



Smart Energy, Sustainable Future

REVIEW OF THE DEMAND RESPONSE PROGRAMME IN THE NATIONAL ELECTRICITY MARKET OF SINGAPORE

CONSULTATION PAPER

Closing date for submission of comments and feedback:

30 November 2020, 4pm

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2020

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REVIEW OF THE DEMAND RESPONSE PROGRAMME IN THE NATIONAL ELECTRICITY MARKET OF SINGAPORE

1. Executive Summary

- 1.1. The Energy Market Authority (“EMA”) is conducting a re-design of the Demand Response (“DR”) Programme that was first implemented in 2016. An effective demand response programme improves the overall efficiency of the market by allowing consumers to respond to real-time market pricing signals and managing their electricity usage. EMA continuously strives to ensure that our programme frameworks remain relevant to facilitate participation by market players and consumers in support of demand side management initiatives for Singapore.
- 1.2. EMA had earlier put out a Consultation Paper “Review of the Demand Response Programme” in 2019 on proposals to tweak anti-gaming measures in the DR programme. EMA received further feedback that a more fundamental redesign would likely better enhance participation rate. Hence, EMA did not proceed with the proposed changes set out in the 2019 paper.
- 1.3. Considering industry feedback on aspects such as the remuneration approach, penalty and compliance regime, EMA conducted an end-to-end review of the DR programme with the aim to enable DR as a cost-effective solution for our electricity market, while ensuring a level-playing field. This paper aims to seek industry views on the proposed features of the revamped DR programme:
 - 1.3.1. Introduction of “Nodal Price-Retail” remuneration methodology, and methods for determining the “Retail” component;
 - 1.3.2. Whether DR participants can be allowed to bid below the Retail rate with the same price floor as energy offers
 - 1.3.3. Introduction of payment for partial delivery;
 - 1.3.4. Reduction of compliance threshold to 90% from 95% and change to penalty formula to align with the AFPS;
 - 1.3.5. Adoption of centrally-determined baselines;
 - 1.3.6. Framework for assessing whether and to what extent a DR participant has delivered scheduled load reductions in different scenarios
 - 1.3.7. Framework for assessing whether and to what extent a DR participant has gamed if it is not scheduled, in different scenarios

- 1.3.8. Potential adoption of sub-metering; and
- 1.3.9. Any other suggestions and feedback on the DR programme which can benefit the industry and facilitate participation.

2. Background

- 2.1. In 2016, EMA implemented the DR Programme to enhance competition in the National Electricity Market of Singapore (“NEMS”). The DR programme allows consumers to participate in the NEMS through voluntarily reducing electricity demand via demand-side bidding, in exchange for a share in the system-wide benefits which result from their actions. The DR programme also benefits the energy system as it provides an additional resource to help the system manage demand during peak consumption periods¹.
- 2.2. However, participation in the DR programme had been low since its inception, with only 4 instances of dispatch in total (2 dispatches in 2018, 2 dispatches in 2020). Energy DR capacity registered was also only 0.05% of peak load. The low participation rate prompted EMA to review the DR programme, which first led to the prior consultation paper published in 2019 on proposals to tweak anti-gaming measures. Feedback received indicated that the proposed measures were insufficient to spur participation, and that a more fundamental review of the programme aspects was required.
- 2.3. In summary, 6 companies responded to the earlier consultation paper. They also provided feedback on key aspects that caused high barriers of entry for DR participants and disincentivised participation:
 - 2.3.1. With payment stated at one-third of consumer surplus, there was too much revenue uncertainty, which failed to offer enough clarity to evaluate a business case;
 - 2.3.2. Self-declared baseline, and the requirement to consume when not cleared for dispatch, were overly onerous;
 - 2.3.3. The penalty was not commensurate with the revenue and compliance framework, as there was no payment for delivery below 100%, and penalty would be imposed for delivery below 95%.
- 2.4. Considering the industry feedback received, EMA reviewed all aspects of the DR programme while taking reference from other jurisdictions with DR programmes to calibrate with best practices. The following section sets out the proposed changes on remuneration, baseline methodology, compliance and penalty regime.

¹ https://www.ema.gov.sg/cmsmedia/Electricity/Demand_Response/Final_Determination_Demand_Response_28_Oct_2013_Final.pdf

3. Review of the DR Programme

Introduction of “Nodal Price-Retail” methodology

- 3.1. EMA received feedback that the current remuneration methodology at 1/3 * Consumer Surplus is highly uncertain to industry, and the chief reason for the low participation rate. The size and certainty of consumer surplus is not guaranteed, so there is a possibility that consumer surplus and hence revenues are close to or equal to zero. Consumers also do not know the surplus size until after they are dispatched, and the MCE and counterfactual MCE are run. Hence, moving to a more predictable remuneration model, while ensuring economic efficiency, will encourage take-up.
- 3.2. There are two broad approaches for remuneration to DR, which are (i) Nodal Price, as seen in PJM and MISO², or (ii) Nodal Price-Retail, as seen in France and Australia. Upon review, EMA proposes to adopt the “Nodal Price-Retail” methodology as this is more economically efficient. It also fulfils the objective to provide DR participants with upfront revenue certainty.
- 3.3. “Nodal Price” refers to the price that DR facilities will see at the load zone or node in which they bid. This is a fair starting basis as DR bids are co-optimised with other bids in the Market Clearing Engine (MCE) in the NEMS. The “Retail” component is removed from the Nodal Price to be paid, given that DR facilities do not pay their retailer for the electricity they do not consume. The grid cost component will not be included in “Retail” as this is not an energy related cost and cannot be avoided given that it is paid for grid infrastructure.
- 3.4. The Nodal-Retail methodology also avoids inefficient situations where DR facilities may run up overly-expensive self-generation or excessively cycle an Energy Storage System (ESS) to earn DR payments.

² Between 2009 and 2011, PJM had adopted the Nodal Price-Retail approach. This was reversed by the FERC Order 745, which required PJM to pay at Nodal Price from 2012 onwards. Similarly, MISO had previously adopted the Nodal Price-Retail approach but adopted the Nodal Price approach after the FERC ruling.

For the DR participant's total incentive to be equal to the full Nodal Price, the payment from the NEMS must equal the Nodal Price, less the determined avoidable retail generation rate, which the DR participant has been able to avoid buying from their electricity retailer.

In effect, Revenue of DR facility

= (A) Retail savings from avoided electricity consumption

+ (B) Nodal Price – (C) Retail

= Nodal Price

As an example, we assume the DR participant buys electricity at \$110/MWh (i.e. Retail=\$110/MWh), and owns a backup diesel generator with Short Run Marginal Cost (SRMC) of \$250/MWh.

- If DR were paid at the full Nodal Price, the DR participant will require DR payment at >\$140/MWh (i.e. \$250/MWh-\$110/MWh) to run the backup generator. The DR participant will curtail its load and self-generate when DR payments >\$140/MWh and not draw from the grid. This is an inefficient market outcome since the more expensive generation priced at \$250/MWh is running, when the value of electricity is only \$140/MWh (i.e. More efficient generation is displaced by less efficient generation).
- In comparison, if DR were paid at Nodal Price-Retail, the DR participant will only choose to bid into the market when the Nodal Price >\$250/MWh.

3.5. EMA recognises that a key challenge lies in setting the “Retail” component. The most ideal way is based on actual retail rates unique to each consumer participating in DR. However, this may not be practical for implementation, given that this requires extensive efforts to collect and verify individual DR participants' bespoke retail rates. Furthermore, an aggregator may aggregate multiple consumers to participate in the market, which will further complicate the determination of the retail rates for each individual consumer. As an alternative, EMA can pre-determine a common “Retail” rate for all DR facilities, and this rate can be made known in advance to industry and updated on a periodic basis. Such a retail rate can be based on:

3.5.1. Rolling average of wholesale prices;

- 3.5.2. Regulated tariff, adjusted for tension levels; or
- 3.5.3. Forward prices in the electricity futures market.
- 3.6. EMA welcomes feedback on the retail rate calibration options set out above, as well as other potential methods.
- 3.7. With the “Nodal-Retail” remuneration approach, there is an implicit price floor as DR participants will generally only bid when the Nodal Prices exceed the Retail component. Hence, the bid price floor at $1.5 * BVP$ would be removed.
- 3.8. As there is a possibility that nodal price may fall below the Retail rate, EMA would like to seek feedback on whether DR participants can be allowed to bid below the Retail rate and apply the same price floor as energy offers (i.e. - \$4,500/MWh).
- 3.9. DR participants will continue to abide by load zones, as is currently practiced.

Introducing Payment for Partial Delivery

- 3.10. DR participants currently receive payment for dispatch if curtailment $\geq 100\%$ of dispatch, and no monies if curtailment $<100\%$ of dispatch. EMA has reviewed this approach and views that it is fairer to introduce payment for partial delivery. This means that if a DR facility is cleared by MCE at 10 MW but curtailed only 8 MW, it will still be paid the “Nodal Price - Retail” for the 8 MW that it has delivered for the system. This is also a common approach adopted in other jurisdictions³.
- 3.11. Payment for partial delivery recognises the value of delivered curtailment and achieves equity between DR and other generation sources in the market. For example, thermal generation receives payment for each MW delivered. EMA recognises that there will be concerns regarding shortfall in delivery by DR providers, which should be equitably dealt with via the proposed revised penalty regime for DR.

Review of Compliance Threshold and Penalty Formula

- 3.12. The current penalty mechanism is identified as another key reason for low DR participation. Industry players viewed that the penalties are overly onerous on DR participants especially given the uncertainty in potential revenue and non-

³ Jurisdictions which adopt payment for partial delivery include PJM, MISO, France, Great Britain, and Australia.

payment for partial delivery. Currently, penalties are levied if delivery <95% of dispatch, and the penalty formula is set at $\text{Min}[1/3 * \text{consumer surplus}, \$4500/\text{MWh}]$.

3.13. EMA is of the view that the compliance threshold can be lowered to 90% from 95%, which will be in line with practices in other jurisdictions⁴. To deter DR participants from consistently under-delivering, EMA proposes to:

3.13.1. Set the penalty formula at $\text{Max}[2 * 0.5 * (\text{USEP} + \text{HEUC}) * \text{MW of deviation}, \$5000]$. This is benchmarked to the AFPS formula, and provides clarity on the quantum of financial penalties, compared to the current formula based on consumer surplus (which may vary and be near zero in some cases).

3.13.2. Introduce debarment of DR participants upon the 4th separate event of under-delivery as they have shown themselves unreliable. They will be required to re-establish credibility through testing. This is based on a “per event” basis. For example, if a DR participant has been dispatched for 2 hours (4 consecutive periods) and under-delivers in each of the 4 periods, it will be counted as a single under-delivery event.

3.14. On balance, while EMA is proposing new incentives such as lower compliance threshold and payment for partial delivery to increase participation, deterrence for consistent under-delivery is also strengthened to prevent gaming behavior.

Adopting centrally-determined baselines

3.15. A baseline is an estimate of the counterfactual quantity of energy that a consumer would have consumed, in the absence of any DR participation. A baseline is needed for the DR participants to offer DR directly into the NEMS, as the delivered curtailment is measured as the difference between baseline and actual consumption. Baselines may be self-declared by the DR participant or centrally determined by the regulator, where the regulator generates an expected profile for baseline consumption for each period of different day types, based on historical data submitted by the DR participants.

⁴ For reference: Australia will allow 95% threshold for 6 to 8 periods, PJM sets a 90% threshold, MISO sets 88% threshold for 4 or more periods, and France and Britain charge penalties for non-delivery rather than a specific threshold number.

- 3.16. The current DR programme uses self-declared baselines, which creates the risk of gaming when the DR participant falsely self-declares a high baseline⁵. Gaming is currently mitigated by (a) monitoring of consumption when DR bids are not accepted, and (b) a price floor of 1.5 * BVP for bid eligibility. If DR bids have not been cleared and actual consumption is found to be lower than declared baseline consumption, penalties are levied.
- 3.17. With the proposed removal of the existing DR offer price floor of 1.5 * BVP, it is proposed to mitigate gaming by adopting a centrally-determined baseline.
- 3.18. EMA notes that the centrally-determined baseline is more aligned with other jurisdictions⁶. To calibrate this, 2 different baseline profiles (one for Weekdays and one for Weekends) can be determined, given the very different demand profiles of Weekdays versus Weekends. The baseline can be based on rolling historical average, with the below lookback periods:
- 3.18.1. 3 months – the last 3 calendar months of historical data (approximately the last 60 Weekday days and 24 Weekend days);
 - 3.18.2. 90 days – the last 90 Weekday days and the last 90 Weekend days respectively; or
 - 3.18.3. 45 days – the last 45 Weekday days and the last 45 Weekend days respectively.
- 3.19. EMA welcomes feedback on the lookback period calibration options set out above, including which can potentially improve the accuracy of projecting consumption for each particular period.
- 3.20. EMA would also like to seek feedback on potential removal of outliers in the calculation of centrally-determined baseline, removing the top 5% and bottom 5% of data, to improve the accuracy of the baseline figures.
- 3.21. The DR participant may also propose their own methodology, which EMA will review and accept if deemed appropriate. EMA welcomes industry feedback on possible refinements or alternative methodologies.

⁵ A gaming example would be for the DR participant to falsely declare a high baseline consumption, enabling it bid a (falsely) large DR load reduction. If this is coupled with a very low-priced bid, the DR participant would clear most or all of the time, enabling it to earn DR revenues for a (falsely) large DR load reduction.

⁶ PJM, MISO, France, and Australia use centrally determined baselines. Australia also allows requests to consider alternative methodologies. Jurisdictions that use self-declared baselines, such as Great Britain, are currently also considering solutions such as sub-metering to address accuracy of self-declared baselines where possible, and centrally-determined baselines otherwise.

3.22. EMA further notes that a centrally-determined baseline is effective for mitigating gaming only to the extent that it accurately and consistently tracks the consumption profile and level on a half-hourly basis in respect of the DR participant. In practice, there will typically be deviations between the baseline half-hourly consumption based on historical data and the actual consumption data. EMA therefore would like to seek feedback on the framework for assessing:

- (a) Whether and to what extent a DR participant has delivered the scheduled load reduction for a given bid period under different scenarios: (i) when the actual load level for the period (P-1) preceding the bid period (P) is above the baseline for P-1; (ii) when the actual load level for P-1 is below the baseline for P-1; and
- (b) Whether and to what extent the DR participant has gamed if it is not scheduled for load reduction for a given bid period under different scenarios: (i) when the actual load level for P is above the baseline for P; (ii) when the actual load level for P is below the baseline for P.

3.23. EMA notes that DR participants may ask how this DR programme baseline differs from the baseline determination under the Forward Capacity Market (FCM) design, which are differentiated between Firm Service Level (FSL) assets or Guaranteed Load Drop (GLD) assets. EMA clarifies that FSL and GLD are FCM-specific terms to differentiate assets with different characteristics when called upon to service Capacity Supply Obligations (CSO). To bid into the Singapore Wholesale Electricity Market (SWEM), DR participants are still required to bid in multiple price-quantity tranches. This is akin to the GLD concept, and applies regardless of whether the participant is on FSL or GLD. Hence, there is no need to conflate the FCM baseline methodologies with the DR programme that operates in the SWEM. Nonetheless, DR participants need to be mindful to ensure that they should meet both their FCM and SWEM obligations, if they have offered and been dispatched in both markets, or be subject to the respective penalties.

Sub-metering could potentially be adopted

3.24. EMA notes that sub-metering has been permitted and adopted on voluntary basis in other markets⁷. Sub-metering could help to identify and monitor different loads within a facility at a more granular level. DR participants could potentially

⁷ In 2019, the European Smart Grids Taskforce recommended that European Union member states develop and share the best practices for sub-metering. In the US, some ISOs have also enabled sub-metering for behind-the-meter generation assets, while other ISOs have explored the use of sub-metering of electric vehicles.

allow complex sites more scope in participation by effectively removing uncontrollable loads from calculations.

3.25. EMA recognises the value of sub-metering, but notes that there are technical issues with sub-metering as well as potentially higher costs. These include setting up metering standards and processes for verifying independence of sub-metered assets. For example, a reduction in load at one sub-meter may potentially be offset simply by an increase in consumption at another sub-meter. Hence, EMA would like to seek industry proposals on sub-metering solutions that can be applied to Singapore.

Removal of monitoring and penalty for bids which are not dispatched

3.26. EMA notes that under the current self-declared baseline scheme, monitoring occurs in the bid period if the bid is not cleared, to verify the declared baseline consumption. Penalty may be levied if consumption is below the declared level.

3.27. In view of the proposal to adopt a centrally-determined baseline scheme and the potential concern raised in paragraph 3.22, EMA would like to seek feedback on whether monitoring and penalty should be removed.

4. Indicative Review Timeline

4.1. Table 1 summarises the indicative timeline of EMA’s consultation for the redesign of the DR programme.

Table 1: Indicative Timeline⁸

Milestone	Date
Consultation Paper	4Q 2020
Final Determination paper	1H 2021
Targeted introduction of re-designed DR	Around end-2023 (subject to time required for system changes)

⁸ EMA reserves the right to vary the dates as deemed appropriate.

5. Summary

5.1. The EMA is revamping the DR programme to increase participation rates. Table 2 below summarises the proposed changes from the current programme.

Table 2: Comparison of policy changes consulted upon

Issue	Current policy	Proposed policy change for consultation
Remuneration Mechanism	1/3 * Consumer Surplus	Nodal Price – Retail, the Retail component is determined
Bid Price Floor	1.5 * BVP	Bid price floor is removed
Payment for Partial Delivery	Payment only if delivery \geq scheduled curtailment	Payment for partial delivery
Compliance Threshold	95%	90%
Penalty Formula	Min [1/3* consumer surplus, \$4500/MWh]	Max [2*0.5*(USEP+HEUC)*MW of deviation, \$5000] benchmarked to AFPS
Baseline	Self-declared	Centrally-determined based on historical data
Sub-metering	No sub-metering currently	Sub-metering could be adopted
Monitoring of bids which are not dispatched	Un-dispatched bids are monitored and penalised if actual consumption falls below declared consumption	To be removed

5.2. This paper seeks views/comments from the industry, including but not limited to the following:

- 5.2.1. Introduction of “Nodal Price-Retail” remuneration methodology, and methods for determining the “Retail” component;
- 5.2.2. Whether DR participants can be allowed to bid below the Retail rate with the same price floor as energy offers
- 5.2.3. Introduction of payment for partial delivery;
- 5.2.4. Reduction of compliance threshold to 90% from 95% and change to penalty formula to align with the AFPS;
- 5.2.5. Adoption of centrally-determined baselines;

- 5.2.6. Framework for assessing whether and to what extent a DR participant has delivered scheduled load reductions in different scenarios
- 5.2.7. Framework for assessing whether and to what extent a DR participant has gamed if it is not scheduled, in different scenarios
- 5.2.8. Potential adoption of sub-metering; and
- 5.2.9. Any other suggestions and feedback on the DR programme which can benefit the industry and facilitate participation.

REQUEST FOR COMMENTS AND FEEDBACK

The EMA invites comments and feedback to Section 3 of the consultation paper.

Please submit your written response via this [survey](#) or through the QR code link appended below by **4pm on 30 November 2020**. Anonymous submissions will not be considered.



For clarifications, please contact EMA Policy and Planning Department (PPD) at ema_policy@ema.gov.sg.

The EMA reserves the right to make public all or parts of any written submissions made in response to this consultation paper and to disclose the identity of the source. Any part of the submission, which is considered by respondents to be confidential, should be clearly marked. EMA will take it into account regarding the disclosure of the information submitted. EMA may also approach the respondents for clarification while the consultation is ongoing.

~ End ~