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De-rating factor methodology for conventional embedded generation technologies

Industry Consultation | 20 January 2022

Context

National Grid ESO in its role as the Electricity Market Reform (EMR) Delivery Body is required to calculate a de-rating factor for each generating technology to participate in the Capacity Market[1]. For conventional generation technologies, the de-rating factors are based on the "Technology Class Weighted Average Availability" (TCWAA) methodology prescribed in the Capacity Market Rules[2]. This approach uses Maximum Export Limit (MEL) values from each Balancing Mechanism (BM) Unit during the winter peak period to calculate an average availability for each generating technology over the seven previous winters. This approach means that data predominantly from transmission-connected generation is used to determine de-rating factors for *all* conventional generating technologies

There are some conventional generating technologies where most, if not all, of the Capacity Market Units (CMUs) are embedded in the distribution network (e.g. reciprocating engines). In such cases, we don't have available data to calculate the de-rating factors directly and there is an assumption that the de-rating factors for these technologies can be represented by one of the transmission generation technologies, which may not be entirely appropriate.

BEIS' Panel of Technical Experts (PTE) included a recommendation in their 2020 report that National Grid ESO should consider reviewing de-rating factors for some embedded generation technologies as new data becomes available[3]. National Grid ESO have now undertaken an assessment in response to this recommendation, building on the work we previously published in July 2021, and believe that an alternative methodology may be more effective for some embedded generating technologies[4]. The EMR Delivery Body is required to consult with industry on these potential changes[5]. We have already engaged with BEIS, Ofgem and BEIS' PTE who are supportive of this consultation.

The scope of this consultation is around the input assumptions to the modelling and the methodology to calculate de-rating factors for reciprocating engines and energy from waste generating technologies. We are not currently consulting on changes to any other technology. Subject to the outcome of this consultation, the changes would be implemented in our modelling for the 2022 Electricity Capacity Report and apply to Capacity Market auctions that occur thereafter. This means that these changes would not apply to the upcoming T-1 or T-4 Auctions due to be held in February 2022. In addition, these changes would not apply retrospectively to Capacity Market agreements that have already been awarded. Subject to the outcome of this consultation, further consultations relating to how any alternative methodology will be written into the Capacity Market Rules would need to be taken forward by BEIS and / or Ofgem at a later date. Questions relating to policy are out of scope for this particular consultation as this is not within our remit.

To support this consultation, we are intending to hold a webinar at 13:00 on 1 February 2022 to go through these changes and provide an opportunity for industry stakeholders to ask questions. Registration details for the webinar are available on the EMR Delivery Body website.

We welcome your views and feedback on the modelling that will help inform the final outcome, which could either be to implement a change or to retain the existing methodology. Responses to the consultation are requested by 17:00 on 17 February 2022.

[1] Rule 2.3.1(a) of the Capacity Market rules https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1018180/capacity-market-rules-consolidation-2021.pdf
[2] Rule 2.3.5 of the Capacity Market rules https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1018180/capacity-market-rules-consolidation-2021.pdf
[3] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/900062/panel-technical-experts-report-on-2020-electricity-capacity-report.pdf
[4] https://www.emrdeliverybody.com/Capacity%20Markets%20Document%20Library/De-Rating%20Factor%20Methods%20for%20Embedded%20Generation.pdf
[5] Rule 2.3.8 of the Capacity Market rules https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1018180/capacity-market-rules-consolidation-2021.pdf

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Please send responses via email to: emrmodelling@nationalgrideso.com. We will publish a response to this consultation by 11 March 2022 on the EMR Delivery Body website.

Questions for consideration

1. Are the new data sources appropriate for calculating de-rating factors for the specified embedded generation technologies? If not, what data sources would be appropriate and how could these be made available to National Grid ESO?
2. Is it appropriate to assume that metered output can be used to represent availability of a CMU given the time periods included within the calculation (i.e. do these time periods represent periods we would reasonably expect these units to be generating if they were available)?
3. Is the shorter history of 3 years appropriate as the basis for the alternative de-rating factor methodology or do we need to consider a longer history (e.g. 7 years) to increase the robustness of the methodology?
4. Is it appropriate to only use gas units in the de-rating factor calculation for reciprocating engines or should both gas and diesel be included?
5. Is it appropriate to include STOR units in the de-rating factor calculation and assume they are fully available on the basis that they receive availability payments? Is it more appropriate to include STOR units on this basis or exclude them from the calculation?
6. Is it more appropriate to focus on high peak demand or high price days in any new de-rating factor methology?
7. Is this alternative method more effective than the existing method, which assumes these embedded generation technologies can be represented by one of the transmission generation technologies? If not, why?
8. Are there any other considerations that could limit the effectiveness of this alternative methodology? If so, what could they be and what impact would they have?

Stakeholder engagement

In addition to this consultation, we have engaged with BEIS, Ofgem and BEIS' PTE, who are supportive of us conducting this consultation. We published a view of our developing analysis in July 2021, inviting feedback from industry stakeholders and stating our intention to further enhance this modelling, signposting the potential for an industry consultation in Q4 2021/22[6]. We have also worked closely with the Distribution Network Operators (DNOs) to improve the quality of the data sources used in our modelling.

Data sources

The two data sources that we have used to carry out this modelling are:

1. Embedded capacity registers published by DNOs[7]
2. Half-hourly time series of metered generation output data National Grid ESO procured through a bilateral contract with Electralink

The embedded capacity registers provide details of the assets connected to each distribution network. They are published monthly by each DNO in response to a Distribution Connection and Use of System Agreement (DCUSA) Change Proposal referred to as DCP350 that was approved in July 2020[8]. The asset registers provide key information including technology type and generating capacity of assets connected to the distribution networks. Crucially, the embedded capacity registers include Meter Point Administration Numbers (MPANs).

[6] https://www.emrdeliverybody.com/Capacity%20Markets%20Document%20Library/De-Rating%20Factor%20Methods%20for%20Embedded%20Generation.pdf
[7] These are published on each DNO website separately
[8] https://www.dcusa.co.uk/change/creation-of-embedded-capacity-registers/

This allows us to uniquely identify the assets and therefore, generating technologies that are responsible for the metered output in the Electralink data.

The Electralink data consists of half-hourly metered generation output for individual generating units. We have a full data set for winters 2016/17 and 2018/19 -2020/21. We have a partial data set for 2017/18. The Electralink data does not contain any additional asset information. Units are only identified by their MPAN.

Table 1 shows the number of units and installed capacity for reciprocating engines and energy from waste generating technologies included in the Embedded Capacity Registers. It also shows the number of units and installed capacity that we have been able to successfully match to the metered output in the Electralink data set. Although reciprocating engines are a single technology class within the Capacity Market, for the purposes of this work, we have separated out diesel and gas, as we believe the additional insight may help inform the outcome of this consultation. We believe that we should be able to use this data set to calculate de-rating factors that are representative of the generating technology class.

Table 1: Summary of data included in our modelling.

Technology	Number of sites on the Embedded Capacity Registers with MPAN	Installed capacity of sites on the Embedded Capacity Registers with MPAN (MW)	Number of sites that have been successfully matched in the Electralink data	Installed capacity of sites that have been successfully matched in the Electralink data (MW)	% sites matched	% capacity matched
Reciprocating engine - diesel	138	990	105	837	76.1%	84.6%
Reciprocating engine - gas	147	1,801	119	1,511	81.0%	83.9%
Energy from waste	136	1,664	123	1,464	90.4%	88.0%

1. Are the new data sources appropriate for calculating de-rating factors for the specified embedded generation technologies? If not, what data sources would be appropriate and how could these be made available to National Grid ESO?

Alternative De-rating Factor method

De-rating factors for conventional generating technologies are calculated based on the TCWAA methodology prescribed in the CM Rules. The intention behind this methodology is to calculate de-rating factors based on the availability of generating units at times of highest demand (i.e. when they will most likely be needed to prevent loss of load for consumers). In considering alternative de-rating factor methods for reciprocating engines and energy from waste, we think it is also important to reflect this intention. Therefore, the approach we have taken is to start on the same basis as the existing methodology that provides some consistency, making adjustments when appropriate, to reflect we are using metered output data to represent the availability of the generating units. This last point is important since it is possible that a unit may be available but not generating. Given that we don't have a data set of MEL values for these units, we have tried to identify periods during which we may reasonably expect these units to be generating, such that we can use a generating unit's metered output to represent its availability. We discussed this in the developing analysis published in July 2021[9].

[9] https://www.emrdeliverybody.com/Capacity%20Markets%20Document%20Library/De-Rating%20Factor%20Methods%20for%20Embedded%20Generation.pdf

2. Is it appropriate to assume that metered output can be used to represent availability of a CMU given the time periods included within the calculation (i.e. do these time periods represent periods we would reasonably expect these units to be generating if they were available)?

We have considered a winter peak period that includes periods within the range Dec - Feb, Mon - Fri, 17:00 - 19:00 on days where the daily peak demand is in the top 10% of daily peak demands for the winter. This is similar to that used in the TCWAA methodology with the main difference being the restricted time period covering the evening peak rather than the longer period of 07:00 - 19:00. We think this is appropriate because our data set uses metered output and reciprocating engines are unlikely to generate for the full day. Only including days where the daily peak demand is in the top 10% of daily peak demands for the winter rather than the top 50% is consistent with the approach currently used for CCGTs. This was justified for CCGTs to mitigate the impact of economically driven outages. We think a similar approach is appropriate here, particularly as we are using metered output data. This means that we are only considering data covering the evening peak on around 12 days each winter. One further difference is that the TCWAA de-rating factor methodology for generating technology classes considers an average over the last 7 winter peak periods. As we have a shorter history of metered output data, we are proposing a shorter history of 3 years. The shorter history is also consistent with the period we use to calculate breakdown rates in our operational modelling in our Winter Outlook Report[10].

3. Is the shorter history of 3 years appropriate as the basis for the alternative de-rating factor methodology or do we need to consider a longer history (e.g. 7 years) to increase the robustness of the methodology?

In the TCWAA methodology, the availability is calculated using the average of all MEL values from BM Units in the winter peak period. We could adopt a similar approach here, averaging all metered output values within the period instead. However, inspection of the data shows that there are many examples where these units don't generate for the full two-hour period over the evening peak. Therefore, we think it is appropriate to apply another adjustment. If a generating unit has a non-zero output on any given day during the winter peak period under consideration (i.e. Dec - Feb, Mon - Fri, 17:00 - 19:00 on days where the daily peak demand is in the top 10% of daily peak demands for the winter) then we assume it is available at its maximum capacity for all periods on that day. We consider the maximum capacity to be the 95th percentile of all half-hourly metered output values over the winter, which is analogous to the TCWAA methodology that uses the 95th percentile of all MEL values. We can then calculate a capacity-weighted average availability for this technology over the winter, with the de-rating factor calculated by repeating this process over three winters and taking an average. This is illustrated in the worked example in the Annex.

There is one other consideration that we believe is appropriate for this methodology. In undertaking this analysis, we identified a number of units that have short-term operating reserve (STOR) contracts. These units receive payments to be available but may not necessarily be generating. Therefore, we believe it may be appropriate to exclude these units from the de-rating factor calculation.

Table 2 shows indicative de-rating factors for reciprocating engines and energy from waste technologies using this alternative methodology based on the embedded generation data[11]. The current Capacity Market de-rating factors for reciprocating engines and energy from waste are based on the TCWAA methodologies for transmission-connected Open Cycle Gas Turbines (OCGTs) and biomass, respectively.

[10] https://www.nationalgrideso.com/research-publications/winter-outlook

[11] Note that we have only included 2 winters in the indicative de-rating values presented here. While we have Electralink data from 2016/17, the Electralink data comprises two distinct data sets. The first data set covering 2016/17 to 2018/19 is a stand-alone data set that isn't integrated in our systems. The second data set covering 2019/20 onwards is a live stream that is integrated in our systems. Subject to the outcome of this consultation, we would work with this latter data set only. Using a three-year history would also include winter 2021/22, which is currently unavailable for us to use in our modelling as the winter hasn't finished. Given the additional complexities of merging data sets and our intention not to use the stand-alone data set should we decide to implement a change, we considered it was reasonable to show indicative results using just 2 winters for the purpose of this consultation.

Table 2: Indicative de-rating factors for reciprocating engines and energy from waste technologies.

Technology	Winter 2019/20 Availability	Winter 2020/21 Availability	Indicative de-rating factor using alternative method	Current Capacity Market de-rating factor[12]
Reciprocating engine - diesel	70.85%	84.03%	77.44%	95.47%
Reciprocating engine - gas	90.93%	90.01%	90.47%	95.47%
Energy from waste	91.01%	94.58%	92.79%	88.55%

We observe that the indicative de-rating factors are lower than those currently assigned to these technologies based on transmission-connected technologies for reciprocating engines while waste is higher. The lower de-rating factors for reciprocating engines may reflect that these stations have a lower availability at winter peak, However, that might be counter-intuitive, given these sites are often newer assets that have recently come forward through the Capacity Market, and so we may have expected their availability to be higher. It's entirely feasible that there are still periods within our assessment where these units were available but not generating, despite trying to identify periods where we may have reasonably expected them to be generating. We have provided some additional considerations below. We should also acknowledge that these units are only obligated to generate during a stress event, and we are yet to have one in Great Britain. It therefore isn't feasible to calculate de-rating factors based only on output during stress events.

Table 2 shows separate indicative de-rating factors for diesel and gas reciprocating engines. Reciprocating engines represent a single technology class in the Capacity Market. There is no distinction for fuel type. The lower indicative de-rating factor for diesel may be due to economic and emission-related factors that mean they generate less than gas. In addition, there has been a reduction in the amount of diesel units coming through the Capacity Market in recent years – a trend that we expect to continue. Given that any change to the methodology would only apply to future auctions, we believe it may be appropriate to only include gas reciprocating engines in any new de-rating factor methodology for reciprocating engines. We think this may be more appropriate than combining both together (capacity-weighted) or seeking to redefine the technology class by fuel type.

4. Is it appropriate to only use gas units in the de-rating factor calculation for reciprocating engines or should both gas and diesel be included?

Additional considerations

Units with STOR contracts were excluded from the assessment shown in Table 2. An alternative option could have been to include the STOR units in the calculation and assume they were all available at 100% even if their output is zero on the basis that they were receiving availability payments. STOR is classed as a relevant balancing service meaning that STOR providers can participate in the Capacity Market, and arguably that these units should contribute to the de-rating factors for those technologies. We don't exclude STOR units in the TCWAA methodology for other generating technologies, although we should highlight that we have MEL values to assess their availability. Table 3 shows how the indicative de-rating factors in Table 2 would change if we include STOR units and assume they are 100% available.

[12] See Table 3 in the 2021 Electricity Capacity Report https://www.emrdeliverybody.com/Capacity%20Markets%20Document%20Library/Electricity%20Capacity%20Report%202021.pdf

Table 3: How indicative de-rating factors in Table 2 could change if we include STOR units and assume they are fully available.

Technology	Indicative de-rating factor if STOR units are included and assumed fully available
Reciprocating engine - diesel	81.02%
Reciprocating engine - gas	92.84%
Energy from waste	92.79%

5. Is it appropriate to include STOR units in any new de-rating factor calculation and assume they are fully available on the basis that they receive availability payments? Is it more appropriate to include STOR units on this basis or exclude them from the calculation?

In the alternative methodology we only considered periods over the evening peak 17:00 - 19:00, Mon - Fri, Dec - Feb on days where the daily peak demand is in the top 10% of all daily peak demands for the winter. Instead of focussing on high demand days, we also considered the same periods on days of high system prices (i.e. analogously to demand we considered days that had a maximum system price that was in the top 10% of all daily maximum system prices). Table 4 shows how the indicative de-rating factors in Table 2 would change had we focussed on days with high system prices rather than peak demand. We believe it may be more appropriate to focus on demand as prices may be driven by other factors, potentially unavailability of generating units.

Table 4: How the indicative de-rating factors in Table 2 could change if we focus on days with high system prices rather than days with high peak demand.

Technology	Indicative de-rating factor if STOR units are included and assumed fully available
Reciprocating engine - diesel	70.93%
Reciprocating engine - gas	88.50%
Energy from waste	94.16%

6. Is it more appropriate to focus on high peak demand or high price days in any new de-rating factor methodology?

Conclusion

We have undertaken an assessment of whether we can develop alternative de-rating factor methodologies for some specific embedded generating technologies, namely reciprocating engines, and energy from waste, using new embedded generation data. We have done this to try and improve this aspect of our modelling, particularly in response to recommendation 53 from BEIS' PTE report published in July 2020[13]. We believe there is merit in using the new embedded generation data to determine Capacity Market de-rating factors for these specific technologies. However, we recognise there are assumptions and limitations in the alternative methodology presented, particularly on the use of metered output to represent a unit's availability. We have endeavoured to present these in a transparent manner that will allow stakeholders to provide an informed response to this consultation. However, we should recognise that there is already an assumption in the existing methodology that the availability of these technologies can be represented by the availability of other transmission-connected technologies, which may not be appropriate either. Therefore, we acknowledge that the outcome is not straight forward. Depending on the outcome of this consultation, we may need to consider how we work with industry stakeholders to obtain and develop alternative data sources that better reflect *availability* of embedded generators to allow us to improve our de-rating factor modelling for embedded generation, as recommended by BEIS' PTE.

7. Is this alternative method more effective than the existing method, which assumes these embedded generation technologies can be represented by one of the transmission generation technologies? If not, why?
8. Are there any other considerations that could limit the effectiveness of this alternative methodology? If so, what could they be and what impact would they have?

[13] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/900062/panel-technical-experts-report-on-2020-electricity-capacity-report.pdf

Annex

Worked example of how we use a unit's metered output to represent its availability

Suppose we consider two units labelled A and B. Unit A is assumed to have a capacity of 100 MW as this is the 95th percentile of all its metered outputs over winter. Unit B is assumed to have a capacity of 20 MW. Table 5 shows an example of their metered output and assumed availability on three fictitious days that represent the entire winter peak period in this example. On day 1, unit A doesn't generate at all and so is assumed unavailable. Unit B generates for two half-hour periods and so we assume it is available for all periods over the evening peak on this day. On day 2 both units generate for all periods and so are assumed fully available. Even though unit A outputs 102 MW, we consider its availability is 100 MW based on its 95th percentile of all metered outputs over winter. On day 3, both units generate for some periods over the evening peak and are assumed to be fully available, even though they don't reach full output.

Table 5: Worked example to illustrate how we use metered output to represent availability

Day	Time	Unit A output (MW)	Unit A assumed availability (MW)	Unit B output (MW)	Unit B assumed availability (MW)
1	17:00	0	0	20	20
1	17:30	0	0	20	20
1	18:00	0	0	0	20
1	18:30	0	0	0	20
2	17:00	100	100	20	20
2	17:30	102	100	20	20
2	18:00	100	100	20	20
2	18:30	100	100	20	20
3	17:00	50	100	0	20
3	17:30	75	100	10	20
3	18:00	50	100	0	20
3	18:30	0	100	0	20

The average availability for unit A over these three days is 66.67 MW[14]. The average availability of unit B is 20 MW. If these two units represented the entire fleet for this technology, then the capacity-weighted availability for this particular winter would be the sum of the average availabilities divided by the sum of the capacities: (66.67 + 20) / (100 + 20) = 72.22%, similar to the approach used in the TCWAA methodology. The de-rating factor for the technology would then be determined by repeating this calculation for each of the three previous winters and taking the average.

[14] This is given by the sum of 0+0+0+0+100+100+100+100+100+100+100+100 = 800 divided by 1200 (i.e. the number of periods 12 multiplied by its capacity of 100 MW, since this would represent its maximum potential availability)