04 July 2017

Mr John Pierce
Australian Energy Market Commission
PO Box A2449
Sydney South NSW 1235

Distribution Market Model – response to Draft Report

Dear Mr Pierce,

Thank you for the opportunity to provide input to the Draft Report on the Distribution Market Model project, which forms part of the Australian Energy Market Commission's (AeMC) technology work program.

Energy Networks Australia is the national industry body representing businesses operating Australia's electricity transmission and distribution and gas distribution networks. Member businesses, who provide energy to virtually every household and business in Australia, see this project as an important and exciting opportunity to assess the future of distributed energy systems, the potential markets which could develop and be encouraged, and the technical and operational enablers which are required to maintain power system safety, security and reliability in transformed markets.

With its latest Report, the AEMC appears to be focusing its technology work program more narrowly on distribution level energy markets, rather than the technical and operational foundations required in transformed distribution systems.

Over the coming decades, the electricity system will transition from one where electricity is largely sourced from large-scale transmission-connected generators, to a system where up to 50% of electricity is provided by distribution-connected resources. The AEMC have rightly identified that distributed energy resources (DER) could significantly contribute to supporting energy services, including wholesale and ancillary services markets. In that context, it would be appropriate to further evaluate the costs and benefits of alternative models to promote energy markets at the distribution level.

However, Australian networks are observing reverse flow in parts of the system *today*. This means that many of the issues relevant to this review are *already* impacting some areas of Australia's distribution network. The forecast uptake and scale of these resources means that, without careful management, the unprecedented penetration of bi-directional electricity flow could breach constraints even at transmission level and put overall system security of supply at risk.

When facilitating new markets, a managed transition - rather than 'a roll of the dice' - will be critical given the significance for small and large Australian customers.

Early action is necessary to ensure the safe, secure and reliable supply of electricity across the network, in the most affordable way. The distribution network must be agile enough to enable new technologies without unintended consequences for the essential service provided by the network - features which are highly valued by customers.

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The Energy Networks Australia submission explains why the AEMC should not to create barriers to the urgent need for frameworks and tools which ensure the safe reliable and secure supply of electricity, in the most affordable way. By proactively addressing these system security requirements and considering a staged sequence of reforms, the AEMC is more likely to advance the new distribution level energy markets it is seeking to promote.

Please don't hesitate to contact Brendon Crown, Executive Director Economic Policy on (02) 6272 1515 if you would like to discuss any aspect of the attached submission.

Yours sincerely,

John Bradley

Chief Executive Officer

Distribution Market Model

Response to Draft Report – July 2017

Energy Networks Australia

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Executive Summary

Energy Networks Australia welcomes this opportunity to respond to the Australian Energy Market Commission's (AEMC's) Approach Paper on its Distribution Market Model.

Energy Networks Australia views the Commission's review as an important opportunity to assess the future of the distributed energy systems, the potential markets which could develop and be encouraged, and the technical and operational enablers which are required to maintain power system safety, security and reliability in transformed markets.

Over the coming decades, the electricity system will transition from one in which electricity is largely sourced from large-scale transmission-connected generators, to a system in which up to 50% of electricity is provided by distribution-connected resources.

It is important to recognise both how rapid the transition is likely to be and the need to maintain the distribution power system in a secure operating state. When facilitating new markets, a managed transition - rather than 'a roll of the dice' - will be critical given the significance for small and large Australian customers. The distribution system must be agile enough to enable new technologies without unintended impacts on essential service features which are highly valued by customers today, including safety, security and reliability.

Many of the issues relevant to this review are *already* impacting some areas of Australia's distribution network. Australia networks are observing reverse flow in parts of the system today, the 'minimum demand' on the high voltage grid in key jurisdictions is moving to reflect Solar PV output in the middle of the day, and in some cases could be met solely by distribution generation within a decade (ie. South Australia) or by 2030 (Victoria). The forecast uptake and scale of these resources means that, without careful management, the unanticipated dispatch and bidirectional flows of energy could breach constraints even at transmission level and put overall system security of supply at risk.

Early action is necessary to ensure the safe, secure and reliable supply of energy across the network in the most affordable way.

With the latest publication, the AEMC's review appears to be focussing more narrowly on distribution level energy markets, rather than the technical and operational foundations required in transformed distribution systems. The AEMC have rightly identified that DER could significantly contribute toward supporting energy services, including wholesale and ancillary services markets. It would be appropriate to further evaluate the costs and benefits of alternative models to promote energy markets at the distribution level.

However, the critical foundation for any distribution level market reform will be the retention of secure system operations. Without appropriate power system

architectures supporting security-constrained dispatch, the growth of DER is likely to result in widespread overload and/or breach of technical constraints on the distribution network. This will impact existing customer service outcomes, drive reactive system expenditure, and will more likely result in limitations on market access or inefficient curtailment of distributed resources. By contrast, proactively addressing these system security requirements and considering a staged sequence of reforms would enable the new distribution level energy markets the Commission is seeking to promote.

The Electricity Network Transformation Roadmap developed by CSIRO and Energy Networks Australia proposed a staged approach to build capability for an actively managed distribution network over the period to 2027, with requisite sensing, hosting capacity analysis, advanced forecasting and modernised power system control architecture. The Roadmap proposes that such activities should be urgently prioritised at the same time as other reforms to animate new DER markets and customer choice, including the streamlining connection guidelines, developing locational valuation of DER within the distribution network and increased procurement of grid support services as a non-network solution. Having established the operational capability to integrate DER at significantly greater scale, the Roadmap anticipates that more fundamental changes, such as distributed energy markets and real-time transactive energy systems could be evaluated in informed way.

There are pressing issues which could be addressed in the AEMC's current inquiry:

- Energy Networks Australia recently raised the issues of distribution level system security in its response to the AEMC System Security Market Frameworks review. We noted that a more specific role may need to be identified for the distribution network to address system security, at least in some jurisdictions in the near future. For instance, Energy Queensland has identified that North Queensland is experiencing the fastest growth in non-synchronous generation connection applications above 1MW in the NEM, much of which is proposed for the sub-transmission network. This subregion will likely reach a point before 2025 where the installed capacity of this non-synchronous generation will be equivalent to the peak load of the region.[1]
- Other jurisdictions have recognised that the participation of distributed energy resources in bulk system wholesale markets administered by a Transmission System Operator will require frameworks to ensure the dispatch is technically and operationally feasible in the distribution system. The New York Independent System Operator's "Roadmap" for DER integration anticipates the need for the utility to work closely with the wholesale market operator to ensure that any dispatch instruction provided by the NYISO "…is a valid and executable instruction by the [DER coordination entity] and maintains safe and

[1] See Energy Networks Australia, *System Security Market Frameworks Review – response to Directions Paper,* 20 April 2017.

reliable operation of the distribution system"[2].

While Energy Networks Australia welcome further examination of the cost-benefit analysis of distribution level energy markets and look forward to its future if it can deliver affordability to customers, the AEMC should not delay the urgent short term need for frameworks and tools which ensure the safe reliable and secure supply of energy in the most affordable way.

1. Context for the AEMC review

This particular review comes in an environment of intense scrutiny of the sector. COAG is in the process of considering a number of recommendations from the recent Finkel Blueprint for the Future Security and Reliability of the Network. The Blueprint recognises that the National Electricity Market needs to increase system security and ensure reliability – as these elements have been compromised by poorly integrated variable renewable electricity generators, including wind and solar.

While the focus of the Finkel Review has been on security and reliability of the wholesale and transmission markets, over the coming decades, the electricity system will transition from one in which electricity is largely sourced from large-scale transmission connected generators, to one where up to 50% of electricity is provided by distribution connected resources.

The AEMC's report appropriately recognises the uncertainty of future technology uptake:

> *"Nevertheless, we cannot know for certain what the future will look like. It may involve high levels of distributed energy resources. Alternatively, technology developments and climate change policies may result in a future with more use of grid-scale renewable generation and storage, rather than at consumer premises*
>
> *We cannot know for certain what the future will look like. e. It is therefore unlikely that Australia's distribution networks will follow the evolutionary path as set out below - we could skip steps, stop at any point, or end up somewhere else entirely.*[3]

Nevertheless Energy Networks Australia and CSIRO analysis highlights the rate of uptake of DER, requiring an agile operational response to maintain distribution and transmission system security and reliability. The Chart below notes the projected Rooftop Solar PV by state in 5 year increments, indicating that in just over a decade Queensland and NSW rooftop solar PV capacity will approximate their current coal-fired generation capacity.

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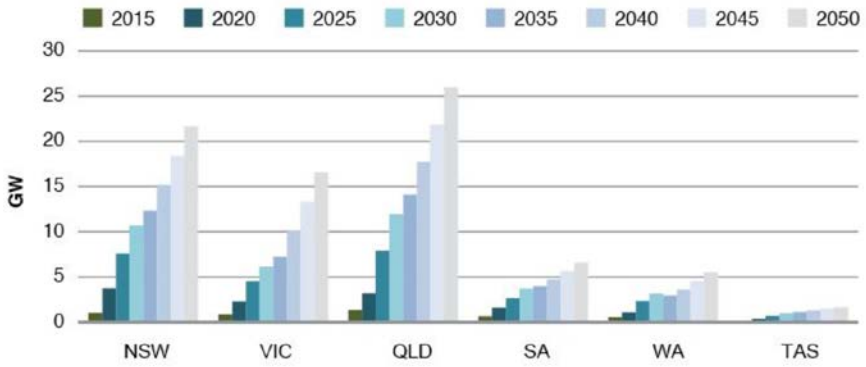
[2] New York Independent System Operator (2017) *Distributed Energy Resources Roadmap*, p.20.
[3] Draft report, p4

Figure 34: Projected installations of rooftop solar by state.



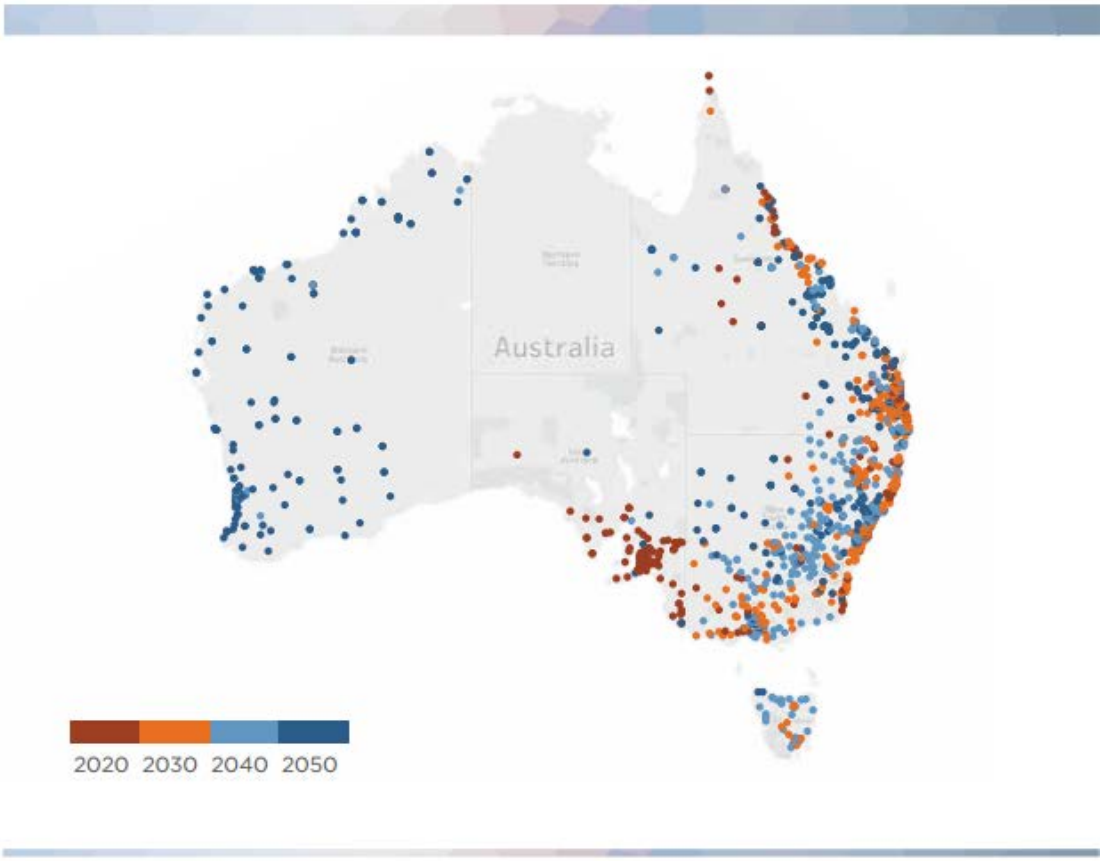
Source: ENTR, p96

By 2030, the CSIRO system analysis highlights the potential for 6 GWh of battery storage in NSW and Victoria, the equivalent of 400,000 residential battery systems. In Queensland, the installed storage could be 50% higher again.

The AEMC have rightly identified that these resources could significantly contribute toward supporting the individual customer benefits, energy markets and network services benefitting all customers. However, the corollary is that these rapidly deployed resources, without appropriate system capabilities and control architectures, have the potential to result in widespread overload and/or breach of technical constraints on the distribution network. In fact, the forecast scale of these resources is such that unanticipated orchestration could breach constraints even at transmission level and put overall system security of supply at risk.

CSIRO reviewed the relationship between the rooftop solar share of total annual load at the zone substation level and reverse power flows as a general indicator of other power quality issues. It was found that reverse power flows occurred at 30% rooftop solar load but were common from around 40% of load. Based on this analysis, CSIRO has plotted the location in which reverse flows are likely to be exhibited in different zone substation by decade. This is outlined in the figure below:

Figure 36: Projected decade in which each zone substation will reach a threshold penetration of rooftop solar adoption (40%) indicative of reverse power flow.



This zone substation analysis indicates that zone substations in South Australia have already met the threshold or will do so around 2020.

The CSIRO analysis is consistent with AEMO forecasts that as early as 2026, rooftop PV will be sufficient to supply 100% of South Australia's demand at minimum demand periods. Even in Victoria, where DER uptake has lagged Queensland and New South Wales, the recent Victorian Annual Planning Report by AEMO indicates that key demand properties of the Victorian system will change relatively quickly. In relation to Minimum Demand on the Victorian system:

- Within 5 years, it will occur in the middle of the day;
- Within 10 years, is forecast to have halved; and
- By 2035, 85% of the minimum demand could be by DER.

Such changes need to be considered in the context of changes in the large scale generation fleet, including the closure of synchronous generation (like Hazelwood power station) which reduces reactive power capability.

Energy Queensland has identified that North Queensland is experiencing the fastest growth in non-synchronous generation connection applications above 1MW in the

NEM, much of which is proposed for the sub-transmission network. This subregion will likely reach a point before 2025 where the installed capacity of this non-synchronous generation will be equivalent to the peak load of the region.[4]

The remainder of the Eastern states will have a significant share of substations over the threshold by around 2030, more so in the populated areas of the coast, but not exclusively so.

Networks businesses are acutely aware of the impact of technology change. Transmission and distribution businesses are already adapting their businesses to meet customer driven changes to the energy landscape. Many of the impact of these changes arise in small locational parts of the network.

2. Refocussing of the Review scope and approach

The AEMC noted in its approach paper that, as part of a broader work program, this Review explores possible distribution market design options that may be available to harness opportunities presented by Distributed Energy Resources. The Consultation Paper notes that:

> *"...the focus of this project is on the technical and regulatory challenges of distributed energy resources on distribution networks."*

Energy Networks Australia considers a focus on power system security, reliability and safety must be retained. Australia is transitioning from a market whereby managing and meeting demand is the issue of primacy to one in which managing potential the potential for excessive localised generation or unconstrained DER dispatch in some parts of the network are the most critical issues. Within this context, we consider that the AEMC's distribution market model review should consider not just "how do we optimise investment and operation of DER", but more so **"how do we optimise investment and operation of DER whilst maintaining reliability, quality and security of supply".**

In its Draft Report, the AEMC now appears to have narrowed its scope further by noting the final report will deliver:

> *"recommendations on possible ways to address **any identified barriers to the development of a market-based approach** to the optimisation of distributed energy resources" [emphasis added]*

Energy Networks Australia recognises that DER offer a range of services to customers, energy markets and network outcomes which have the potential to be optimised. However, the AEMC document appears to engage insufficiently with the

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[4] See Energy Networks Australia, *System Security Market Frameworks Review – response to Directions Paper,* 20 April 2017.

threshold outcomes for power system safety, security and reliability which must be assured in any new framework. These core service features are highly valued by customers and should not be assumed as a given or as able to be "traded off" against other services that DER can deliver. Network orchestration is paramount for power system security and reliability and therefore should be treated as a foundation – not competing – service.

Markets may be highly effective in undertaking an economic optimisation of Distributed Energy Resources for a variety of services within a defined operating envelope of operating conditions, but this market optimisation process cannot happen without appropriate management of the distribution system. Before progressing a particular approach to distribution level energy markets, the AEMC should also undertake analysis to ensure which model will lead to lower cost outcomes for customers given the transaction costs involved.

Network Orchestration is paramount for power system security and reliability

The uncontrolled/uncoordinated operation of tens of thousands, and even millions, of customer DER devices will have significant consequences for the planning and operation of the network. The scenario is analogous to the rapid take-up of air conditioners in the 1990s and 2000s, which challenged the reliability of the power system and network planning, with major blackouts during summer heatwaves in Qld, NSW and SA in the early 2000s. However, there is additional complexity in forecasting and in the fact that the future network will need to manage capacity for bi-directional flows.

Customer expectations of maintaining reliability, quality and security of supply should have precedence over the desirable objective of promoting new market services; recognising the potential for DER markets to assist in meeting those expectations. A high price for market services is of no value if the network has failed due to a breach of technical constraints. Network Orchestration to ensure reliability, quality and security of supply therefore does not represent a conflict of interest. This is highly analogous to the design of the NEM at the wholesale level whereby AEMO optimise dispatch within the physical constraints of the transmission networks & network security. Energy Networks Australia encourages the current review to take account of the institutional mechanisms the Independent Review of NEM Security and the AEMC's System Security Market Frameworks review have found necessary to introduce, in part because a reliance on market-based approaches alone was not providing sufficient confidence in minimum security outcomes in a rapidly transforming energy system.

Network Orchestration is happening now to ensure secure and reliable supply of energy

As the Commission is aware, distribution networks today are addressing the impact of distributed energy resources on the network. Networks are increasing their capacity for monitoring and control; and adopting simple, relatively inexpensive solutions

wherever possible, such as 'tapping down' the distribution transformer voltage. In other cases, it may be necessary to augment customer service mains to reduce impedance or install bi-directional voltage regulators.

A number of networks have trialled battery storage to assess its ability to efficiently manage power quality issues. Energex has used 'direct load control' of customer hot water systems to soak up surplus solar energy as a "solar sponge".

This gradual incremental approach to network orchestration is preferred to step changes in platform and market development, recognising further innovation and trials will be necessary as the level of DER increases.

Higher levels of DER Orchestration will be needed over the next decade

In a future where up to 50% of electricity generation occurs on the distribution network, the role of the network is shifting from solely meeting demand, to addressing congestion and enabling customers to share their energy resources with others. Integrating high levels of variable renewable energy and distributed energy resources markedly increases the complexity of network management and requires the holistic application of advanced technologies and tools to ensure stable and efficient operation.

The role of distribution network management will become increasingly important, irrespective of the future market design for distribution level energy markets and any institutional framework developed.

The development of frameworks which allow for the most efficient delivery of reliable and secure network services represents a 'no regrets' approach which avoids unnecessary delays but would not foreclose the future potential for alternative market structures or future roles for separate distribution system operation where and when they are justified.

The Electricity Network Transformation Roadmap developed by CSIRO and Energy Networks Australia proposed a staged approach to build capability for an actively managed distribution network over the period to 2027, with requisite sensing, hosting capacity analysis, advanced forecasting and the power system control architecture. The Roadmap proposed that such activities should be urgently prioritised at the same time as other reforms to animate new DER markets and customer choice, including the streamlining connection guidelines, developing locational valuation of DER within the distribution network and increased procurement of grid support services as a non-network solution. Having established the operational capability to integrate DER at significantly greater scale, the Roadmap anticipates that more fundamental changes, such as distributed energy markets and real-time transactive energy systems could be evaluated in an informed way.

Energy Networks Australia recently raised the issues of distribution level system security in its response to the AEMC System Security Market Frameworks review. We noted that a more specific role may need to be identified for the distribution network to address system security, at least in some jurisdictions in the near future. For instance, Energy Queensland has identified that North Queensland is experiencing the fastest growth in non-synchronous generation connection applications above 1MW in

the NEM, much of which is proposed for the sub-transmission network. This subregion will likely reach a point before 2025 where the installed capacity of this non-synchronous generation will be equivalent to the peak load of the region.[5]

While Energy Networks Australia welcome further examination of the cost-benefit analysis of distribution level energy markets and look forward to its future if it can deliver affordability to customers, the AEMC should not delay the urgent short term need for frameworks and tools which ensure the safe reliable and secure supply of energy in the most affordable way.

Costs in establishing and maintaining a distribution level energy market need to be considered

Existing DER orchestration trials are currently being undertaken. Distribution network providers are undertaking some of these trials which are currently realising multiple value streams, such that benefits are realised to both network users and the individual customers. In each case, customers are choosing to engage in those trials voluntarily with an upfront understanding of the service regime to optimise the DER and the commercial gain-sharing between individual customer outcomes and the network benefits important to all customers. Where potential network constraints are managed (including through purchasing of DER) multiple value streams can be readily delivered since demand-driven network constraints typically only occur very infrequently. A key gap in current trials, however, is that they do not yet integrate the function of managing import and export constraints to dispatch. Trials are currently being scoped to address this gap.

A market model may therefore be highly effective in undertaking the optimisation of energy purchases and sales from these various resources in an environment where up to 50% of electricity is provided by distribution-connected resources.

However, the complexity and cost of establishing a market should be carefully considered alongside the benefits and it is likely trials will be highly valuable in informing decisions about the relevant advantages and disadvantages of various delivery models. The complexity and cost of establishing a market should be carefully considered alongside the benefits and trials could be highly valuable in informing these decisions.

For example, if participants are not willing to disclose the price at which they are willing to buy/sell energy (for example to enable peer to peer transactions between households with different retailers) in distribution level energy markets, then opportunities and benefits for more granular real time markets may be limited.

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[5] See Energy Networks Australia, *System Security Market Frameworks Review – response to Directions Paper,* 20 April 2017.

3. Orchestration and DER Optimisation

Using markets to optimise distributed energy resources for a number of value streams

The AEMC objective appears distribution-level energy markets

The AEMC recognises that distributed energy resources have the opportunity to provide real energy, reactive energy and reserves which can support a number of different services in the market. It also recognises the potential benefit for greater choice by customers in how they use the output from any distributed energy resources they own.

> *Optimisation provides a way to send signals to whoever has control of the distributed energy resource to provide the service that will deliver the most value at that point in time. This optimisation process gives consumers the ability to maximise the benefits of an investment in distributed energy resources by enabling them to, if they choose, receive the maximum possible benefit of utilising and selling the full range of services that the asset is capable of providing, given transaction and information costs, and technical constraints*[6].

The emergence of a fully functional distribution level energy market is likely to begin with opportunities for decentralised energy to be aggregated and traded in the existing wholesale electricity market. In the future, more advanced retail markets and services, are also likely facilitating the sale of energy and other services from DER, essentially ranging from a "peer to peer" trade to a "many to many" transactions as an energy product. However, given the current market arrangements for the buying and selling of energy, the Roadmap recommended that consideration to these markets be given at the end of the decade:

> *there is the possibility towards the end of the Roadmap decade that consideration will have been given to the development of a distribution energy market, initiated by non-network stakeholders. Such considerations should be undertaken as these markets begin to emerge and mature.*[7]

All evidence internationally suggests that the development of a fully functioning distribution level energy market would most likely take a very significant time to develop, probably in excess of a decade timeframe. Some of these factors are outlined below:

The ability of DER to deliver the services required

Firstly, it is important to recognise that participation in some of these markets, requires certain technical prerequisites that cannot necessarily be achieved by all DER. Certain characteristics are critical if DER is to provide frequency regulation or

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[6] Roadmap p81
[7] Roadmap p81

fast contingency reserve capability for example. The "firmness" required for energy flows enabled by a distribution network in wholesale markets requires new considerations of network capacity and operations.

Other jurisdictions have recognised that the participation of distributed energy resources in bulk system wholesale markets administered by a Transmission System Operator will require frameworks to ensure the dispatch is technically and operationally feasible in the distribution system. The New York Independent System Operator's "Roadmap" for DER integration anticipates the need for the utility to work closely with the wholesale market operator to ensure that any dispatch instruction provided by the NYISO "…is a valid and executable instruction by the [DER coordination entity] and maintains safe and reliable operation of the distribution system"[8].

The development of more sophisticated energy markets based on transactive market principles, will also require fundamentally new trading and pricing arrangements for networks.

The need for a physical system and architecture to support the financial market

It is important that the design of electricity markets has careful regard to the physical elements that support market outcomes. There is enormous potential for individual devices to be aggregated, as 'virtual power stations' or orchestrated, and diversity attributes may be used to provide an increased level of certainty over the provision of the required service. However there unsolved additional technical complexities, such as:

- Ensuring a sufficiently firm response from a large fleet of devices acting in a coordinated manner in operational timeframes whether under long-term contracts or real time price signals; and
- The control architectures necessary to avoid the potential for unintended consequences of large scale synchronised switching for system security and stability.

It is likely that these issues can only be evaluated with lived experience in real operational trials and demonstration processes. This will assist a better evaluation of both the uncertainty of grid services and the additional transaction or interface costs likely to be associated with alternative delivery models, including more automated digital markets or platforms.

In summary, all the international reports[9] we are aware of consistently suggest that there are considerable challenges involved in developing distribution level energy markets aimed at optimising energy related services in a single market environment.

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[8] New York Independent System Operator (2017) *Distributed Energy Resources Roadmap*, p.20.
[9] A list of the variety of expert reports contributing to the Electricity Network Transformation Roadmap can be found on Energy Networks Australia's website. In particular, we note the "Future Market Platforms and network optimization – Synethesis Report" which we provided to AEMC staff earlier this year.

This may be economic some time in the future but it is not yet clear that the benefits associated with a distribution level energy market would be sufficient to outweigh the costs.

Roadmap emphasises the need for incremental steps to manage the network as a necessary precursor to distribution level energy markets

This is why the Roadmap emphasises the need for incremental steps which allow a "no regrets" approach without foreclosing on the optimisation of a range of services that DER can provide:

> *More sophisticated forms of incentives and price signals are likely to evolve as the size and sophistication of these markets increases. However, it is likely that the benefits of deferred network investment will be substantially greater than other benefits in the short term, and significant value will be obtained if this can be monetised early*[10].

Why Network Orchestration is different

The Roadmap discusses Network Orchestration at length. In the context of the roadmap,

> *"orchestration" allows the free flow of energy, including the reverse flow of energy between localised low voltage network areas and into higher voltage networks. Networks have the visibility and the market tools to economically balance energy flows without the need to "build out" constraints.*

The focus of the Roadmap is the optimisation of the network, not distributed energy resources, on the basis that where well integrated, aggregated distributed energy resources can provide a cost-effective alternative to capital intensive network investments in specific locations. Despite this focus, the Roadmap is not assuming that Network Service Providers would come to DER markets with an exclusive or advantaged position. Instead, it proposes a Network Optimisation Market in which the network would:

- transparently disclose the potential opportunities for DER solutions, and
- procure DER services where this is more economic than a traditional network solution.

To avoid the traditional network solution, clearly the network provider will require a defined understanding of the firmness of the service and a clear contractual agreement with the DER host, whether an individual customer, aggregator or retailer.

The Roadmap notes:

> *On current projections, investment in battery storage is likely to reach a critical mass before 2030 and without appropriate incentives or orchestration, mass scale battery charging profiles could lead to export/import imbalance in*

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[10] CSIRO and Energy Networks Australia 2017, Electricity Network Transformation Roadmap. Synthesis Report: Future Market Platforms and Network Optimisation.P7

distribution networks or new peak demand events which would drive additional network investment.

Managing such high levels of DER on the network will require enhancements in the monitoring, modelling and planning capabilities of network businesses. In the absence of such investment, distributors will need to continue to rely on 'broad brush' limits placed on DER (such as hard, network-wide export limits) which are highly inefficient given that such limits may only be required for short periods and in certain locations on the network.

Incentives for investment at the right time and place

Network orchestration involves establishing the incentives for investment in new distributed energy resources in the right place and at the right time through better cost reflective network pricing and incentive mechanisms. Sending the right signals will not only bring forth the right investment at the right time. It will also reduce the additional network costs that may be incurred with rapid uptake of unorchestrated DER across the network.

However, there is a real opportunity to unlock further value from customer investments in distributed energy resources through direct, targeted incentive signals. Incentives for network support 'in the right place, at the right time' would achieve an integration of new technologies and complement the more efficient broad-based network tariff structures.

More sophisticated forms of incentives and price signals are likely to evolve as the sophistication of grid architecture and markets increases. Inevitably this will also include management of reverse flows of energy (or export constraints) as well as demand driven constraints or replacement decisions. This will necessarily require the development of transparent information for DER participants on the network requirements which may take the form of hosting analysis or heat maps which shows the location and amount of DER that can be accommodated or would add value at various locations.

Network orchestration does not compete with or foreclose opportunities for other value streams

Network Orchestration does not prevent the end use customer being presented with a variety of options for us and orchestration of DER. In order to promote choice, customers should be free to make their own decisions when offered with incentives for another party to access their DER output. This is not available to customers under current market arrangements in which the customer's retailer has full control over the value of the DER output with broad-based feed in tariffs imposed in some jurisdictions.

The prioritisation of various uses of DER should be able to emerge through contractual arrangements between willing participants. Customers may choose to contract directly with a network or an aggregator, or alternative may choose allow

their retailer to use the output in exchange for lower energy charges.

Network Orchestration does not constrain choice – it expands it by ensuring a secure and reliable network for the expanded services that a wide variety of stakeholders are looking for. This is likely to occur through more transparent arrangements with customers and their retailer on a platform that recognises the relative constraints at the network level.

If implemented correctly, the Roadmap predicts within 10 years, retailers and market actors respond to incentives where up to a third of their customers will participate in the orchestration of customer owned distributed energy resources, either passively or actively, in order to drive efficient network outcomes.

However, by making Network Orchestration a second order issue which effectively requires reliable and secure supply of energy to compete with all other possible value streams puts at risk the very services the AEMC is trying to promote.

Impact on early foreclosure

There is no evidence to suggest the early actions of the Roadmap provide any barrier to the future development of distribution level energy markets which can optimise DER for a range of services beyond DER over the next decade. In fact the Roadmap facilitates the benefits of distribution level energy markets and potentially brings forward the option to develop these markets with the value created in procuring network services.

On the contrary, by creating barriers for network procurement of DER until a sufficient layer of DER is present and markets for other services have been established has the potential to create an irreversible impact on affordability, reliability and security of network services. Certainly the benefits from the Roadmap that have been accepted and relied on by many stakeholders – including the Finkel Review – would be lost if networks were precluded from being able to manage the impact of distributed energy resources on the network.

4. Concerns with AEMC's Assessment Framework

The Commission's principles to guide its analysis of the technical and regulatory challenges raised by distributed energy resources, the possible models of future distribution system operation that may be available to address them, and their advantages and disadvantages are consistent with its approach paper. The AEMC suggested stakeholders largely agreed with these principles. However, the Energy Networks Australia response raised concerns with the principles. These are outlined below.

Definition of Distributed Energy Resource

The AEMC's definition of distributed energy resource appears incomplete in excluding the non-dispatchable rooftop solar PV systems. Such Solar PV resources currently provide the most significant source of distributed energy on the system.

We note the AEMC's reasoning for maintaining its definition of distributed energy resource. However, the report itself still appears to refer to the commonly accepted term. For example, the report mentions "there is expected to be a large future demand for distributed energy resource technologies, such as solar PV, energy storage and electric vehicles.[11]" We urge the AEMC to address this inconsistency in its final report.

Efficient and fair outcomes

The Commission infers that customer outcomes are maximised through its market design principles while acknowledging trade-offs are likely to occur between different principles. However, incorporating a principle that ensures efficient and fair outcomes for customers would ensure that the *realised* customer outcomes (not only choice) are given primacy in the Commission's considerations.

Contestability Outcomes and Customer Outcomes.

The AEMC in its Draft Report Approach Paper restates a position of the Commission's Integration of Storage Report that *"…the economically regulated arm of a DNSP would be prevented from supplying battery storage devices at consumer premises…"* but it could procure such services.

Energy Networks Australia supports regulatory reforms focussed on customer outcomes, which allow networks to deliver services efficiently. As the Commission notes in its recent Consultation Paper on Contestability of Services:

> *"It is the services provided by an asset that are classified under the existing economic regulatory framework, not the assets themselves. An asset could provide multiple services, some of which are regulated and others that are competitive. As such,* ***introducing restrictions on the ownership of assets (or the ability of network businesses to earn a regulated return in relation to an asset) into the regulatory framework would need to be considered carefully in order not to create any unintended outcomes and may not be the best approach.***[12] ***(emphasis added)***

[11] Draft Report p11

[12] AEMC (2016) National Electricity Amendment (Contestability of energy services) Rule 2016

Competition and Customer Outcomes

There are numerous technical, operational, regulatory and market issues associated with both the impacts and opportunities for distributed energy resources. Such complexity can lead to high transaction costs and any further development of DER optimisation markets should take into account the long term customer benefits.

The creation of complex market arrangements can effectively create a barrier to new entrants entering into energy markets already under intense scrutiny in terms of the effectiveness of the current frameworks to promote meaningful competition.

To the extent that the AEMC is favouring evolving platforms based on current competitive arrangements, this has the potential to create further barriers to entry in competitive markets where high degrees of market share and vertical integration are already present. In this regard we note analysis by the Finkel Review and ESCOSA and other stakeholders on the level of vertical integration in some jurisdiction and would recommend the ACCC review its impact on competition[13,14].

Participant neutrality in market design

One of the shortcomings of the draft report is its concentration on networks and the justification of why networks should not perform a range of functions

> *As set out above, the Commission does not consider it appropriate for the party who is responsible for providing common distribution services (i.e. a DNSP) to take on the function of optimising investment in and operation of distributed energy resources and the services that they provide[15].*

However, the draft report contemplates almost all other combinations of parties to perform a DER optimisation function – other than networks

> *The future may see the emergence of a range of business models that seek to maximise the full value of services provided by distributed energy resources on consumers' behalf - each interacting individually with the local DNSP and transmission-level markets to settle arrangements regarding the buying and selling of particular services. A workably competitive market will determine whether this optimising function is most efficiently achieved by multiple parties or by one party across a particular geographic region (which may or may not be a current distribution network), or indeed via multiple parties responding to an 'invisible hand'[16].*

The AEMC justifies its stance in chapters 2, 3 and 4 of the report, primarily on the basis that:

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[13] ESCOSA: Advice on justification for July 2016 South Australian retail electricity price increases, 21 April 2017
[14] Independent review into the future of the National Electricity Market, p87
[15] Draft Report p.38
[16] Draft Report p.9

- Networks are not independent because they have a financial or regulatory interest in the provision of a particular service
- Networks are not exposed to financial incentives to provide and understandable and transparent approach to influence behaviour

In determining who should optimise markets, the Report emphasises that a level playing field for optimising investment in, and operation of distributed energy resources is created if the party carrying out the optimisation function is independent and is not exposed to a financial interest in one of the multiple potential DER services.

> *The optimising function is carried out by a party who does not have a specific interest in one or more of those services being provided, or in a particular way. That is, it is independent. If the optimising function is taken on by a party who has a particular financial or regulatory interest in the provision of a particular service (i.e. where the provision of that service has a higher value to the party who takes on the optimisation function than to what the consumer's preference would be), then that party is acting in accordance with its own interests and is unlikely to make decisions that result in the full value of that asset being maximised.*[17]

The Report explicitly concludes that DNSPs would be inappropriate to undertake such an optimising function, without applying the same reasoning and assessment to any other market participant.

> *The Commission considers that the optimising function is best carried out by a party that does not have a financial or regulatory interest that would result in them favouring the provision of one service over another, other than in response to efficient price signals. As set out above, the Commission does not consider it appropriate for the party who is responsible for providing common distribution services (i.e. a DNSP) to take on the function of optimising investment in and operation of distributed energy resources and the services that they provide*[18]*.*

However, the arguments put forward by the AEMC which preclude networks from being a party to optimise DER could just as equally apply to the gentailer sector as evidenced in the table below:

AEMC's rationale against DNSP's role in DER optimisation	Gentailer considerations
The DNSP has an incentive to focus on the network benefits of distributed energy resources only… optimisation should make sure that individual issues or system needs are looked as part of	Gentailers have an incentive to focus on benefits that maximise their financial interest and will not be looking at the whole picture if their financial interests are not satisfied (for instance where they do not have sufficient market share or

[17] Draft Report p34
[18] Draft Report p38

the whole picture	penetration in a particular region)
The DNSP may have a limited incentive to share some or all information about constraints or limitations on its network, or where investment in the network may be valued, unless required to do so	The Gentailer will have an even greater incentive not to share information about 'unlocked' value in certain markets, if it is in the gentailers financial interest not to do so. The difference between the two parties is that there is more opportunity to require DNSPs to disclose information under common regulatory arrangements where information asymmetry exists in current retailer markets.
The DNSP may have less of an incentive to establish effective price signals to show the highest value use of distributed energy resources, which means that the full range of services that can be provided by distributed energy resources is unlikely to be optimised	The logic of the AEMC position on the DNSP is unclear, given the DNSP should be incentivised to achieve the most efficient solution to a given network service requirement. Whether this represents the highest value use of the DER will emerge when the DER host considers the opportunities available when faced with the DNSP opportunity. To the extent that the logic holds, it would apply equally to a Gentailer as it would a DNSP.
The regulated DNSP may have an incentive to limit access by distributed energy resources to transmission-level markets, for example to prioritise their network benefits	This is stated without evidence or supporting logic. As above, DNSPs should be incentivised to achieve the least solution for a given network need. While a distribution network is precluded under regulation from differential treatment of customers in the manner the AEMC suggests, even if this were possible it would not be in the financial interest of the DNSP to do so. A DNSP which did frustrate the ability for a DER host to access wholesale markets would find that financial incentive (whether a payment, battery subsidy or network charge discount) offered for the grid support service would be commensurately *more* costly because the DER Host would perceive less value in the arrangement. By contrast, it does not appear that the

	AEMC has engaged with any incentive for Gentailers to establish VPPs or control of DER dispatch for the purposes of enhancing their wholesale or retail market position. This is despite relatively high, and increasing, levels of vertical integration noted by the recent Finkel Review.

The AEMC Report does not assess other participants against its criteria, other than network businesses and to a lesser extent AEMO. Energy Networks Australia strongly recommends a more neutral approach to future assessment frameworks to ensure a balanced evaluation of options.

5. Market Enablers and responses to questions

Information

We agree with the AEMC that efficient investment in and operation of distributed energy resources relies on these parties having access to information about:

- where distributed energy resources could or should be installed
- the costs of installing and operating distributed energy resources on the distribution network
- any constraints (including network constraints) that may affect how the distributed energy resources are operated
- opportunities for distributed energy resources to provide services to other parties or markets, and the value that is placed on those services being provided
- the technical impacts of distributed energy resources installation and operation on the network, both at a localised level and across the network as a whole.

Nevertheless, additional information will not be sufficient. With additional penetration of DER, the aggregate technical impact needs to be considered, with the impacts more severe if the uptake and operation of distributed energy resources is uncoordinated or in a non-orchestrated manner.

While we also agree with the AEMC's assessment of the need for further investment in technical capability, it ignores other network, standards and workplace enablers outlined in the Roadmap that also need to be trialled and developed and the consideration of how these costs will be recovered, particularly if there are costs in developing access to wholesale markets from very decentralised parts of the network.

Network Tariffs

We agree with the AEMC that tariff reform is a crucial element of the energy transition. However, while network tariffs have changed substantially to be more cost-reflective, the uptake by retailers has been virtually non-existent. We also agree that the signalling of future costs is usually time specific, locational and temporal.

However, we do not agree with the AEMC's view that the answer lies in developing complex tariff arrangements through annual pricing proposals that incorporate "fully cost reflective" tariffs to every household. Analysis by Energeia demonstrates that, because of this, using broad based tariffs to send time based, locational and temporal signals leads to inefficient outcomes. Similarly establishing network pricing frameworks which sets a unique tariff for individual customers would be complex and expensive and unlikely to deliver sufficient benefit to justify the cost.

This is particularly the case when one considers that market settlement of energy occurs at a much more averaged centralised level, with no real signal of the actual price of energy beyond the wholesale price at the node. In reality the costs to the customer of purchasing the energy output from a solar panel next door could be much cheaper than what the customer is paying their retailer. However there is no signal of this price at the locational level and these buyers and sellers are forced to transact through retailers who do not allow transfer of energy under separate arrangements.

The AEMC has not considered this lack of transparency of full cost reflectivity of energy at the decentralised level. Placing obligations on networks to develop complex tariff structures which establish fully cost reflective tariffs to signal temporal and time specific costs, while ignoring the lack of transparency of the cost of energy at these locations appears to be using the sledge-hammer to crack the peanut while leaving the walnut intact.

Question 1

Do stakeholders consider that there are any other barriers to the development and implementation of cost-reflective network tariffs? How material are these barriers? Are there other means for them to be addressed?

We have raised in previous consultation with the AEMC and in our Roadmap, the evidence that the rule changes made in respect of tariffs have not delivered to expectations, evidenced by the fact that there has been little, if any, retailer transition away from legacy tariffs and there is little visibility or transparency over the likelihood of meter penetration being sufficient to ensure network tariff reform is delivered efficiently.

We are also not yet convinced of the value, or willingness of the community, to accept locational nodal pricing and not at all clear if SRMC is a meaningful or useful concept for the pricing of distribution services.

Question 2

Do stakeholders consider that there are any 'missing markets' or 'missing prices' beyond those that will be implemented through cost-reflective network tariffs? If so, what are these?

We note above our concerns that the AEMC has paid little attention to the cost reflectivity of energy purchased and sold at the decentralised level. This seems to be a greater priority than creating obligations on network tariffs to be "fully cost reflective" particularly given the lack of retailer interest in transitioning from existing legacy tariffs.

Question 3

Do stakeholders consider that an open access regime will continue to be appropriate in an environment of increasing uptake of distributed energy resources and more constraints on distribution networks? If not, what principles or considerations should be taken into account in determining whether a different access regime is more appropriate?

It is not entirely clear whether the specific issue identified by the AEMC is directly related to rule 5.5, or whether this issue is should be separately explored, given it is exacerbated by the AEMC's Transmission Connection and Planning Rule Change Final Determination. While we believe this issues warrants further consideration, it takes focus away from more important considerations that this particular review needs to address. However if the AEMC believes there is a strong correlation between the issue of clause 5.5 and the distribution market model, we would welcome any further explanation.

In respect of issues associated with open access to distribution networks, we note the AEMC's finding that:

> *In a future where the patterns of investment in distributed energy resources and flows across distribution networks are much more uncertain, an access regime that provides greater flexibility may be required to facilitate more efficient coordination between these two types of investment.*[19]

Energy Networks Australia is of the view that foreclosing opportunities for network optimisation outlined in the roadmap is a symptom of the issues identified by the AEMC and will lead to higher costs and poorer outcomes to customers. This is why the Roadmap recommendation regarding development of network optimisation markets are so important for the affordable, reliable and secure supply of energy.

Question 4

Is there support for the Commission's proposal that the deletion of clause 6.1.4 of the NER be explored?

[19] Draft Report p57

It is important to note that the alternatives considered by the AEMC have no impact on the revenues earned by Network businesses. In other words, networks do not make additional returns by opening up new avenues of pricing for customers exporting to the grid. Deletion of clause 6.1.4 would potentially alter the amount of revenue DNSPs recover from each customer, rather than the total amount of revenue recovered from all customers.

We have mentioned in our submission however, that the network may face additional costs if DER is to operate in new markets – particularly wholesale services. If DNSPs were to levy network charges on the export of energy, customers exporting energy would contribute to the cost of upgrading network infrastructure to cope with increased energy flows associated with the installation of distributed generation.

While this issue should be further explored, there should be full analysis of retailer incentives to pass both costs and benefits on to customers and a recognition of how the AEMC sees networks applying pricing principles for these arrangements that ensures affordable supply to all customers.

Question 5

Are there any other aspects of the development of Australian standards that are relevant and should be considered?

The AEMC draft report does not reference the Roadmap, which outlines a series of milestones which look toward future standards that provide a future open platform approach. To the extent that the AEMC has not already reviewed these materials, we recommend the materials for review.

Question 6

Are there any other aspects of the development of Australian standards that are relevant and should be considered?

The AEMC draft report does not reference the Roadmap, which includes the milestone that by 2021, electricity networks are recognised for demonstrating that their investments are based on customer value, improving service performance and response times, and enabling more flexible network products.

Energy Networks Australia's analysis of current Australian market frameworks has identified issues with inconsistent technical standards for grid connection of distributed energy resources (DER). This issue has been identified as a major concern by industry stakeholders in numerous reports and reviews including the ENTR.

The development of National guidelines to standardise the connection of DER into the grid has therefore been identified as a critical action to facilitate better integration of growing numbers of customer resources into the grid. Development of such a guidelines is identified as one of the flagship projects in the Roadmap Implementation.