis consistent with the determination of the Capacity Requirement itself. The methodology achieves this by co-determining the de-rating curves and Capacity Requirement for each demand scenario.

3.4.7 The GCS uses a different approach to determine capacity adequacy. For the RoI, it uses a forecast of outage rates augmented by inclusion of a number of high-impact, low-probability outages. This approach could not be used for the CRM as it would not generate a reasonable set of de-rating curves to associate with the Capacity Requirement.

3.4.8 The SEM Committee also note that the implied de-rating factors from the GCS analysis are much lower than those derived under this methodology with a system-wide value of ~15% in the GCS compared to ~10%.

3.4.9 The SEM Committee is not convinced that there is a case for significantly reducing the de-rating factors used in the CRM to drive a higher capacity requirement more consistent with

the GCS analysis. However, it will ask the TSOs to look for opportunities in future to incorporate adequacy analysis in the GCS which is more consistent with the CRM.

3.4.10 The SEM Committee recognises that the description of the treatment of non-market demand in the methodology was not fully clear, in particular for wind and solar capacity. This has been corrected in the revised Appendix 1 which forms part of this Decision. For wind, its de-rated capacity was used to adjust peak demand while a typical load factor taken from historic performance was used to adjust the total energy demand. For solar, irradiation data from the ENTSO-E Pan-European Climate Database was used to estimate a capacity factor. For all other capacity, the demand adjustment used a flat profile based on a typical load factor for the capacity type taken from historic performance.

3.4.11 Within the analysis performed for the methodology, the impact of low wind on days of high demand is captured by use of the de-rated capacity for wind which takes account of the historic coincidence of low wind at times of high demand.

3.4.12 The derating methodology applied to the interconnectors makes a conservative assumption and assumes that the interconnectors are exporting at their maximum potential (i.e. 950MW) at times of scarcity in GB. This increases the probability of scarcity arising in the I-SEM and so the probability of coincident scarcity. This acts to reduce the de-rating factor applied to interconnector capacity. This has been clarified in the revised Appendix 2 which forms part of this Decision.

Treatment of Operational Reserves within the Capacity Requirement

3.4.13 The SEM Committee recognises that a case could be made for the inclusion of some measure of reserve requirement within the Capacity Requirement.

3.4.14 For the determination of capacity requirement in GB a value for the reserve needed to cover the largest single infeed is added to demand when considering whether a generation portfolio meets their security standard (a LOLE of 3 hours). GB does *not* add capacity equal to the largest single infeed, but only the reserve required to cover this infeed from the capacity requirement. In particular, GB recognises that some of this infeed is covered by the supply side (e.g. triad avoidance) and by generation not contracted via their capacity market (e.g. MaxGen or Emergency Assistance from the interconnectors).

3.4.15 The SEM Committee is of the view that the TSOs need to make the direct case for the inclusion of some measure of reserve within the capacity requirement in the I-SEM, with evidence supporting this case, before it can properly make a Decision on its inclusion.

3.4.16 In addition to the inclusion of any reserve requirement, there are a number of other factors applying in the first transitional auction which will increase the size of the Capacity Requirement including the CRM3 (SEM-16-039) decision to acquire sufficient capacity to meet the demand at the end of the transitional period, the slope of the demand curve and the use of the Option B auction format in the transitional period to resolve locational security of supply issues.

3.4.17 Given the use of the Option B auction format, which means that capacity will be purchased over-and-above the capacity requirement to resolve local security of supply issues, the SEM Committee has decided not to include any measure of reserve requirement within the T-1 transitional auction. This minimises the risk of over-procurement and the associated costs of consumers. The level of overall procurement will be monitored following the first transitional auction.

3.4.18 After the transitional period and once the CRM auction moves to its enduring solution (Option D), the SEM Committee has decided that some measure of reserve could be included within the auction, contingent on the SEM Committee being convinced by the case made by the TSOs for such inclusion under 3.4.15.

3.4.19 The level of this reserve inclusion would be subject to consultation prior to each capacity auction. This consultation would be part of the broader consultation on the level of the Capacity Requirement and would cover both the proposed level and a detailed justification. This justification should consider actual operational practice and, as in GB, the coverage of any reserve requirement which is available to the TSOs without securing additional capacity through the CRM.

Technology Groupings

3.4.20 The use of Technology Classes is driven from CRM Decision 1. The classes were selected to provide an appropriate balance between two key drivers:

- grouping together units with closely related outage drivers; and
- ensuring groups had a sufficient diversity of units that the historically derived outage rates would be stable and contain a representative mix of longer and shorter outages.

It was important to recognise that some outage types occur only infrequently and a Technology Class with very few units could have an unreliable and volatile de-rating curve as a major outage for a single unit enters and exits the historic period analysed. This could lead to either over- or under-procurement of capacity.

3.4.21 Despite this objective, for two Technology Classes, storage and interconnectors, there are very few units in the Technology Class and this creates the potential for volatile and unreliable de-rating factors. In consequence, the SEM Committee has decided that for these two categories the most recent 10 years of historic data will be used to derive outage rates. For all other Technology Classes, the most recent 5 years of historic data will be used as set out in the consultation paper.

3.4.22 Given the desire to group units based on similar outage drivers, as outages are the basis of reliability and so de-rating, the use of Technical Offer Data is not appropriate as this does not contain any relevant data.

3.4.23 The SEM Committee agree that it is not appropriate to group AGU and DSU capacity in the same class.

3.4.24 The SEM Committee has decided that AGU should not be a Technology Class at all. The de-rated capacity of an AGU should be determined by summing the de-rated capacity of each of its component Generators. The de-rated capacity for each of the component Generators will be determined based on their size and Technology Class. This approach will be drafted into the CMC.

3.4.25 The SEM Committee has decided that a Technology Class for DSU will be created.

3.4.26 The SEM Committee agrees that a Technology Class for solar should be created.

3.4.27 The SEM Committee does not agree that a Technology Class is needed for "wind and other technologies". This situation is covered by the aggregation of units permitted within a Capacity Market Unit. No evidence has been presented that suggests a wind unit combined with battery storage can deliver a greater contribution to capacity than the two units considered separately. While the combined unit would have a greater probability of being able to deliver capacity at times of scarcity than the wind unit alone, this is fully captured by the de-rated capacity of the storage unit.

3.4.28 The SEM Committee recognises that using an average outage rate for a Technology Class may over-estimate the capacity that will be delivered if the auction results tend to favour units with outage rates above the average. Units with higher outage rates will face greater risk of exposure to uncovered difference payments and would rationally be expected to price this risk into their auction bids. Such units should be less likely to be awarded capacity from an auction than the more reliable units in the Technology Class. Use of a higher outage rate (than average) for the Technology Class will tend to blunt CRM exit signals. There is no clear age-related influence on the outage characteristics observed in statistical analysis of the historic data for SEM plant. This partly reflects the confounding impact of low running hours for some of the older plant but also the relatively youthful mix of GT-based capacity in the SEM. As a result, the SEM Committee intends to retain the consulted approach, but will monitor auction results for any systematic bias weakening the hedge to consumers.

Marginal de-rating curves

3.4.29 As stated in Appendix 1 to the consultation paper, each point on a de-rating curve is established by adding a unit of a given size (in steps of 100MW) for that Technology Class to each Capacity Adequate Portfolio. Demand is added until the LoLE value for the augmented portfolio returns to exactly 8 hours. The ratio of the additional demand which could be served to the size of the notional unit added represents the de-rating for that size of unit. This approach is independent of the size of any actual or potential unit on the system, but is used to establish a curve covering the full range of units which exist or could be proposed.

3.4.30 The SEM Committee sees no clear advantage to switching to a smaller step size for determining the de-rating curves given the modest change in de-rating factors obtained with a 100MW step-size.

3.4.31 The SEM Committee has decided that rather than providing de-rating factors for named interconnectors, the methodology should determine a de-rating curve for interconnector capacity as it does for all other technology classes. This ensures that proposed interconnectors have access to a de-rating curve at the time of Qualification.

3.4.32 Even within the consultation responses, a wide range of outage rates were quoted by existing DSU capacity. Historic data reinforces the fact that the capacity made available by DSU capacity is below its DSU MW Capacity (as defined under the Grid Code) and varies significantly from unit to unit.

3.4.33 DSU MW Capacity represents the maximum capacity that could be achieved if all elements of a DSU responded to their maximum extent *at the same time*. In practice, consultation responses suggest that a DSU aggregator under the I-SEM would aggregate individual demand supply "units" to achieve a given level of capacity that can be reliably delivered. The link between this reliable capacity and the DSU MW Capacity will depend on the nature and reliability of the individual units being aggregated.

3.4.34 The SEM Committee agrees that it is not possible to set a single de-rating curve that would apply to all DSU capacity. Instead the Committee has decided that a de-rating curve will be set which represents a maximum contribution from any DSU with a negative tolerance band applied to provide flexibility for DSU aggregators to Qualify the capacity which they can reliably deliver from their portfolio.

3.4.35 The SEM Committee has decided that the de-rating curve used for DSU should be the System-Wide one. The negative tolerance band will be based on the historic availability performance of DSU, but will take account of changes in the aggregation of demand response which the move to the I-SEM is expected to cause. This methodology avoids any issue that a DSU could be subject to "double de-rating".

3.4.36 There is a risk that with this broad tolerance band, DSU aggregators may systematically over-state their reliable capacity. This would weaken the security standard and the hedge to consumers. A similar concern exists for other types of aggregated capacity and, in particular, AGUs. In line with the treatment of AGUs proposed under the CMC, the SEM Committee has decided that as part of their Application for Qualification under the CMC, DSUs will need to submit evidence that the unit can deliver the capacity being Qualified.

3.4.37 The primary area of concern with respect to the five randomly chosen Capacity Adequate Portfolios related to variation in the included wind. Wind is fixed in all Capacity Adequate Portfolios for a given demand scenario at the same level using a de-rating determined in a first pass determination of its contribution. The process is laid out in greater detail level in the revised Appendix 1.

3.4.38 Given the relatively modest variation in de-rating factors for different classes and sizes of unit, the expected variation in the Capacity Requirements derived from different portfolios is very low, varying between 40 and 100 MW across the whole spread of scenarios.

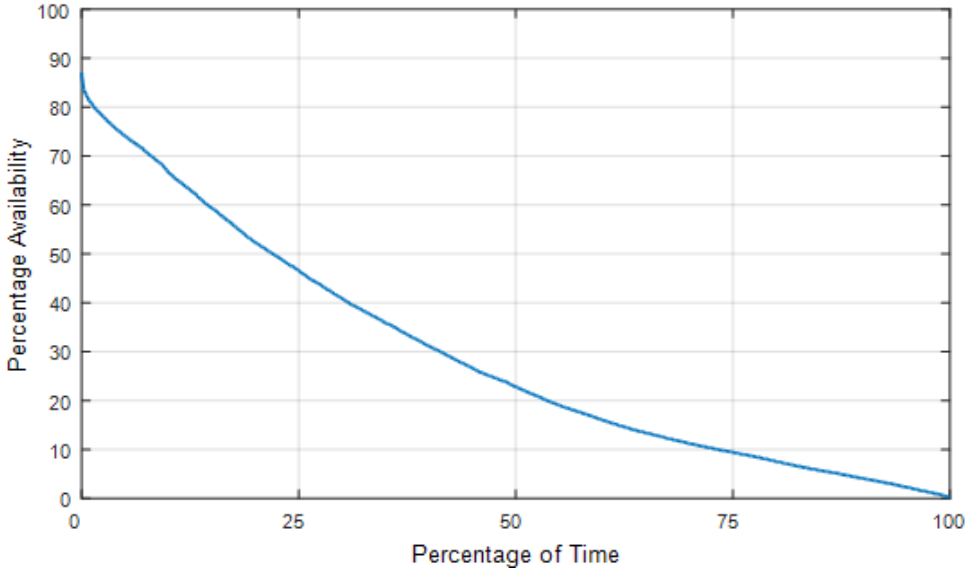
3.4.39 The use of largely random portfolios is sensible for the first transitional auction, but once capacity is awarded for a Capacity Year some of the portfolio become fixed.

3.4.40 The SEM Committee has decided that any capacity already awarded a Reliability Option for a Capacity Year should be fixed in all Capacity Adequate Portfolios for that year.

3.4.41 For most Technology Classes, the de-rating curves can be determined on the assumption that an outage on one unit in that class is not correlated with outages on any of the other units. This means that each unit can be viewed independently and its de-rating based on the size of that individual unit.

3.4.42 For wind and solar the outages on one unit are correlated with the outages on all the other units in the same class. This is clearly illustrated in Figure 6 which would show data distributed on (or very close) to a horizontal line if outages between units were not correlated. As a result, it is not appropriate to consider individual units or even subsets of units when determining the de-rating factor to be applied.

Figure 6: Availability Duration curve for SEM Wind, 2014



3.4.43 The SEM Committee has decided that for any technology classes where outages are highly correlated between units, the de-rating factor should be set on the basis of the whole class, rather than individual units. The de-rating factors for such units will be based on the results of a first pass through of the process which determines the de-rating curves. For this pass, Capacity Adequate Portfolios are constructed for each demand scenario without any contribution from the technology class being analysed. The whole technology class is then added, using the wind profile which corresponds to the demand scenario, and the additional demand which can now be covered while retaining the 8 hour LOLE standard is determined. This enables a de-rating factor to be obtained for each demand scenario in a method analogous to that used for the standard blocks of capacity used for other technology classes. This process is set out in greater detail in Appendix 1.

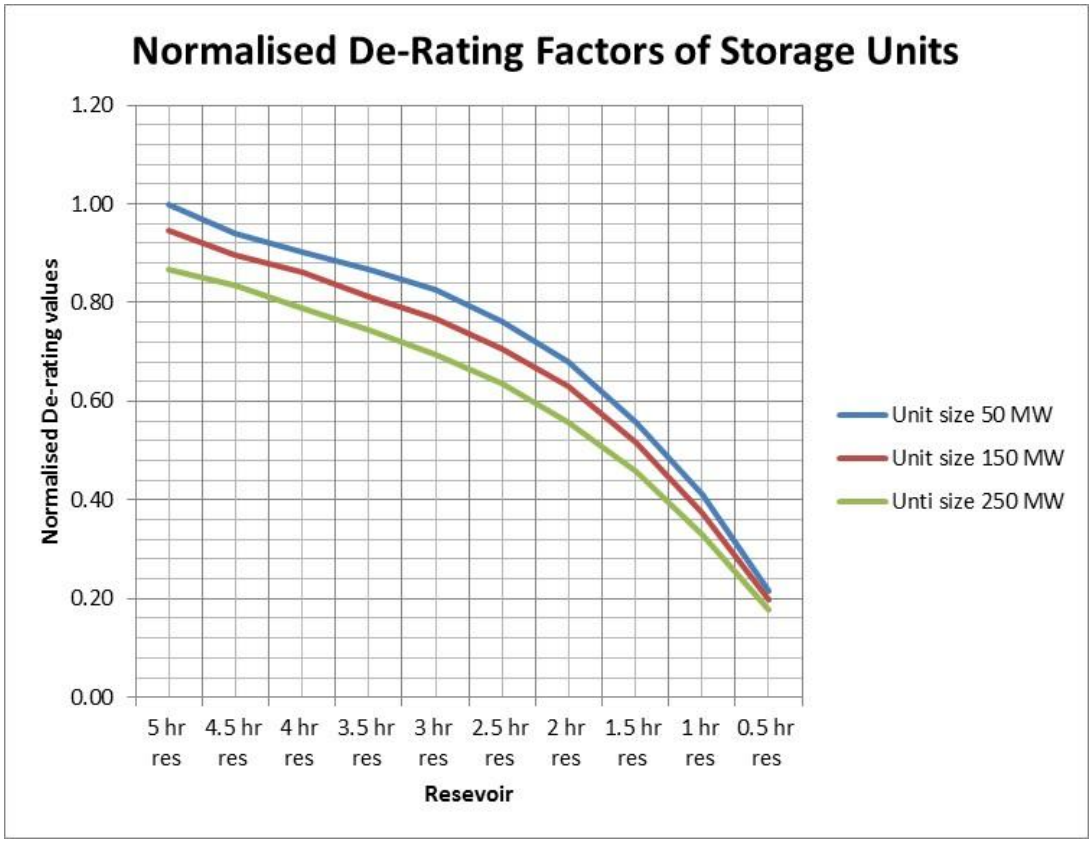
3.4.44 The consultation paper contained only a brief description of the de-rating approach taken for storage units and noted that further work was needed. It provided a methodology and de-rating factor for the existing storage on the system, but no way to generalise this to cover new storage capacity.

3.4.45 The capacity contribution of a new storage unit will depend on the size of the reservoir, i.e. for how many hours it can provide capacity, and the volume of storage on the system. As the volume of storage increases, its incremental contribution to reducing LoLE declines as the demand peak is increasingly flattened and the ability to refill the reservoir without raising LoLE in off-peak hours declines.

3.4.46 As for other technologies, the additional demand that could be served by adding a notional storage unit was determined. Unlike for other technology classes, this analysis was performed both for different sizes of unit (e.g. 100, 200 and 300MW) but also for different reservoir sizes, measured in hours of deliverability at maximum capacity. A cycle efficiency of 70% was assumed for this analysis.

3.4.47 This analysis was used to determine factors (storage-duration factors) which describe how the de-rating for a unit would vary with unit size and reservoir size. The larger the unit and smaller the reservoir, the smaller the factor. Figure 7 illustrates a set of storage-duration factor curves showing how the de-rating factor varies with reservoir size (measured in hours of production at full load). Each curve representing a unit of a different size.

Figure 7: Storage Duration Factor Curves



3.4.48 These storage-duration factors will then be applied to the "reference" de-rating factor derived for the existing storage capacity to generate de-rating curves for potential storage capacity.

3.4.49 The SEM Committee recognises that the storage methodology set out in 3.4.44 to 3.4.48 is not perfect. In particular, offering a 10 year reliability option to a new storage unit locks in the de-rating factor for the whole period. If more storage capacity is subsequently built in the I-SEM, this locked in factor will over-estimate the actual contribution being made by the unit. This situation is unavoidable given the need to offer stable, long-term reliability options to make new capacity financeable.

3.4.50 The "reference" de-rating factor is based on the existing pumped storage capacity on the system and the outage characteristics of such capacity. New storage capacity, e.g. CAES or battery, may have different outage characteristics from a pumped storage plant but there is very limited historic data available to reliably establish such outage characteristics. As for other new technology categories, other storage technologies will initially be assumed to have the outage characteristics of the System-wide technology class but, over time, it may become appropriate to create separate Technology Classes for specific storage technologies. The "reference" de-rating factor to which the storage-duration factors will be applied will use these System-wide outage characteristics for new storage technologies.

3.4.51 The SEM Committee recognises that the methodology laid out in this section is a significant elaboration of the one laid out in the consultation paper. The SEM Committee has decided that this methodology will be used for the first transitional auction. Given the long lead times for installation of new storage capacity and the current capacity surplus, this auction is not expected to yield significant volumes of new storage capacity. Prior to the first subsequent auction, the methodology will be consulted on as part of the broader consultation carried out prior to each capacity auction as set out in 2.4.2.

3.4.52 Autoproducer units have an associated Trading Site Supplier Unit (TSSU) and this was not directly considered in the consultation. For some autoproducers, it will never make economic sense to reduce consumption by the TSSU and such a site can only deliver capacity from its Generator Units. For other autoproducers, there may be a price at which it is economically sensible to reduce consumption by the TSSU at times of system stress as well as delivering capacity from their Generator Units.

3.4.53 The SEM Committee has decided that autoproducer units should be de-rated on the basis of their Maximum Export Capacity (MEC). However, for some units there will be a difference between:

i their MEC; and

ii the total Registered Capacity of their units less their Maximum Import Capacity.

There may be a need to bid this capacity above MEC at a price higher than the Existing Capacity Price Cap to ensure that it is not awarded a Reliability Option and so expected to reduce consumption uneconomically. The SEM Committee recognises this need, but in

applying to bid above the Existing Capacity Price Cap for this capacity, an autoproducer will need to provide evidence to support the need for a higher cap.

3.4.54 Dual-rated units were not explicitly mentioned in the consultation, but a question about their treatment was raised at the Rules Working Group.

3.4.55 The SEM Committee has decided that dual-rated units should be de-rated on the basis of the maximum capacity they can deliver using either fuel. However, for some units there will be a significant cost involved in switching from the lower capacity fuel to the higher capacity fuel to deliver the full de-rated capacity of the unit. These costs may exceed the Existing Capacity Price Cap.

3.4.56 The SEM Committee recognises this need, but in applying to bid above the Existing Capacity Price Cap for this capacity, a dual-rated unit will need to provide evidence to support the need for a higher cap.

Interconnector De-Rating Factor Methodology

3.4.57 The consultation paper set out a methodology to be used to determine interconnector de-rating in line with the decision laid out in CRM 2 (SEM-16-022) to use historic data unaffected by changes to the market in both the SEM and GB. The SEM Committee remains unconvinced that analysis of historic price and flows or fundamental modelling offer a sensible route for modelling interconnectors between the SEM and GB at this time. In future, once data on relevant outcomes from the I-SEM and GB (including the impact of its capacity market) are available, then this position may be revisited.

3.4.58 Since the dataset used for the consultation paper was fixed, National Grid has issued a new set of Future Energy Scenarios (FES). This 2016 FES show a substantial shift from the 2015 FES and, in particular, a major reduction in conventional, transmission-connected generation and in most scenarios an increased dependence on renewable and embedded generation. These scenarios show substantially greater tightening of GB margins, especially in 2020 and 2021.

3.4.59 Given these changes to GB, the use of transmission-connected demand and generation in the consultation paper is no longer appropriate. The methodology has been updated to model the demand served by both transmission and distribution- connected generation in GB. This increased the correlation between SEM and GB daily peak demand to around 95%.

3.4.60 The switch to modelling all demand, required modelling of production from embedded solar generation which in turn required the methodology to switch from a Monte Carlo simulation of winter days to a month-based approach to capture the variation in solar profiles across the winter. This approach would apply more generally to any external market where the volume of installed solar capacity was material.

3.4.61 As the consultation paper identified, the strongest driver of interconnector de-rating was the capacity margin in GB. As a result, the updated interconnector methodology set out in

Appendix 2 includes results for all four of the 2016 FES scenarios. In general, the RAs should consider a broad range of potential scenarios for external markets when determining the de-rating to be applied to interconnectors.

3.4.62 Unlike in the SEM, the RAs have no influence on the availability of data or the range of scenarios available for external markets and so the basic interconnector methodology may need to be adapted from time-to-time. Any such necessary changes would be set out in the consultation process described in 2.4.2.

3.4.63 The consultation paper considered coincident scarcity in GB and the I-SEM, taking account of the correlation between both demand and wind in the two markets. It also considered that scarcity in GB would lead to the interconnectors exporting from the I-SEM to GB. The consultation paper took the very conservative view that at such times the interconnectors would be exporting at maximum capacity (i.e. 950MW) from the I-SEM to GB. Given the export limitations on Moyle that exist within the GB system, the current situation where the total export from I-SEM is limited to 580MW is included in Appendix 2.

3.4.64 The SEM Committee recognises that the GB market has recently seen prices in both the DAM and BM significantly above the expected level of the RO strike price in the I-SEM. Some of this is clearly driven by the more than 4GW of capacity contracted in the Supplemental Balancing Reserve which cannot participate in the market. The Supplemental Balancing Reserve will cease once the GB capacity market goes live in 2017/8 and this capacity will either close or participate in the market.

3.4.65 The methodology set out in the consultation paper identifies scarcity in GB if the available capacity is unable to meet the sum of demand and operating reserve. During the DAM and IDM, generation only needs to satisfy demand: so, under the methodology, scarcity is considered to exist in GB even if demand is some 3GW less than the available capacity. This "buffer" means that the methodology is already taking a conservative view of the risks of scarcity in GB which should capture those times when GB prices rise above the RO strike price. The SEM Committee is not convinced that any change is required to the methodology in response to recent high GB prices.

3.4.66 The SEM Committee recognises that at I-SEM go live and prior to implementation of XBID, the trading opportunities over the interconnectors during the Intraday Market will be limited. They also recognise that trading across the interconnector in the Balancing Market is limited to SO-SO trades.

3.4.67 The Interconnector Operating Protocols (IOPs) explicitly recognise the need for the GB and SEM systems to provide mutual support at those times when one of the systems is anticipating difficulty in meeting demand or maintaining security on the transmission system. These circumstances are a very good match to the conditions that would trigger administered scarcity in the I-SEM. The only grounds for refusing such support are issues with meeting demand or maintaining security on the supporting system, i.e. when there is coincident scarcity.

3.4.68 The SEM Committee believes that given the mutual assistance requirements in the IOPs, that the proposed interconnector methodology effectively captures the contribution of the interconnector at times of scarcity in the I-SEM, including when there is coincident scarcity in GB.

3.4.69 Prices in the I-SEM above the RO strike price without administered scarcity should, by design, be very rare events. In addition to the mutual support at times of scarcity, the IOPs also allow for a further 400MW of SO-SO trading to occur using prices bid at 17:00 on the day before trading. The SEM Committee takes the view that this trading, coupled with the limited opportunities available in the IDM, should be sufficient to ensure that the consulted methodology captures the availability of the interconnector to deliver energy from GB to the I-SEM at times when difference payments are due.

3.4.70 The proposed methodology used the capacity contracted by the CRM, via the Capacity Requirement, as the measure of the installed capacity in the I-SEM which drives the simulation of scarcity events. This is consistent with the approach of using Capacity Adequate Portfolios based on the 8 hours LoLE standard to determine the Capacity Requirement and de-rating curves in the general methodology. The analysis carried our as part of CRM Decision 1 indicates that increasing the SEM capacity by less than 250MW altered the security standard to 3 hours of LoLE. A very similar result was obtained from more recent and detailed modelling carried out for the Parameters Consultation paper.

3.4.71 The SEM Committee does not believe that determining the de-rated curves for the interconnectors on the basis of a different security standard to that used for all other capacity meets the principle of equity. The importance of consistent treatment is reinforced by the objective, set out in CRM Decision 2, of moving to a hybrid solution for interconnector participation whereby generator units in external markets will be able to participate in the CRM.

3.4.72 As the historic data illustrates, interconnectors do have occasional outages that last for a significant period, multiple months. To capture these longer outages, it is important that a long historic time base is considered and, in particular, that outages are averaged across the whole technology class so that the limited historical performance of a single new or relatively new interconnector does not skew its de-rating factor to be either excessively optimistic or pessimistic. It is worth noting that the indicative forced outage rates determined for the interconnector technology class are broadly in line with the assumptions ENTSO-E are planning to use for HVDC interconnectors as set out in its recent Medium-term Adequacy Forecasting consultation.

3.4.73 As set-out in 3.4.21 above, the SEM Committee has decided that the determination of outage rates for the interconnectors will be based on the most recent 10 years of historic data. For the avoidance of doubt, this will include all outages for which data is available up

to the time of determination. Updated calculations of the outage rates on this 10 year basis are included in Appendix 2[3].

3.4.74 The SEM Committee recognises that the Moyle interconnector is made up of two poles and that outages on these poles are largely independent. For a lower marginal de-rating to be applied through the general methodology, the two poles would need to participate in the CRM as separate units. This is consistent with the treatment of CCGT units with multiple gas turbines. Based on current participation, no change to the methodology is required.

3.4.75 The SEM Committee further recognises that failure of the interconnector has the same impact on the market as failure of a generating unit of the same size. Consequently, the marginal de-rating for an interconnector should be based on its Aggregate Import Capacity (the analogue for Registered Capacity or MEC in a generating unit) and not the Effective Interconnector Capacity. For any new interconnector the proposed Aggregate Import Capacity should be used.

3.4.76 The consultation paper gave specific de-rating factors to be applied to each of the existing interconnectors. The methodology needs to be robust to accommodate proposed new interconnectors and so the methodology should produce full de-rating curves for the interconnector Technology Class. Given this need, the concept of Effective Interconnector Capacity will be determined by applying a de-rating factor that applies to each external market, e.g. GB, France. This factor (the External Market De-rating Factor) will recognise the de-rating arising from the issue of coincident scarcity and the non-outage related ability of the interconnector to deliver power from the external market. The product of the Aggregate Import Capacity for an interconnector and the External Market De-rating Factor for the associated market will be the same as the Effective Interconnector Capacity used in the consultation paper.

3.4.77 Given the above, particularly the substantial shift in the latest available GB Future Energy Scenarios (2016 FES) showing a major reduction in generation, the interconnector de-rating factor is reduced quite substantially to reflect a lower probability that capacity will be able to import from GB at times of scarcity in the I-SEM.

3.4.78 Given the most likely outcomes in GB in the period to 2021, the SEM Committee has decided to use a de-rating factor that reflects a balance between the No Progression scenario with full export capability to GB and the Slow Progression scenario with restrictions on Moyle export to GB. Based on the indicative results presented in this appendix, this would be a de-rating factor of 50% for 2021. This value would be consistent with the values currently being used by GB for the de-rating of flows from the I-SEM to GB.

[3] These indicative calculation do not capture the current EWIC outage, but the final determinations will have access to more data and will capture the historic extent of the outage at that time.

3.5 SEM COMMITTEE DECISIONS

3.5.1 The SEM Committee has decided that the Capacity Requirement and De-Rating methodology will be as set out in the consultation paper with the following changes:

- Operating reserve will not initially be included in the Capacity Requirement;
- Outage rates for Technology Classes with very few units, currently storage and interconnectors, will be determined using the last 10 complete years of history, rather than the 5 years used more generally;
- The de-rated capacity of an AGU will be determined as the sum of the de-rated capacity of the Generators which make up the AGU;
- DSUs will be de-rated on the basis of the System-Wide De-rating Curve, but will be permitted a negative tolerance to qualify below this level. This level will be set based on historic DSU availability, but adjusted for the changes to the I-SEM. The qualification level will need to be evidenced in the qualification process under the CMC;
- The SEM Committee has decided that any capacity already awarded a Reliability Option for a Capacity Year should be fixed in all Capacity Adequate Portfolios for that year;
- The SEM Committee has decided that for any technology classes where outages are highly correlated between units (currently wind and solar), the de-rating factor should be set on the basis of the whole class, rather than individual units. Initially this will apply to the wind and solar classes;
- The de-rating curve for storage units for the first transitional auction will be based on a reference de-rating factor derived from existing storage capacity and a set of storage-duration curves. These curves will be determined by analysing the additional demand which can be served by storage units of a range of MW sizes and reservoir capacities. The reference de-rating factor used for new storage technologies (i.e. other than pumped storage) will use the outage characteristics of the System-wide Technology Class;
- The methodology for storage units will be consulted as part of the broader consultation prior to the first auction after the first transitional auction;
- Autoproducer units will be de-rated from their MEC. For capacity which can only be delivered by demand reduction, autoproducer units will be able to bid above the Existing Capacity Price Cap, subject to RA approval. Such approval will be based on evidence provided by the Participant prior to qualification in line with the rules laid out for the Unit Specific Offer Cap in the CMC;
- Dual-rated units will be de-rated on the basis of the higher of their two capacities. For capacity above the lower of the two capacities, dual-rated units will be able to bid above the Existing Capacity Price Cap, subject to RA approval. Such approval will be based on evidence provided by the Participant prior to qualification in line with the rules laid out for the Unit Specific Offer Cap in the CMC;
- De-rating of interconnectors will be based on their Aggregate Import Capacity;
- Demand and wind profiles and the least-worst regrets analysis will be at the half-hourly level;
- De-rating curves should be produced for the interconnector and solar Technology Classes;

- An External Market De-rating Factor will be determined for each external market linked by an existing or proposed interconnector. This will represent the deliverability of capacity from that market to the I-SEM at times of scarcity excluding the impact of interconnector outage;
- Determine outage rates for interconnectors based on the most recent 10 years of historic data; and
- The determination of coincident scarcity in the I-SEM and an external market will be modelled on the basis of the demand served from both transmission and distribution connected generation for that market. The RAs will consider a broad range of scenarios for the external market when coming to a view as to the appropriate level of interconnector de-rating.

3.5.2 The SEM Committee has decided that any decision on the inclusion of a measure of reserve within the Capacity Requirement requires further evidence.

3.5.3 The amended methodologies are set out in Appendices 1 and 2 to this Decision, or will be incorporated into the CMC where appropriate. In the event of disagreement between the appendices and this Decision, the Decision will take priority.

3.5.4 The Regulatory Authorities may choose to adjust the capacity requirement used in the auction from the de-rated capacity requirement determined in accordance with this decision for a number of reasons, including (but not limited to) non-bidding capacity, de-rating factor tolerance bands and expected failure to deliver capacity.

3.5.5 The Regulatory Authorities will verify that the interconnectors have been correctly input into the TSOs De-Rating Methodology and that the de-rating factors have been determined in accordance with the published methodology and any associated agreed procedures.

3.6 NEXT STEPS

3.6.1 In advance of the first enduring capacity auction, the TSOs will prepare a paper justifying the inclusion of some measure of reserve within the Capacity Requirement. On the basis of this paper the SEM Committee will decide on whether reserve should be included within the Capacity Requirement.

3.6.2 If the SEM Committee decides that some measure of reserve should be included within the Capacity Requirement then the level and detailed justification of such reserve inclusion will be appropriately consulted upon prior to the relevant capacity auction. This consultation is expected to form part of the broader consultation on the level of the Capacity Requirement for the relevant auction.

3.7 TECHNOLOGY CATEGORY TABLE DECISION

The Technology Classes for the first transitional auction are given in the table below:

Table 6: Initial Technology Classes

Technology Class	Units included
Gas turbine	All units with gas turbine as prime mover, i.e. OCGT, CCGT and GT-based CHP
Steam Turbine	All units with a steam turbine as prime mover, i.e. coal, oil and peat fired units
Hydro	All hydro units
Pumped Storage	All pumped storage units
Other storage	All other storage units, e.g. CAES, battery
Wind	All wind units
Solar	All solar units
DSU	All DSU

4. TOLERANCE BANDS

4.1 INTRODUCTION

4.1.1 CRM Decision 1 allowed for the possibility of tolerance bands to be applied to the unit-level De-Rating Factors determined for capacity providers. These tolerance bands would allow some flexibility in the level of participation required from dispatchable plant in the RO auction.

4.1.2 The decision required that these bands should be both tight and should only be sufficient to cover "legitimate technical variation in the relevant plant".

4.2 CONSULTATION SUMMARY

4.2.1 The technology groupings proposed by the TSOs for determination of De-Rating Factors were such that the "legitimate technical variation" between plant within each grouping was very limited.

4.2.2 The Demand Side Unit (DSU) technology grouping does contain units with substantially different technical characteristics, but such capacity is not required to participate in capacity auctions. This means that the lack of a tolerance band will not lead to exposure of DSUs to unmanageable difference payments.

4.2.3 It could be argued that there is legitimate technical variation between single and multi-shaft gas turbine plant. Under the SEM, each "shaft" of each of the multi-shaft gas turbine plant participates in its own right and it is assumed that this behaviour will carry over into the I-SEM. As a result, there does not seem to be a requirement for a tolerance band to be applied to cover this variation.

4.2.4 On the basis of the above discussion, the SEM Committee was **minded-to** set the tolerance bands to +0%, -0% at I-SEM go-live. The intention would be to keep this decision under review.

4.3 SUMMARY OF RESPONSES

4.3.1 Of those who responded on tolerance bands all but two did not agree with the SEM Committee's minded to position to set a zero tolerance band.

4.3.2 Most considered tolerance bands important to reflect plant differences within the technology groupings. Some referred to the lack of evidence to justify such a minded-to position and that it was not clear what is meant by "legitimate technical variation". Furthermore, there was a strong view that zero tolerance bands do not reflect the intention of CRM decision 1 to have tolerance bands.

4.3.3 Tolerance bands, other than zero, would provide market participants flexibility at times of high delivery concern, and that market participants would have a better understanding of delivery risk.

4.3.4 Specific to DSUs a non-zero tolerance band was viewed appropriate to reflect the discrepancy between the forced outage rate for DSUs and the indicative values of the DSU AGU group, and proposed ±10%.

4.3.5 A respondent in support of a zero-tolerance band considered flexible PQ pairs as an alternative. To the extent that parties want to reflect the risk of having a de-rating factor below that of the marginal de-rating factor for the technology type, they can do so through the flexible PQ pairs they submit to the CRM auction.

4.4 SEM COMMITTEE RESPONSE

4.4.1 The outage data analysed to establish the Technology Classes show unit outages generally tightly clustered around the proposed rates. In general, units which ran very few hours did show lower outage rates consistent with their limited running. As the current surplus in the SEM decline, such units would be expected to run more frequently and their outage rates to converge with the Technology Class value. A small number of units had markedly higher outage rates than would be expected but the SEM Committee does not want the presence of a negative tolerance band to delay the exit of unreliable capacity.

4.4.2 Other than as caused by variations in running hours, there was no clear separation in outage rates for open and closed cycle gas turbine units nor between solid- and liquid- fuelled steam turbine plant. However, it is possible that for specific units such technical variation from the Technology Class average may exist.

4.4.3 The change in delivery incentives as the market moves from the CPM to the CRM is expected to alter future outage behaviour.

4.4.4 Use of tolerance bands around the base de-rated capacity for a unit largely affects its exposure to difference payments at times of failure. A less reliable unit may wish to reduce its de-rated capacity to manage its expected exposure (i.e. its delivery risk): however, given the CRM 1 Decision (SEM-15-103) to make the tolerance bands tight, this ability is constrained. A more reliable unit may wish to recognise this reliability and contract for a larger volume of de-rated capacity.

4.4.5 Reducing a unit's de-rated capacity reduces its exposure to uncovered difference payments, but at the cost of a reduction in its annual option fee. Increasing a unit's de-rated capacity has the reverse effect, i.e. increasing the annual option fee but at the cost of increased exposure to uncovered difference payments.

4.4.6 The decision to make use of any flexibility in de-rated capacity provided by a tolerance band will depend not only on the perceived reliability of a unit but also on the balance of the risks laid out in 4.4.5. This balance or risks is dependent on both the level of Full Administered Scarcity Price (FASP) and the expected clearing price in the capacity auction.

4.4.7 From CRM Decision 3 (SEM-16-039), FASP will be set to 3000€/MWh for the transitional T-1 auctions. This level, coupled with the analysis of Net Going Forward Costs set out in the CRM

Parameters Consultation Paper (SEM-16-073), means that balance of risk between the level of annual option fee and exposure to uncovered difference payments is likely to be dominated by the annual option fee for less reliable capacity. Any loss in annual option fee from using the negative tolerance band will exceed the potential reduction in uncovered difference payments. For more reliable capacity, the gain in additional option fee payments from using any positive tolerance band will exceed any potential increase in uncovered difference payments.

4.4.8 The position set out in 4.4.7 means that if tolerance bands were used in the transitional auctions, there would be an incentive for all capacity to offer into the capacity auction making use of the positive tolerance band independent of its reliability. This skewed offering of capacity undermines the basis of the Capacity Requirement and would weaken the security standard and the hedge provided to consumers.

4.4.9 Additionally, with no experience of the operating of the CRM capacity auctions to draw upon there are practical barriers to setting an appropriate level for the tolerance bands for the first transitional auction.

4.4.10 The SEM Committee has decided that the tolerance bands should be set to zero for the transitional auctions. This position will be reviewed for the enduring auctions once the enduring value of FASP has been determined and when there will be experience from the transitional auctions available to support the setting of appropriate levels for the tolerance bands.

4.4.11 The one exception to the general consistency in outage rates across Technology Classes was for DSU. The SEM Committee have recognised this in allowing a negative tolerance to be applied to DSU as set out in paragraph 3.5.1.

4.5 SEM COMMITTEE DECISIONS

4.5.1 The SEM Committee has decided that, with the exception of DSU, the tolerance bands will be set to zero for the transitional auctions. This decision will be reviewed for the enduring auctions once the enduring value of FASP has been determined.

5. NEXT STEPS

5.1.1 The relevant portions of this Decision will be elaborated in the Capacity Market Code which is currently going through the Rules Working Group process.

5.1.2 The values for the Capacity Requirement and each of the De-rating Curves to be used in the first transitional auction will be published to a timetable consistent with the Qualification process. The enduring process and timelines are expected to be set out in the Capacity Market Code. It is anticipated that these determinations will include historic data from 2016.

5.1.3 The methodology for storage units will be consulted as part of the broader consultation prior to the first auction after the first transitional auction.

5.1.4 After the CRM transitional period and once the CRM auction moves to its enduring solution, the SEM Committee, following justification being received from the TSOs, intend to review the need and level of operating reserves when deciding upon the annual capacity requirement.

5.1.5 Furthermore, CRM parameters are currently being consulted on and due to close on 21 December 2016. A decision on these is expected in March 2017.

5.1.6 All the above papers will be published on the SEM Committee website:

www.semcommittee.com

6. ACRONYMS

ACPS	Annual Capacity Payment Sum
AGU	Aggregated Generator Unit
BNE	Best New Entrant
CACM	Capacity Allocation and Congestion Management
CCGT	Combined Cycle Gas Turbine
CMC	Capacity Market Code
CMU	Capacity Market Unit
CPM	Capacity Payments Mechanism
CRM	Capacity Remuneration Mechanism
DCCAE	Department of Communications, Climate Action & Environment
DECC	Department of Energy and Climate Change
DfE	Department for the Economy
DSR	Demand Side Response
DSU	Demand Side Unit
EC	European Commission
EEAG	The Environmental and Energy State Aid Guidelines
ENTSO-E	European Network of Transmission System Operators – Electricity
EU	European Union
FASP	Full Administered Scarcity Price
FES	NGC's Future Energy Scenarios
FOR	Forced Outage Rate
GB	Great Britain
GB CM	Great Britain Capacity Market
HLD	High Level Design
IED	Industrial Emissions Directive
I-SEM	Integrated Single Electricity Market
LoLE	Loss of Load Expectation
LOLP	Loss of Load Probability
MEC	Maximum Export Capacity
MRP	Market Reference Price
MW	Megawatt
MWh	Megawatt hour
NetCONE	Net Cost of New Entry
NG	National Grid
OCGT	Open Cycle Gas Turbine
RAs	Regulatory Authorities
SEM	Single Electricity Market
SCR	Suppliers Contribution Rate
TSC	Trading and Settlement Code
TSOs	Transmission System Operators
VoLL	Value of Load Load
VTOD	Validation Technical Offer Data