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Energy Security Board

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Submission to the Energy Security Board in response to the Capacity Mechanism High-level Design Paper

Please find attached a public submission for the consideration of the Energy Security Board on behalf of Energy Consumers Australia.

Yours sincerely,

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Policies to enable mass-market participation in a capacity mechanism

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Introduction

Econalytics has been engaged by Energy Consumers Australia (‘ECA’) to review the Energy Security Board’s Capacity Mechanism High-level Design Paper (‘ESB Paper’) and propose actionable policy and market design choices that could be implemented to enable significant and meaningful mass-market (residential and small business) participation in the capacity market through providing demand response and energy efficiency resources.

Enabling demand response and energy efficiency will ensure a more efficient use of existing resources and lower energy costs for all consumers. Consumers who provide demand response and energy efficiency resources will receive further cost savings. From an operational perspective, bringing about large-scale mass-market participation in demand response will be essential in ensuring sufficient dispatchable and flexible supply to meet system needs as fossil fuel generators retire, more intermittent generation comes online, and demands on the grid increase with electrification of the economy. While most demand response capacity has historically been provided by larger customers, it is our belief that mass-market participation will increase over time as electrification and falling telemetry and computational costs increase the volume of mass-market load that is cost-effectively controllable. Thus, all policy recommendations are focused on promoting demand response and energy efficiency in general, with the assumption that this will be sufficient to ensure mass-market participation. These policies are summarized in Table 1 and discussed in more detail later in the report.

The rest of the report proceeds as follows: in Section 1 we discuss the value of demand-side participation in capacity markets. In Section 2 we introduce case studies of several capacity markets that procure significant amounts demand response and energy efficiency resources. In Section 3 we have a more detailed discussion of our policy recommendations and describe how they are implemented in each of the case study jurisdictions. Finally, in Section 4 we respond to several of the ESB’s stakeholder questions that were most relevant to enabling demand response and energy efficiency resources in the capacity market, largely drawing on the policy recommendations earlier in the report.

We understand that ECA will incorporate or reference this submission with their own response to the ESB Paper.

Table 1: Recommended policies to enable demand-side participation

Ensuring that demand response, energy efficiency (and consumer energy resources) are on the supply-side of the market	•More competitive and enables a wider range of business models than just retailers. •Greater visibility and **dispatchability** for the system operator.
Creating products that allow for seasonal capacity requirements and seasonal resources	•Demand response and energy efficiency resources may be seasonal loads that cannot meet a year-round product definition, but are still valuable in meeting seasonal peak demand. **Ensuring flexibility of capacity products will promote participation** of lower cost resources.
Fine tuning the market design to ensure cost-effective mass-market participation is realized	•Prior to market inception and at regular intervals thereafter, a demand response and energy efficiency potential study should be undertaken to assess the potential for cost-effective demand-side market participation. •Annual **reviews of demand-side participation should be institutionalized** with participation assessed against the potential study and policies fine tuned as needed.
Technology neutrality to award capacity ratings that align with contributions to system reliability needs	•Ensure all resource types are enabled to participate and awarded **capacity ratings consistent with reliability contributions** and with regards to the optionality provided by the technology.
Align market cost allocation and capacity product definition with intervals driving system reliability needs	•Retailers will have a greater incentive to provide and compete for demand response and energy efficiency resources since doing so will **reduce their capacity cost obligation and earn capacity market revenues.**
Multiple auction periods ahead of delivery year	•Initial auction several years ahead provides sufficient time to build new supply. •Annual reconfiguration allows system operator to adjust demand quantity and participants to **adjust supply commitments**.
Transparency and simplicity	•Demand response and energy efficiency resources are flexible and will **adapt to alternative product definitions**. Opaque de-rating that occurs in an integrated model will not account for this. •Testing requirements should be transparent so they can be integrated into bid offers.

Section 1: Value of demand-side participation in capacity markets

Electricity systems require demand and supply to be balanced within tight limits in real-time. Traditionally, sufficient generation capacity has been built to meet system demand at all times. Moving forward, as Australia decarbonizes and electrifies its economy, electricity demand will grow at the same time as large amounts of existing thermal generation retires. Much of the new generation capacity entering the market will come from intermittent generation (wind and solar) and these resources alone may not be sufficient to meet demand at all times. While some new dispatchable generation and storage capacity will need to be built to meet this increased demand and integrate intermittent generation, in many cases it will be more cost-effective to make better use of existing resources, by adapting demand to meet supply.

Enabling and supporting mass-market and large-scale demand response and energy efficiency in the capacity market is an immediate opportunity that should be embraced. It provides a ready source of dispatchable capacity for the system operator in responding to the dynamic electricity needs of the market. It also empowers and rewards electricity consumers for managing their demand. The proliferation of internet-connected smart appliances will make it increasingly easier to orchestrate small load shifts across many consumers, leaving consumer comfort unaffected, but yielding large demand savings in aggregate. The electrification of heating and transport will extend these opportunities even further. Enabling customers to change when and how they consume electricity will in many cases be a relatively cheap and flexible alternative to building physical storage or generation capacity.[1]

Demand response is a temporary and voluntary reduction in consumption in response to a signal, while energy efficiency is a permanent reduction. Demand response and, to a lesser degree, energy efficiency, are common products in a number of capacity markets and have regularly demonstrated an ability to either shift load to another period or to reduce peak demand. As a flexible and fast acting resource, demand response can also help to integrate intermittent renewable generation. For example, a hot water heater could receive signals to run concurrently with solar generation, but momentarily shut down when cloud cover reduces output.

Energy efficiency and demand response can reduce the need for expensive capacity to be built to meet just a few hours of peak demand per year. A recent study by the Australian Renewable Energy Agency (ARENA), found that enabling load flexibility would reduce electricity system costs for consumers over the next twenty years by $6-18 billion in net present value,[2] with the higher values achieved in scenarios with greater levels of electrification and consumer adoption of self-generation (solar and batteries).[3] These consumer savings are realized through:

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[1] *Consumers may be willing to shift load because they desire energy services rather than energy itself and thus are indifferent to the exact time when an appliance runs. Alternatively, consumers may place a relatively low value on electricity consumption at certain times and/or for certain purposes, relative to its costs. Thus, they may be willing to curtail usage, or shift it to cheaper periods. For example, consumers may be indifferent to the exact time that their electric vehicle charges, or their washing machine runs. Or they may not notice when their air-conditioner pre-cools the room slightly above the thermostat set-point and then allows the temperature to drift back to slightly below the set-point before kicking in again. Or they do not care if their home is warm in winter due to better insulation, or more extensive operation of their electric heater. These are all positive examples of flexible load. However, it is dangerous to assume that* all *load flexibility is positive, since some consumers may find themselves in a state of vulnerability where they decide to forgo consumption of electricity during peak periods in order to afford food, accommodation or other essential services, even though the individual and societal value of their electricity consumption is relatively high (e.g. health preserving heating needs).*

[2] *In the study, the costs of controlling, orchestrating and aggregating load are outside of the model. These costs will ultimately be borne by consumers, lowering the estimated load flexibility benefits.*

[3] *ARENA (2022), "Valuing Load Flexibility in the NEM", p.111*

- Load reduction and load shifting which reduces the need to build new generation and storage capacity, resulting in lower build costs to the system,
- Load flexibility which lowers generation dispatch at peak times, resulting in lower fuel and variable cost savings,
- Load flexibility which allows consumers to avoid price spikes, lowering their exposure to high priced periods in the wholesale market.

The ARENA study assumes that load flexibility is on the demand-side of the market, not the supply-side, with different technologies responding to different wholesale market prices 'triggers' to reduce demand. This means that resources are not paid directly, but instead save on wholesale market costs. Moving demand response to the supply-side of the capacity market will further increase these benefits by providing AEMO with more certainty over future net demand and providing them with an additional dispatchable resource in a world of increasingly fewer dispatchable options. Demand response is already being treated as a supply-side resource in the wholesale market through the Wholesale Demand Response Mechanism and would similarly become part of price formation under the ESB's proposed two-sided market.

The 'fuel' for demand response and energy efficiency already exists, all that is needed are the market rules to level the playing field and allow virtual generators to undertake the investment necessary to unlock this abundant and under-utilized resource. Ensuring equal access to the capacity market, creating capacity products that accommodate demand response and energy efficiency and ensuring that capacity payments for all resources are consistent with services rendered, are a few such examples. While residential and small business consumers, through their demand flexibility and energy efficiency investments have the potential to provide meaningful capacity, it is not a given that this will be realized. Unlike a battery or a gas-fired generator, residential and small business consumers are not undertaking investments in home energy equipment, or optimizing their lifestyles, to meet the needs of the energy system or the energy (or capacity) market. Policies that can value stack for consumers will help encourage more participation, lower system costs and transfer some revenues away from generators back to consumers. For example, aligning capacity market cost allocation with capacity product definitions will better incentivize retailers to use demand response and energy efficiency. The Australian experience with rooftop solar demonstrates that consumers are eager to be more active participants in the energy system with greater control over their energy costs. The ESB can increase the chances that demand response and energy efficiency provide low-cost capacity through a well-designed mechanism that recognises both the importance of demand-side resources and their unique characteristics and allows sufficient flexibility to enable these resources to compete on a level-footing with traditional supply-side resources.

Section 2: Case studies

To develop and support our policy recommendations, we have undertaken case studies of five capacity markets across three continents where demand response, and in some cases energy efficiency, can bid into the market as a supply-side resource. This encompasses PJM and ISO-NE in North America, the United Kingdom (UK) and France in Europe and the WEM in Western Australia.

In PJM, demand response has been allowed to compete in capacity markets since market inception in 2007, while energy efficiency was first allowed to enter the market in 2012.[4] In ISO-NE, both demand response and energy efficiency have been able to directly compete in capacity auctions since inception

[4] *Liu (2017), "Demand response and energy efficiency in the capacity resource procurement: Case studies of forward capacity markets in ISO New England, PJM and Great Britain ", Energy Policy, Vol.100 (2017), p.272*

in 2010. Capacity markets in both the UK and France began operating more recently in 2017.[5,6] In the UK demand response has been able to compete in capacity market auctions since 2018. In France, demand response has been actively competing for dispatch in the wholesale market since 2013, several years prior to the inception of the capacity market.[7] In Western Australian demand response has been participating in the capacity mechanism since its inception in 2006.

Table 2: Overview of case study markets

Country/ Market	Peak Demand Season	Total Capacity Procured (GW)	Agency	Product	Capacity definition	Peak definition
Australia (WEM)	Summer	5 GW	Australian Energy Market Operator	Demand Response Capacity Credits	All year. 200 hours per capacity year	8am - 8pm working days
PJM	Summer	144 GW	PJM Regional Transmission Organisation	Capacity Performance Demand Response	Separate summer and winter delivery seasons.	Summer: 10am-10pm working days. Winter: 6am to 9pm working days.
				Capacity Performance Energy efficiency		Summer: 1pm-5pm working days. Winter: 5pm-7pm working days.
ISO-NE	Summer	34 GW	ISO-NE Regional Transmission Organisation	Active demand capacity resources (ADCRs) (Demand Response)	All year	-
				On-peak Energy Efficiency	Summer and winter	Summer: 1pm-5pm working days. Winter: 5pm-7pm working days.
				Seasonal peak Energy Efficiency	Summer and winter	When hourly system load is at or greater than 90% of the forecast peak
United Kingdom	Winter	44 GW	National Grid Electrical System Operator (ESO)	GB Capacity Market	System stress events (defined by system operator) with 4 hours notice	-
France	Winter	92 GW	RTE (transmission system operator)	French Capacity Certificates	Winter	Winter workdays 7am to 3pm and 6pm to 8pm +B4:I10

Both of the North American systems and the WEM are summer peaking, while the UK and France are winter peaking. That being said, both ISO-NE and PJM had significant winter supply constraints during the polar vortex of 2014, that led to significant "pay-for-performance" capacity market reforms, with PJM changing product definitions, and ISO-NE changing the financial incentive structure.[8, 9]

Demand response and energy efficiency can play a significant role in meeting peak demand. Figure 1 shows the share of each market's total capacity procurement that is met by demand response and energy efficiency resources.

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[5] *Liu (2017), "Demand response and energy efficiency in the capacity resource procurement: Case studies of forward capacity markets in ISO New England, PJM and Great Britain ", Energy Policy, Vol.100 (2017), p.272*

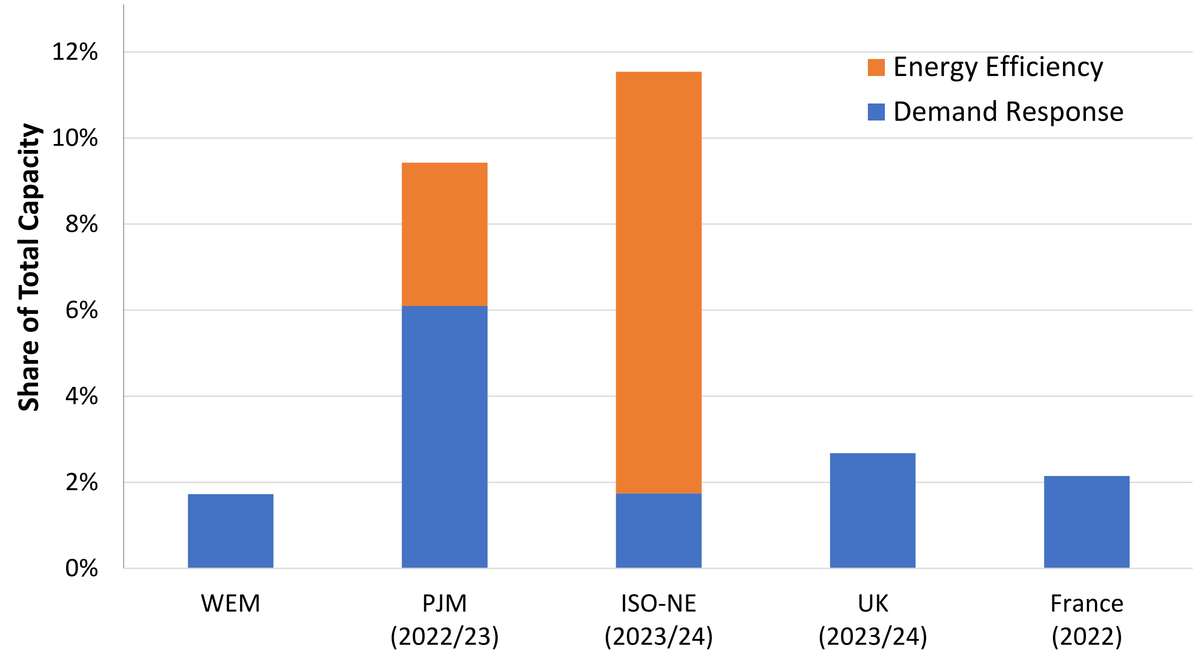
[6] *SEDC (2017), "Explicit Demand Response in Europe - Mapping the Markets 2017", Smart Energy Demand Coalition, p.80.*

[7] *SEDC (2017), "Explicit Demand Response in Europe - Mapping the Markets 2017", Smart Energy Demand Coalition, p.81*

[8] *Brattle (2019), "International Review of Demand Response Mechanisms in Wholesale Markets", p.26.*

[9] *Liu (2017), "Demand response and energy efficiency in the capacity resource procurement: Case studies of forward capacity markets in ISO New England, PJM and Great Britain ", Energy Policy, Vol.100 (2017), p.273.*

Figure 1: Demand response and energy efficiency as a share of total market capacity



Notes:

Australia	*Assignment of Capacity Credits for the 2021/22 capacity year*
PJM	*Auction year 2021, for delivery 2022/23*
ISO-NE	*Auction year 2020, for delivery 2023/24*
United Kingdom	*Demand response: auction year 2019, for delivery 2023/24*
France	*Auction year 2021, for delivery 2022*

The demand-side share of capacity provided ranges from 11.5% in ISO-NE to 2% in France and Western Australia. While one may perceive these contributions as modest, demand share measures avoid the highest cost generation and storage approaches to providing capacity. Accordingly, even relatively small contributions can provide significant cost savings.

In absolute terms, PJM has the largest volume of demand-side participation, with a combined 13.6 GW of combined demand response and energy efficiency capacity in delivery year 2022/23. While demand response made up nearly two thirds of demand-side resources in PJM in delivery year 2022/23, it only amounted to 15% of demand-side capacity in ISO-NE for delivery year 2023/24. This difference in constitution is potentially because:

- The level of utility energy efficiency obligations tends to be smaller in states served by PJM than ISO-NE.[10]
- PJM only allows demand savings activities to participate in the capacity market for up to four years. In ISO-NE demand savings activities can offer into the market at their full capacity rating as long as they are operable.[11] The average measure life in ISO-NE is approximately seven years,

[10] *Liu (2017), "Demand response and energy efficiency in the capacity resource procurement: Case studies of for\ward capacity markets in ISO New England, PJM and Great Britain ", Energy Policy, Vol.100 (2017), p.276.*

[11] *Liu (2017), "Demand response and energy efficiency in the capacity resource procurement: Case studies of forward capacity markets in ISO New England, PJM and Great Britain ", Energy Policy, Vol.100 (2017), p.276.*

but resources can participate for a maximum of 30 years (pending annual measurement and verification (M&V)).[12] A potential middle ground would be to allow for energy efficiency measures to offer into the market for their full lifetime, but decrease their capacity rating over time to account for organically occurring changes in technology.

None of the other markets studied allowed energy efficiency participation, although the UK did conduct a pilot study in 2014 to evaluate whether energy efficiency could compete alongside demand response and storage in the capacity market.[13] The study concluded that energy efficiency would not be competitive with demand response and storage in the market, although the pilot design was far from a level playing field, with limitations on participation for measures with shorter payback periods, a limited measure lifespan and challenging deadlines and application requirements.[14]

Section 3: Recommended policies to promote demand-side participation

A. Ensuring that demand response, energy efficiency and consumer energy resources are on the supply-side of the market

Conceptually, demand response, energy efficiency and consumer energy resources can be accounted for either on the supply or the demand-side of capacity markets. In practice however, these resources are far more valuable when placed on the supply-side of the market for a number of reasons:

- **Binding capacity commitments.** Supply-side participation of demand response and energy efficiency in the capacity market will create binding contractual commitments for capacity delivery, with penalties for non-performance. This enables the system operator to have more confidence in the quantity and availability of demand response and energy efficiency measures, relative to demand-side participation, which does not require any binding supplier commitments.[15]

- **Increased visibility and certainty.** Having demand response and energy efficiency on the supply-side of the market means that these resources will be bidding into the capacity auction. This will give the system operator a clearer picture of the volume and characteristics of demand response and energy efficiency resources that would enter the market (at different prices) and allows them to more accurately procure other capacity resources to meet demand. If demand response and energy efficiency is on the demand-side of the market, the system operator will need to both try and estimate historical demand response and energy efficiency deployment, as well as forecast the growth of these resources in the future delivery year. This is no simple task as the former is hard to identify among load fluctuation, and the latter depends on assumptions about how technological capability will translate into realized delivery.

- **Greater controllability.** Supply-side demand response resources will be dispatchable by the system operator, a valuable attribute in a world where dispatchable resources are increasingly diminishing. Demand-side demand response resources, used by retailers and other obligated

[12] *Brattle (2021), "The Benefits of Energy Efficiency Participation in Capacity Markets", p.2*
[13] *Department for Business Energy & Industrial Strategy (2019), "Electricity Demand Reduction (EDR) Pilot – Final Evaluation Report", p.6*
[14] *Department for Business Energy & Industrial Strategy (2019), "Electricity Demand Reduction (EDR) Pilot – Final Evaluation Report", pp.6-8*
[15] *Brattle (2021), "The Benefits of Energy Efficiency Participation in Capacity Markets", p.3*

parties to avoid high wholesale costs or reduce their share of capacity market obligations, will not be dispatchable by the system operator.

- **Increased competition.** Placing demand response and energy efficiency on the supply-side of the capacity market will allow non-obligated parties access to capacity payment revenues in addition to revenues from participating in the wholesale and ancillary services markets (both of which should decrease with the introduction of the capacity mechanism). This will allow a greater number of alternative business models to enter the market and compete with retailers. Under demand-side accounting, only retailers would benefit from demand response and energy efficiency in the capacity market since they could use these resources to reduce their share of capacity obligations.

Demand response is already being treated as a supply-side resource in the wholesale market through the Wholesale Demand Response Mechanism and would similarly become part of price formation under the ESB's proposed two-sided market. The recommendation to put demand response and energy-efficiency on the supply-side of the market would be consistent with this.

To properly account for demand response and energy efficiency as a supply-side resource, peak demand forecasts need to estimate total load as if *no* demand or energy efficiency capacity were to be delivered through the capacity market. In this way, once demand response and energy efficiency capacity are accounted for as a supply resource, there is an accurate picture of the remaining net demand to be met by other forms of capacity.

Table 3: Accounting for demand response and energy efficiency capacity in forecasts

WEM	To forecast future demand, AEMO creates a historical load profile that is the sum of 'sent out' generation and an estimate of distributed solar generation.[16] They do not appear to account for historical demand response dispatch, although the same methodology being used to account for distributed solar generation would work equally well with demand response.
PJM	In creating its load forecasts, the system operator adds dispatched demand response back into the historical load data for the relevant dispatch interval. These 'reconstituted' historical load data are then used as an input into all system load forecasts made by the system operator. For energy efficiency the system operator assumes that all forecasts are already net of energy efficiency (including that which will eventually be procured in the capacity market). An energy efficiency add-back mechanism is then used to increase the quantity of capacity to be procured, so as to exactly offset the supply-side energy efficiency procured. If the energy efficiency add-back and energy efficiency procured do not exactly match, the auction is iteratively re-run until the volumes equalize). Qualified energy efficiency may participate in the capacity auction for up to four years only. For energy efficiency the system operator assumes that all forecasts are net of energy efficiency (including that procured in the capacity market). An energy efficiency add-back mechanism is then used to increase the quantity of peak demand. This add-back is intended to be equal to the supply of energy efficiency capacity cleared in the market.[17]

[16] *Robinson Bowmaker Paul (2022), "2022 Assessment of System Reliability for the South West Interconnected System", pp.7-9*

[17] *Brattle (2021), "Enabling Cost-Effective Energy Efficiency in PJM's Capacity Market", pp.5-9*

ISO-NE	For demand response the same 'reconstituted' historical load approach is used as PJM. For energy efficiency, the system operator conducts a load forecast that is based on historical demand levels and incorporates adjustments based on the pace of energy efficiency gains as consistent with energy efficiency standards and inputs from utilities and state agencies regarding their energy efficiency programs. In the capacity market, energy efficiency measures are qualified for the specified measure life relative to a baseline that aligns with either standard business practice or a specified policy. In some cases, the volume of qualified energy efficiency in the capacity market is larger than the aggregate energy efficiency measures' reduction to the load forecast, so the load forecast (and hence total capacity procurement volumes) are grossed up to the but-for level of demand that would exist absent the energy efficiency measures.
UK	The system operator estimates 'gross' historical demand by summing together transmission network demand with estimates of all distribution system generation including demand response.[18] Forecasts of future load growth are made for five different scenarios, each representing a potential future state of the world. Each scenario comes with its own set of assumptions on the pace and extent of adoption of different end-user appliances/devices and changes in behaviour. Future demand forecasts apply these growth levers to current gross historical demand.
France	There is no centralized capacity forecast informing capacity requirements, rather retailers and other obligated parties forecast their own peak demand and purchase capacity certificates to meet their obligations. Obligated parties can use demand response on the demand-side to reduce their capacity obligation or purchase it on the supply-side through capacity certificates.[19]

B. Creating products that allow for seasonal capacity requirements and seasonal resources

Seasonal capacity products will allow seasonably varying capacity needs to be met more cost-effectively than under an annual design, by fully recognising differences in seasonal needs and differences among resources' seasonal capabilities and cost.[20] A seasonal capacity mechanism will help ensure:

1. **Less excessive capacity.** Procuring capacity that can perform year-round at the level required to meet the higher season peak, will result in excess capacity being procured for the rest of the year.[21]

2. **More participating resources.** Seasonal resources can fully participate in the market and the full seasonal contribution of annual capacity resources can be realized. There will likely be many demand response and energy efficiency resources that are based on seasonal loads, that cannot participate in an annual market, but can contribute lower cost capacity to a seasonal market. For example, demand response or energy efficiency resources based on cooling or space heating

[18] National Grid ESO (2022), "FES Modelling Methods 2022", p.37

[19] RTE (2021), https://bilan-electrique-2021.rte-france.com/mecanisme-marches-effacements/, last accessed 21/07/2022

[20] Brattle (2018), "Opportunities to More Efficiently Meet Seasonal Capacity Needs in PJM", p.8

[21] Brattle (2018), "Opportunities to More Efficiently Meet Seasonal Capacity Needs in PJM", p.3

will only contribute capacity in the summer and winter, respectively. Additionally, some capacity sources that operate year-round will have different capacity ratings in summer and winter. For example, solar is less productive in winter than summer, as is some fossil fuel generation during more extreme cold snaps. Seasonal products will allow them to offer their full capacity value for each period into the market rather than the lower of the two, as is common with annual product designs.[22]

3. **Better price signals**. Seasonal products will better reflect marginal resource costs. Annual products average these out, sending poor market price signals to participants.[23]

PJM already has summer and winter seasonal capacity products, although capacity needs to be matched across both seasons (using a market optimisation algorithm). For capacity delivery year 2022/23, seasonal capacity was only 0.5% of total capacity procured, but consisted almost entirely of summer-only demand response and energy efficiency matched to winter-only wind capacity.[24] Although a small share of total capacity, these products are important for enabling demand response and energy efficiency, making up 5% of total cleared capacity for both resources.[25]

PJM is actively discussing establishing a full seasonal product market with stakeholders. MISO has already filed to propose a seasonal market to FERC; Ontario already has a seasonal capacity market.

Table 4: Seasonality of capacity products

WEM	Annual (limited to 200 hours for offer obligations)
PJM	Alongside annual capacity offers, market participants may submit summer or winter only capacity offers. PJM's auction clearing optimization algorithm matches equal quantities of summer and winter seasonal capacity, thereby creating a uniform annual capacity commitment.[26]
ISO-NE	Annual (limited seasonal supply matching through bilateral contracts). Some energy efficiency is summer-only.
UK	Annual
France	Annual

C. Fine tuning the market design to ensure cost-effective mass-market participation is realized

Demand response and energy efficiency are low cost and flexible resources that have made substantial contributions to capacity requirements in other jurisdictions. In addition to lowering capacity costs for all consumers, revenue from these resources will directly benefit participating consumers. A capacity market that provides revenue certainty for developing demand response and energy efficiency resources, can play a significant role in enabling these resources to develop to their full potential.

[22] Brattle (2018), "Opportunities to More Efficiently Meet Seasonal Capacity Needs in PJM", pp.4-7
[23] Brattle (2018), "Opportunities to More Efficiently Meet Seasonal Capacity Needs in PJM", p.8
[24] PJM (2021), "2022/2023 RPM Base Residual Auction Results", pp.12-14
[25] PJM (2021), "2022/2023 RPM Base Residual Auction Results", pp.12-14
[26] PJM (2022), "PJM Manual 18: PJM Capacity Market", Revision 52, p.16

However, there are many potential barriers to overcome in engaging more demand response and energy efficiency in terms of technology costs and standards, business models, market rules and regulations.

Recognising the importance to consumers of developing cost-effective demand response and energy efficiency capacity, we recommend that a systematic review is established to ensure that market adjustments can be made over time, if required. To this end, prior to market inception, a demand response and energy efficiency potential study should be undertaken to assess the potential contribution that these resources could cost-effectively make towards meeting peak demand. This study should be updated every few years, noting changes in demand-side load, technology capabilities and costs. After market inception, annual reviews of demand-side participation should be institutionalized with penetration assessed against the potential study and policies adjusted as need be.

This assessment could become part of an overall consumer-focused outcomes role undertaken by an independent market/mechanism monitor.

D. Technology neutrality to award capacity ratings that align with contributions to system reliability needs

To ensure a level-playing field that allows all cost-effective resource types to participate in the market, capacity award ratings need to be consistent with resource reliability contributions. To this end, capacity ratings should take into account:

- The outage rates for each resource,
- That some faster-responding resources may have greater reliability value and capacity ratings than slower-responding resources (e.g. 24-hour notice, vs. 10 min notice),
- That energy limited and intermittent resources may have non-availability during shortfall events,
- That thermal resources with high and low temperature correlated outages or risk of fuel supply limitations during weather events will have lower capacity value.

In evaluating options for resource accreditation, the guiding principles should be to: (1) help ensure that reliability will be maintained; (2) provide a reliability-neutral exchange rate among resources, both to enable reliable substitutions and to signal efficient investment; (3) help incentivise resource owners to enhance, maintain, and operate their facilities to be able to perform when needed most, by reflecting demonstrated performance in their accreditation; and (4) recognize modelling and data limitations that may differ among types of resources.[27]

For all consumer energy resources including demand response and energy efficiency, capacity ratings need to be grossed up to include avoided transmission and distribution losses.

[27] *Brattle (2022), "Capacity Resource Accreditation for New England's Clean Energy Transition. Report 1: Foundations of Resource Accreditation", p.46*

Table 5: Capacity accreditation/de-rating

WEM	Technology specific de-rating requirements: • Scheduled generation derated based on calculated sent out capacity performance at 41 degrees Celsius. • Intermittent generation derated based on past or forecast performance during peak demand intervals. • Demand response is based on the amount it can reduce its consumption, measured as a decrease from its relevant demand. The relevant demand is set at the 95th percentile of the demand response's associated load measured in the previous capacity year's 200 hours with highest total sent out generation.
PJM	Technology specific de-rating requirements: • Thermal generation derated based on installed capacity performance over the past 15 years' summer de-rated by the units forced outage rate. • Intermittent generation and batteries de-rated using Effective Load Carrying Capability (ELCC). ELCC models how the resources can displace firm capacity while maintaining reliability standards.[28] • Demand response capacity is de-rated by the registered capacity multiplied by the forecast pool requirement (FPR).[29] The FPR is 1 plus the unforced reserve margin for PJM.[30] This essentially means that you do not need to account for unforced outages for demand response capacity, since this is unserved load. • Energy efficiency is de-rated according to the lower of the summer and winter peak period demand reductions multiplied by the FPR.[31]
ISO-NE	Technology specific de-rating requirements: • Traditional thermal generators and energy storage resources have capacity accreditation based on maximum output during peak demand conditions. This does not consider outage rates or fuel supplies.[32] • Intermittent resources are de-rated according to their median performance during pre-defined reliability hours (hours ending 18–19 in winter and 14–18 in summer, plus any system-wide scarcity condition hours), averaged across the previous five years.[33] • Demand response and energy efficiency are accredited at their installed capacity value and increased by average avoided peak and transmission losses.[34] For all resource types, capacity ratings are calculated in both the summer and winter seasons, with the lower of the two values awarded as the resource's capacity value.[35,36] There is a proposal to move to marginal annual ELCC for all resources.

[28] ESB (2022), "Summary of International Case Studies", p.27
[29] ESB (2022), "Summary of International Case Studies", p.27
[30] PJM (2014), "PJM Demand Response Overview", p.60
[31] ESB (2022), "Summary of International Case Studies", p.27
[32] Brattle (2022), "Capacity Resource Accreditation for New England's Clean Energy Transition. Report 1: Foundations of Resource Accreditation", p.12
[33] Brattle (2022), "Capacity Resource Accreditation for New England's Clean Energy Transition. Report 1: Foundations of Resource Accreditation", p.12
[34] ISO-NE (2022), "Market Rule 1", section III.13.1.4.2.A

UK	Technology specific de-rating requirements. De-rating is applied uniformly to technology classes: • Thermal generation is de-rated based on historical average availability during winter high demand periods.[37] • Storage is de-rated using Equivalent Firm Capacity (EFC). Like ELCC, EFC models how the resources can displace firm capacity while maintaining reliability standards.[38] • Demand response is de-rated on the basis of Average Availability of Non-BSC Balancing Services, which is a balancing service for the short-term operating reserve (STOR) offered on a committed basis.[39] STOR is an out of market reserve and may differ in performance from capacity market demand response.
France	Technology specific de-rating requirements: • Non-dispatchable capacity is rated on its average output for capacity peak dispatch periods over the last 5 years (10 for run-of-river hydro) • Dispatchable capacity is scaled down based on duration of capacity it could provide, with 10 hours a day for 5 consecutive days being considered a full credit. • A technology specific scalar is applied as a further de-rating based on the likelihood of delivery.[40] • Demand response providers need to demonstrate that they can meet their capacity obligation one year prior to delivery.[41]

E. Align market cost allocation and capacity product definition with intervals driving system reliability needs

While residential and small business consumers, through their demand flexibility and energy efficiency investments, have the potential to provide meaningful capacity, it is not a given that this will be realized. Unlike a battery or a gas-fired generator, residential and small business consumers are not undertaking investments in home energy equipment, or optimizing their lifestyles, to meet the needs of the energy system or the energy (or capacity) market. Aligning market cost allocation and capacity product definitions will ultimately create a value stack for consumers, encouraging more participation, lower system costs and a transfer of revenues away from generators back to consumers.

This value stacking can be done by aligning cost allocation with cost causation and assigning capacity costs to retailers based on their share of load during coincident peak and/or scarcity event hours. Retailers will have a greater incentive to procure/provide demand response and energy efficiency resources, since doing so will both reduce their capacity cost obligation and earn them capacity market

[35] *Resource owners can also engage in bilateral agreements to pair complementary summer and winter resources, so as to submit a higher aggregate annual capacity rating.*

[36] *Brattle (2022), "Capacity Resource Accreditation for New England's Clean Energy Transition. Report 1: Foundations of Resource Accreditation", p.12*

[37] *ESB (2022), "Summary of International Case Studies", p.20*

[38] *ESB (2022), "Summary of International Case Studies", pp.36-39*

[39] *ESB (2022), "Summary of International Case Studies", p.20*

[40] *ESB (2022), "Summary of International Case Studies", pp.10,34*

[41] *SEDC (2017), "Explicit Demand Response in Europe - Mapping the Markets 2017", Smart Energy Demand Coalition, p.90*

revenues. In Western Australian, AEMO noted that the 2020-21 peak demand was reduced by 146 MW as a result of cost allocation incentives for retailers.[42]

Table 6: Cost allocators and product definitions

WEM	Costs are allocated to retailers based on their contribution to system peak demand based on metered consumption during the year's 12 highest demand peak intervals. Cost allocations are calculated monthly, and each month's consumption are adjusted by an adjustment ratio to ensure that the sum of retailer obligations equals the capacity requirement. The capacity product definition is broader, with the capacity obligation being year-round supply. [43] Demand response needs to be notified at least two hours prior to dispatch.[44]
PJM	Costs are allocated to retailers by their share of the system coincident peak, based on the 5 highest weather-normalized load of hours of the past summer. Capacity product definitions are broader and differ across demand response and energy efficiency. The peak period for demand response is 10am to 10pm in summer and 6am to 9pm in winter. For energy efficiency it is 1pm to 5pm in summer and 5pm to 7pm in winter. In all cases the peak is working days only. Demand response must offer into the market during peak periods and is dispatched as with other resources. Demand response is expected to fully respond within 30 to 120 minutes, depending on the resource type.[45]
ISO-NE	Costs are allocated to retailers by their share of the system coincident peak based on the single highest hour of the year. Demand response is called as needed and needs to be available at all times. Energy efficiency has two separate products, each with their own peak definitions. On Peak energy efficiency is time based with peaks from 1pm to 5pm in summer and 5pm to 7pm in winter, working days only. Seasonal Peak energy efficiency is assessed when hourly system load is higher than 90% of forecast peak demand. Demand response is required to bid into day ahead and real-time markets year-round and can be committed and dispatched as with any other resource, subject to its operating parameters. Non-fast-start demand response can be committed for dispatch in the day ahead market and dispatched in real-time, while fast-start demand response can be committed and dispatched in real-time.[46]
UK	Costs are allocated based on a retailer's share of net demand for periods of high demand in the delivery year.[47] The high demand period is 4pm to 7pm in the winter months, November to February.[48]

[42] AEMO (2021), "Analysis of response to Individual Reserve Capacity Requirement in 2020-21 Hot Season"
[43] Energy Policy WA (2022), "Wholesale Electricity Market Rules", Clause 7.6.1F
[44] Energy Policy WA (2022), "Wholesale Electricity Market Rules", Clause 7.6.1F
[45] PJM (2022), "PJM Manual 18: PJM Capacity Market", Revision 52, p.73
[46] Brattle (2019), "International Review of Demand Response Mechanisms in Wholesale Markets", p.30
[47] Low Carbon Contracts Company. https://www.lowcarboncontracts.uk/capacity-market-charge, last accessed 16/07/2022
[48] EMR (2022), "Capacity Market", last accessed 21/07/2022

	Capacity providers are required to deliver their contracted capacity during emergency events (termed "system stress" events). They are given a warning notification four hours before a system stress event.
France	In France, each retailers' capacity obligation is determined by their customers' usage (MWh) during peak hours on peak consumption days (called PP1). 15 PP1 days are called per year.[49] For capacity dispatch, there is a broader definition of event days – PP2. PP2 days include peak consumption days (PP1) and any other days that the system is under stress. Between 15 and 25 PP2 event days can be called every year. [50] Participants receive a day-ahead notification for both PP1 and PP2 days.[51]

F. Multiple auction periods ahead of delivery year

An initial auction several years ahead of the delivery year provides developers sufficient time to build new supply. In the years after the initial auction and ahead of the delivery year, regularly occurring reconfiguration auctions can allow the system operator to adjust the quantity demanded and participants to adjust supply commitments. For example, the standard US practice is to have an auction 3 years ahead of the delivery year, followed by annual reconfiguration auctions. This is especially important for demand response and energy efficiency suppliers, since they will have greater uncertainty at the initial auction in their abilities to enrol participating customers.

Table 7: Auction timing and frequency

WEM	Single pricing period through an administrated capacity pricing mechanism T-3 prior to delivery period. Suppliers unable to meet their obligated capacity ahead of the delivery year can request a reduction in their obligation from the system operator. Historically sufficient capacity has been procured to account for this, however if further capacity is required, there is a supplementary capacity mechanism to make up any shortfall.
PJM	Initial auction at T-3, which aims to procure all of the required capacity and incremental auctions at 20 months, 10 months and 3 months ahead to rebalance quantities. Capacity providers can offer additional capacity into the incremental auctions or bid to buy back capacity if they need to unload some of their obligations. Bilateral trades are also permitted. [52]
ISO-NE	Initial auction at T-3, which aims to procure all of the required capacity (subject to a demand curve) and incremental auctions each subsequent year to rebalance

[49] *Enoptea (2018), "What do days PP1 and PP2 correspond to?".*
[50] *Enoptea (2018), "What do days PP1 and PP2 correspond to?".*
[51] *Enoptea (2018), "What do days PP1 and PP2 correspond to?".*
[52] *ESB (2022), "Summary of International Case Studies", p.29*

	quantities. Capacity providers can offer additional capacity into the incremental auctions or bid to buy back capacity if they need to unload some of their obligations.[53]
UK	A main auction at T-4 to secure the full capacity requirement and a balancing auction at T-1. [54]
France	Capacity can be sold bilaterally, over the counter, or through organized auctions. There are 15 auctions in total – one in T-4, four in T-3 and T-2 and six in T-1. Capacity can be traded during and after the delivery year. Compliance is assessed three years after the delivery year. [55]

G. Transparency and simplicity

Demand response and energy efficiency resources are flexible and will adapt to alternative product definitions. While we generally support de-rating approaches that accurately account for resource availability when needed (as discussed under technology neutrality above), such approaches are likely less suitable for demand-side resources, where the attributes are highly malleable. Opaque de-rating that occurs in an integrated model will not account for this. It also lacks transparency for participants and does not send clear market signals of when and how capacity is needed.

Demand response capacity, especially aggregation of mass-market participants, is likely best estimated by the suppliers themselves,[56] who best understand their technologies, customers, and optimisation strategies. A clearly defined demand response testing regime and performance incentives/penalties for non-delivery of contracted capacity will ensure that suppliers have the right incentives to only offer capacity into the market that they have a high chance of delivering.

Energy efficiency capacity can be assessed over its lifetime relative to a baseline sectoral load forecast. This usually results in a declining capacity value relative to the baseline over time as historical data and new industry practices become endogenized into the load forecast.

Testing requirements for demand response should be transparent so that testing costs can be adequately integrated into bid offers by participants. In general, testing periods should be matched as closely as possible to actual dispatch conditions. This will help ensure accuracy of measurement for the system operator and also minimize costs for participants (higher avoided wholesale energy costs). If demand response is dispatched, then it should not be subject to further testing. In the UK costly testing requirements for demand response have proven contentious.[57]

[53] *Brattle(2022), "Capacity Resource Accreditation for New England's Clean Energy Transition. Report 1: Foundations of Resource Accreditation", p.6*

[54] *ESB (2022), "Summary of International Case Studies", p.22*

[55] *ESB (2022), "Summary of International Case Studies", p.29*

[56] *This is different to the demand response and energy efficiency study, which is intended to estimate the potential for these resources across the whole market. Rather, here we are talking about a particular demand or energy efficiency product, executed by a specific supplier. For example, an aggregator orchestrating temperature offsets on thermostats for space cooling will best be informed on their proprietary algorithm dictating the depth and length of reductions.*

[57] *ESB (2022), "Summary of International Case Studies", p.6*

Table 8: demand response testing regimes

WEM	Demand response tested twice yearly. • A facility test to measure its ability to curtail demand equal to its associated capacity credit value. • A verification test conducted between 1 October and 30 November (or within 20 days of registration for a new demand response provider), to curtail demand of at least 10% of its capacity credit value.
PJM	Demand response that is not dispatched during its availability period must perform a mandatory test to demonstrate it can meet its capacity commitment or receive a penalty.[58] Energy efficiency resources are assessed on the basis of a post-installation Measurement and Verification (M&V) Report, submitted prior to the delivery year, thus it is binary, energy efficiency is either performing or it isn't throughout the delivery year.
ISO-NE	If not dispatched, then demand response must perform a mandatory test to demonstrate it can meet its capacity obligation. Summer and winter dispatch/testing obligations are independent.[59]
UK	Test required before delivery year, dispatch during emergency events. [60]
France	Demand response providers need to demonstrate that they can meet their capacity obligation one year prior to delivery.[61]

Section 4: Questions for Stakeholders

We have identified the following stakeholder questions raised by the ESB as being most relevant to enabling demand response and energy efficiency. While our policy recommendations are summed up above, we have repackaged them to match the stakeholder questions for convenience.

Q1. What measures could be put in place to improve AEMO's forecasting process and to access the best information from retailers and large customers on their likely demand?

Demand response, energy efficiency and consumer energy resources need to be put on the supply-side of the capacity market so that AEMO can accurately account for them in forecasting net capacity needs. If demand response and energy efficiency are on the demand-side of the market, AEMO will need to both estimate historical demand response and energy efficiency deployment, as well as forecast the growth of these resources in the future delivery year. This is no simple task as the former is hard to identify among load fluctuation, and the latter depends on assumptions about how technological capability will translate into realized delivery.

To properly account for demand response and energy efficiency as a supply-side resource, peak demand forecasts need to estimate total load as if *no* demand or energy efficiency capacity were to

[58] PJM (2020), "Load Management Performance Report 2019/2020 (mid Delivery Year update)", p.4.

[59] ISO-NE (2022), "Market Rule 1", section III.1.5.1.3.1"

[60] Ofgem (2021), "Informal Consolidated Version of the Market Rules", p.199

[61] SEDC (2017), "Explicit Demand Response in Europe - Mapping the Markets 2017", Smart Energy Demand Coalition, p.90

be delivered through the capacity market. In this way, once demand response and energy efficiency capacity are accounted for as a supply resource, there is an accurate picture of the remaining net demand to be met by other forms of capacity.

Q4. If there is a risk of the emergence of more than one at-risk period in the NEM how should that be addressed?

We strongly support creating separate seasonal capacity products to allow for a wider range of market participation and lower costs for consumers. Seasonal capacity products will allow seasonably varying capacity needs to be met more cost-effectively than under an annual design by fully recognising differences in seasonal needs and differences among resources' seasonal capabilities and cost.[62] A seasonal capacity mechanism will help ensure:

1. **Less excessive capacity.** Procuring capacity that can perform year-round at the level required to meet the higher season peak will result in excess capacity being procured for the rest of the year.[63]

2. **More participating resources.** Seasonal resources can fully participate in the market and the full seasonal contribution of annual capacity resources can be realized. There will be many demand response and energy efficiency resources based on seasonal loads that cannot participate in an annual market but can contribute lower cost capacity to a seasonal market. For example, demand response or energy efficiency resources based on cooling or space heating will only contribute capacity in the summer and winter, respectively. Additionally, some capacity sources that operate year-round will have different capacity ratings in summer and winter. For example, solar is less productive in winter than summer, as is some fossil fuel generation during more extreme cold snaps. Seasonal products will allow them to offer their full capacity value into the market rather than the lower of the two, as is common with annual product designs.[64]

3. **Better price signals**. Seasonal products will better reflect marginal resource costs. Annual products average these out, sending poor market price signals to participants.[65]

PJM already has summer and winter seasonal capacity products, although capacity needs to be matched across both seasons (using a market optimisation algorithm). For capacity delivery year 2022/23, seasonal capacity was only 0.5% of total capacity procured, but consisted almost entirely of summer-only demand response and energy efficiency matched to winter-only wind capacity.[66] Although a small share of total capacity, these products are important for enabling demand response and energy efficiency, making up 5% of total cleared capacity for both resources.[67]

PJM is actively discussing establishing a full seasonal product market with stakeholders. MISO has already filed to propose a seasonal market to FERC; Ontario already has a seasonal capacity market.

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[62] Brattle (2018), "Opportunities to More Efficiently Meet Seasonal Capacity Needs in PJM", p.8
[63] Brattle (2018), "Opportunities to More Efficiently Meet Seasonal Capacity Needs in PJM", p.3
[64] Brattle (2018), "Opportunities to More Efficiently Meet Seasonal Capacity Needs in PJM", pp.4-7
[65] Brattle (2018), "Opportunities to More Efficiently Meet Seasonal Capacity Needs in PJM", p.8
[66] PJM (2021), "2022/2023 RPM Base Residual Auction Results", pp.12-14
[67] PJM (2021), "2022/2023 RPM Base Residual Auction Results", pp.12-14

Q6. What approaches should be used to de-rate different technologies? Should different approaches apply to different technologies?

De-ratings should be technologically neutral to ensure all resource types are enabled to participate and are awarded capacity ratings consistent with their reliability contributions. In evaluating options for resource accreditation, the guiding principles should be to:

1. Help ensure that reliability will be maintained,
2. Provide a reliability-neutral exchange rate among resources, both to enable reliable substitutions and to signal efficient investment,
3. Help incentivise resource owners to enhance, maintain, and operate their facilities to be able to perform when needed most, by reflecting demonstrated performance in their accreditation, and
4. Recognize modelling and data limitations that may differ among types of resources.[68]

To this end capacity accreditation should account for:

- The outage rates for each resource;
- That some faster-responding resources may have greater reliability value and capacity ratings than slower-responding (e.g. 24-hour notice, vs. 10 min notice),
- That energy limited and intermittent resources capacity ratings should account for possible non-availability during shortfall events,
- That thermal resources with high and low temperature correlated outages or risk of fuel supply limitations during weather events will have lower capacity value.

Demand response and energy efficiency resources are flexible and will adapt to alternative product definitions. While we generally support de-rating approaches that accurately account for resource availability when needed, such as de-rating based on peak period performance within an integrated model, such approaches are less suitable for demand-side resources, where the capacity attributes are highly malleable. Opaque de-rating that occurs in an integrated model will not account for this. It also lacks transparency for participants and does not send clear market signals of when and how capacity is needed.

Demand response capacity, especially aggregation of mass-market participants, is likely best estimated by the suppliers themselves, who best understand their technologies, customers, and optimisation strategies. For example, an aggregator orchestrating temperature offsets on thermostats for space cooling will best be informed on their proprietary algorithm dictating the depth and length of reductions. A clearly defined demand response testing regime and performance incentives/penalties for non-delivery of contracted capacity will ensure that suppliers have the right incentives to only offer capacity into the market that they have a high chance of delivering.

Energy efficiency capacity can be assessed over its lifetime relative to a baseline sectoral load forecast. This usually results in a declining capacity value relative to the baseline over time as historical data and new industry practices become endogenized into the load forecast.

For all consumer energy resources including demand response and energy efficiency, capacity ratings need to be grossed up to include avoided transmission and distribution losses.

[68] Brattle (2022), "Capacity Resource Accreditation for New England's Clean Energy Transition. Report 1: Foundations of Resource Accreditation", p.46

Q7. What is the right balance between transparency/simplicity and accuracy [in de-rating]?

Transparency/simplicity will benefit new entrants and technologies, while accuracy is more easily accomplished with existing capacity and established technologies. A two-pronged approach that provides more transparent and simple de-ratings to new entrants, especially those with unproven technologies, and more accurate/complex to established technologies and existing capacity will strike the right balance between minimizing costs while encouraging new capacity.

Q8. Should de-rating factors be determined at a technology class/region level or at a station level?

This will vary by generation type, if the range of potential outcomes are limited, then technology specific de-rating factors makes sense, with large penalties for non-compliance. If there is large variation in potential outcomes, then station-level makes more sense. For demand response, outcomes will be highly variable and depend on the specific technology and supplier and thus station level de-ratings are optimal. For energy efficiency, it may be a mix of the two depending on the specific energy efficiency measure being used.

Q13. Do you agree with holding two auctions for each delivery year and is this timing appropriate? If no, what auction frequency and timing is appropriate and why?

Multiple auctions for each delivery year is preferred. An initial auction several years ahead of the delivery year will provide developers with sufficient time to build new supply. In the years after the initial auction and ahead of the delivery year, regularly occurring reconfiguration auctions can allow for both the system operator to adjust the quantity demanded and participants to adjust supply commitments. For example, the standard US practice is to have an auction 3 years ahead of the delivery year, followed by annual reconfiguration auctions. This is especially important for demand response and energy efficiency suppliers, since they will have greater uncertainty at the initial auction in their abilities to enrol participating customers.

Q17. Do stakeholders have a view on the optimal duration of certificates or price certainty for new capacity?

Even a 1-year mechanism will provide far more revenue certainty than the NEM has previously provided. To avoid shifting too much investment risk onto consumers it would be better to start with 1-year price and quantity guarantees for new entrants. This could be ramped up in subsequent delivery years if supplier response is below expectations.

Q35. Should de-rating be based on pre-defined time periods or a forecast of when the anticipated trigger periods are expected to occur?

De-ratings should be technologically neutral to ensure all resource types are enabled to participate and are awarded capacity ratings consistent with their reliability contributions. To this end, both de-rating and the capacity product definition should align with scarcity event periods. If there is a time period element to the product definition, then this should be reflected in the de-rating.

Q39. What do you consider to be the most appropriate mechanism to allocate costs to retailers?

Aligning market cost allocation and capacity product definitions will create a value stack for demand response and energy efficiency. This will benefit consumers by encouraging higher demand response and energy efficiency participation, leading to lower system costs and a transfer of revenues away from generators back to consumers.

This value stacking can be done by aligning cost allocation with cost causation and assigning capacity costs to retailers based on their share of load during coincident peak and/or scarcity event hours. Retailers will have a greater incentive to procure/provide demand response and energy efficiency resources, since doing so will both reduce their capacity cost obligation and earn them capacity market revenues. In Western Australian, AEMO noted that the 2020-21 peak demand was reduced by 146 MW as a result of cost allocation incentives for retailers.[69]

[69] *AEMO (2021), "Analysis of response to Individual Reserve Capacity Requirement in 2020-21 Hot Season"*