22 January 2020

Mr Arek Gulbenkoglu
A/General Manager, Distribution
Australian Energy Regulator
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Melbourne VIC 3001

Email: AERinquiry@aer.gov.au

Dear Mr Gulbenkoglu

Energy Queensland submission to the Australian Energy Regulator – Assessing Distributed Energy Resources (DER) Integration Expenditure

Energy Queensland Limited (Energy Queensland) welcomes the opportunity to provide comment to the Australian Energy Regulator on its Consultation Paper on Assessing DER Integration Expenditure (the Consultation Paper). The attached submission is provided by Energy Queensland, on behalf of its network businesses Energex Limited and Ergon Energy Corporation Limited.

Energy Queensland's responses to the consultation questions are included in the attached submission, which is available for publication.

Should you require additional information or wish to discuss any aspect of this submission, please contact me on [redacted] or Barbara Neil on [redacted].

Yours sincerely

[redacted]

Trudy Fraser
Manager Policy and Regulatory Reform
Telephone: [redacted]
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Encl: *Energy Queensland's submission to the Consultation Paper*

Energy Queensland Submission on Assessing DER Integration Expenditure

Consultation Paper

Energy Queensland Limited

22 January 2020

About Energy Queensland

Energy Queensland Limited (Energy Queensland) is a Queensland Government Owned Corporation that operates a group of businesses providing energy services across Queensland, including:

- Distribution Network Service Providers, Energex Limited (Energex) and Ergon Energy Corporation Limited (Ergon Energy);
- a regional service delivery retailer, Ergon Energy Queensland Pty Ltd (Ergon Energy Retail); and
- affiliated contestable business, Yurika Pty Ltd (Yurika), which includes Metering Dynamics Pty Ltd (Metering Dynamics).

Energy Queensland's purpose is to "safely deliver secure, affordable and sustainable energy solutions with our communities and customers" and is focussed on working across its portfolio of activities to deliver customers lower, more predictable power bills while maintaining a safe and reliable supply and a great customer experience.

Our distribution businesses, Energex and Ergon Energy, cover 1.7 million km^2 and supply 37,208 GWh of energy to 2.1 million homes and businesses. Ergon Energy Retail sells electricity to 740,000 customers.

The Energy Queensland Group also includes Yurika, an energy services business creating innovative solutions to deliver customers greater choice and control over their energy needs and access to new solutions and technologies. Metering Dynamics, which is a part of Yurika, is a registered Metering Coordinator, Metering Provider, Metering Data Provider and Embedded Network Manager. Yurika is a key pillar to ensuring that Energy Queensland is able to meet and adapt to changes and developments in the rapidly evolving energy market.

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1 Introduction

Energy Queensland Limited (Energy Queensland) welcomes the opportunity to provide comment to the Australian Energy Regulator (AER) on its Consultation Paper on Assessing Distributed Energy Resources (DER) Integration Expenditure (Consultation Paper). This submission is provided by Energy Queensland, on behalf of its network businesses Energex Limited (Energex) and Ergon Energy Corporation Limited (Ergon Energy).

Energy Queensland, as a signatory to the Energy Charter[1], is of the view that any framework for DER expenditure should consider customers' future expectations of energy supply. As part of Energex's and Ergon Energy's recent Regulatory Proposals to the AER we engaged broadly with our customers to determine their expectations and what the network businesses should do to support these expectations.

Our community leaders'[2] top three investment priorities were:

1. supporting renewable energy, including managing solar connections on the grid;
2. new technologies to prepare the network for the future; and
3. collaborating with customers on demand management.

Figure 1 Community leaders forum report (page 18) investment priorities

[1] www.theenergycharter.com.au
[2] Community leaders forum report - https://www.talkingenergy.com.au/36356/documents/90404

Our community leaders' engagement also indicated that these expectations must be managed in such a way as to maintain affordability, which is one of their largest concerns. With this in mind, the overall economic benefit of DER to the community and individual customers (for both export and self-consumption), must be considered in addition to network impacts. Consideration of the value of DER to the economy, and customer views on this, must be taken into account in any assessment of supporting network expenditure to enable this. The total community benefit from customer adoption of DER should also be considered as an input to forecast DER adoption that will need to be accommodated into distribution networks to support the value that this DER provides to the broader national electricity market (NEM).

For example, the Australian Energy Market Operator's (AEMO's) 2020 Integrated System Plan (ISP) forecasts that by 2040 DER could provide 13-22% of the total energy in the NEM therefore becoming fundamental to system stability and security. To this end, Energy Queensland suggests that doing so on a case by case basis could become administratively complex and Energy Queensland suggests a broader consideration of DER related investments is required against the broader benefits of greater levels of DER connection. Without an overall system view of the total economic benefit of enabling DER any assessment of the impacts of DER may be biased towards a cross subsidised technology or solution which is not in the best interests of all customers.

Energy Queensland's network business are already supporting a country-leading rate of DER adoption including:

- connection of 1177 medium to large-scale DER connected (with 643MW of total capacity), 4 committed projects in construction (with 205MW of total capacity) and a further 91 projects in various stages of the application process (with a total of 3.95GW estimated capacity).
- In small-scale residential and commercial-sized DER, Energex and Ergon Energy have connected more than 580,000 photo-voltaic (PV) systems with a total capacity of around 2,600MW.

Energy Queensland's network businesses have a range of current initiatives to support growth in DER connections, as represented in Energex's and Ergon Energy's recent Regulatory Proposals to the AER. However, many of these initiatives can only manage DER penetration to a particular point at which more active network strategies may be required, particularly if customer participation in emerging markets through aggregators grows as anticipated over coming years.. Energy Queensland is concerned that the proposed AER framework which is focused towards cost minimisation based on historical forecasts and investments, does not appropriately consider future approaches required to support customer adoption of DER and emerging opportunities for industry transformation.

Energy Queensland notes the objective of this consultation is to define a framework for identifying options, assessing consumer benefits and considering appropriate project timing, which will supplement the existing Expenditure Forecast Assessment Guideline (EFA Guideline). Notwithstanding that such a framework is required, we consider that customer, government and industry Distribution Access policies and expectations should be a driving force in determining what the expectation for connecting DER will be.

In response to the AER's invitation to provide comments on the Consultation Paper, Energy Queensland has outlined its approach to DER integration and the initiatives our network businesses are implementing to address future DER challenges in the following section. Energy Queensland has also provided responses to the questions raised in the Consultation Paper in Section 3.

Energy Queensland is available to discuss this submission or provide further detail regarding the issues raised, should the AER require.

2 Specific comments

As part of our commitment to the Energy Charter, Energy Queensland continues to explore options to enable a cost effective and smooth transition to a high DER future that benefits all customers, both those with and without DER.

To date, most residential customers connected to Energex and Ergon Energy low voltage (LV) networks have been able to connect and export up to 5kW on single phase and 15kW on 3-phase connections. This has been mainly due to our network businesses' proactive approach to supporting customer driven adoption of DER by updating DER Connection Guidelines; utilising progressive inverter-setting standards; expanding load control programs for use in areas of high PV penetration; limiting allowable export for larger systems based on network hosting capacity; and a range of network strategies listed in Appendix C of the Consultation Paper. Our 2020-2025 Regulatory Proposal also includes investment proposals for intelligent grid capabilities to support dynamic operation of commercial and industrial scale DER to suit local network conditions while maximising available customer export.

Our ability to continue to connect small-scale DER with limited expenditure to meet our customers' changing DER expectations will be defined by the value placed on DER, network availability and future network operational opportunities such as the emergence of Distribution System Operator (DSO) frameworks.

Energy Queensland agrees with independent research from the Electric Power Research Institute (EPRI) commissioned by the Australian Energy Market Operator (AEMO) and the Australian Energy Market Commission (AEMC)[1] which suggests that some form of active management of the LV network, including consideration of concepts such as flexible export arrangements for customers with DER, may be key future enablers for all customers (those with and without DER) to maximise the benefit from DER investments while minimising total system costs.

> *"Given its current levels of PV generation, a high percentage of which is residential rooftop systems, Australia is one of a few countries that face the need for smallscale PV feed-in management, a scenario arising earlier than most"* (EPRI[2], pg. 9) Such future capability will need to be supported through distribution network service providers' (DNSPs') relationships with customers, market participants and their core capability in reliably and securely managing the network. A critical

[1] https://www.aemc.gov.au/our-work/our-forward-looking-work-program/integration-ofDER/grid-of-future.

[2] https://aemo.com.au/-/media/Files/Electricity/NEM/DER/2019/StandardsProtocols/EPRI-PV-Feed-in-Management-Report.pdf

enabler for this future to be well managed is improved network visibility to support a high-DER future. Energy Queensland is currently contributing to key pieces of work exploring such future capability, including the joint Energy Networks Australia (ENA) and AEMO Open Energy Networks (OpEN) program, which supports the need for improved network visibility as a no-regrets capability to enable a high DER future. Energy Queensland recommends that any development of DER expenditure valuation is not done in isolation of other projects that are investigating DER opportunities such as the AEMC / ARENA Distributed Energy Integration Program (DEIP) and OpEN.

Energy Queensland has considerable experience in working directly with customers and a range of stakeholders through bilateral network arrangements. This includes programs such as load control over customer appliances, with approximately 874MW[3] of load under control across Energex's and Ergon Energy's networks, demonstrating how all Queenslanders currently benefit from frameworks that trade some level of customer control for incentives. The success of programs such as this and our PeakSmart airconditioning load control program is to a large extent, attributable to working with industry and customers to ensure customer amenity is maintained. Energy Queensland believes this is an example of how approaches to tariff design, connection agreements and network capability can be combined to address market transformation while managing increasing levels of DER at minimal cost. This is all achieved through a customer centric approach.

In order to progress toward a customer centric solution for integrating DER, Energy Queensland's network businesses are also proactively collaborating with the industry, universities and market bodies on several innovative initiatives, such as:

- Proposed deployment over the 2020-2025 period, of commercial and industrial dynamic export management such that 50 per cent of our existing DER enabled commercial and industrial customers and all of our new commercial and industrial customers will have the option of dynamic DER export.

- State estimation with the University of Queensland which has successfully proven that network visibility can be economically gathered from a small number of measurement points; and

[3] https://www.ergon.com.au/__data/assets/pdf_file/0006/765069/2019-20-Demand-Management-Plan.pdf, pg.12

- the evolve project in partnership with the Australian National University and several other networks which is exploring how dynamic envelopes could be published to customers and the market in near-real time to provide key information to support market operations within available network capacity.

- The Energex Home Energy Management System Pilot which explores the links between emerging aggregator and virtual power platform (VPP) capabilities and our demand management programs. This pilot is seeking to understand customer and market readiness for a “set and forget” solution that provides our customers additional value delivered through market aggregators whilst helping the DNSPs to manage their networks. The trial is investigating the interrelationships both commercially and technically between all parties.

Through such research and trials, Energy Queensland is developing an understanding of the benefits, limitations and requirements for the next range of solutions to economically integrate higher levels of DER into the Queensland networks.

Energy Queensland’s DER research programs are focused on enabling our customers to participate in markets through agents and platforms such as retailers, aggregators and VPPs to promote efficient use of the distribution network. Our intention is to support the opportunity for our customers with and without DER to benefit from an energy supply chain that maximises the value of DER. Through progressively exploring the opportunity and designing and trialling new solutions Energy Queensland expect to identify least-cost, no regrets investments to provide economically efficient enablement of high DER futures.

In terms of assessing the value of DER, theoretically there are many DER use cases. However each tends to only leverage the potential of DER for a small period of time. Bundling all use cases that are satisfied concurrently and considering the challenges of increasing levels of aggregation of resources in response to broader market opportunities, can significantly change the economics and return on investment. It is important for any future framework to assess DER integration expenditure to allow for value stacking to capture the overall value of DER. Improved network visibility and leveraging data analytics are key factors in supporting such frameworks.

Energy Queensland will continue to contribute to industry work exploring these themes through engagement on programs such as the AEMC and ARENA led DEIP which is considering how to explore such challenges. In all of this work Energy Queensland is committed to delivering improved outcomes for customers while ensuring affordability, reliability and safety levels expected by our customers and communities are maintained.

3 Table of detailed comments

Consultation Paper Feedback Question	Energy Queensland Comment
Foundational Questions	
1. Are our assessment techniques outlined in our Expenditure Forecast Assessment Guideline (the EFA Guideline) sufficient to assess DER integration expenditure?	DER expenditure differs to other investment drivers. This is primarily due to the future potential for increased customer desire for DER connections, and increased reliance on DER to provide system energy and security services. , If this future potential is to be accounted for in the value of enabling DER then historic expenditure and business models will no longer be an accurate representation of required future expenditure, particularly given the uncertainty over pace of change, customer driven uptake and system reliance of DER. We suggest that a potential deficiency of the EFA Guideline is that it assesses DNSP capital and operational expenditure in the context of consumers of electricity only. However, customers with DER should be considered as both consumers and generators. Moreover, past costs when DER was low may not be a good indication of future costs when DER is high. We suggest that as DER penetration increases a range of more innovative approaches will be required to meet our customers' expectations and that these innovative solutions may be in the form of innovative business models. While the EFA Guideline is significantly broad to cover a range of assessment techniques, a substantial portion of them are utilising previous costs and are therefore focussed on past expenditure which all occurred under a different technology, policy and customer paradigm, e.g. benchmarking, methodology reviews, policy reviews etc. Notwithstanding, we agree that a cost benefit analysis is a fundamental requirement for any investment decision and having clear business cases with appropriately justified inputs is necessary for any regulated business to make investments that will ultimately be funded by all customers. There may also be several gaps in how the EFA Guideline is applied to embedded networks and how it appropriately addresses customer equity in terms of enabling DER that supports system security and provides one individual customer benefit at the expense of others. Therefore, further

	consideration and guidance should be given to determine what assessment technique should be applied, specifically: • Trend analysis may not account for a rapid acceleration in technology uptake. • Benchmarking is largely historic and may not consider that previous spend is not sustainable nor the varying difference across the businesses in technology uptake. • The forward-looking costs of predictive modelling trend analysis can be subject to significant error and variation depending on the future state scenarios modelled. • Any technique based on historic DNSP-only investment drivers (peak demand) are unlikely to account for the potential competing investment drivers such as peak demand, reverse power flow, market participation and system security. Finally, customer equity should be considered which will inform considerations such as availability for customer export, as well as how much investment should be placed in a network to achieve a desired level of customer DER/market participation. While some of our customers will be able to participate in markets and will therefore expect high levels of availability to maximise their direct investment, it is uncertain what level of participation should be required to be enabled at the expense of others who will not be able to or do not wish to participate.
2. What form of guidance should we include to clarify how our assessment techniques apply to DER integration expenditure? For example, should we update the EFA Guideline to be more prescriptive, or only include principles to allow for greater flexibility in our assessment and information requirements as DER integration matures?	A combination of flexibility and definition of critical costs will ensure that the AER and DNSPs are adaptable to change in the DER environment. There are some costs and values which are largely outside a DNSP's control and expertise and guidance as to these metrics should be provided by the AER so as to remove doubt. For example, the value of export kWh, the minimum availability for a customer to participate in markets and the equity of enabling customer participation in markets, and the value of system security. Flexibility is important as we enter an accelerating period of renewable generation growth, where the risks of supply will change with the transitioning generation mix and locations. The cost and costassumptions are likely to be driven by the geospatial needs and the reliance on system security from DER resources.
1 – Information Provision	
What information is reasonable and necessary in identifying and evidencing the impact of DER on the demand for standard control services and hence on maintaining the	It is unclear whether the AER is asking what information is required for determining the impacts of DER on demand (need) for standard control services (SCS) or what information is required to

quality, reliability or security of supply of standard control services.	determine the impacts of DER on network elements, and therefore how this impacts service delivery, capacity reliability, power quality etc. Greater visibility of DER impacts can reduce the requirement for augmentation through more targeted solutions and options and/or enabling greater export while maintaining power quality. This enhanced visibility in combination with granular network management can also lead to more efficient network utilisation and enablement of customer DER. As stated above, Energy Queensland is working on several projects with market bodies, industry and research organisations to explore this value and capability requirement to inform future cost benefit business cases. While modelling is required to forecast expenditure with varied input such as market behaviour, government policy, technology changes and proliferation levels, an effective balance must be reached between thorough analysis and over analysis. Energy Queensland considers that the information required to determine the impacts of DER on demand (need) for SCS, as they relate to customers' desire for higher levels of DER connection include: - Exported kWh as this relates to the value the customer may receive from the market; - Generated kWh as this relates to the value the customer personally receives from offsetting their energy consumption; - Imported kWh as this relates to the value customers gain from the network; - Peak demand (kW) as it defines the maximum capacity the network needs to supply; - Peak export demand (kW) as it defines how quickly customers wish to export – recognising that in the future peak export could begin to exceed peak demand (import) on both an individual customer and a collective aggregated level at different points on the network; and - Availability as it determines how available the customer is expecting their connection to be. This may change in the future with batteries that are able to 'back up' a house where appropriate safety changeover devices are included in a connection's design. - Other considerations such as motor starts, reactive power etc. It is also important to recognise that the energy market is rapidly evolving, and that the information needs now may differ substantially if customer choices, technologies, policy or regulations change rapidly.

2 – Options Analysis	
What range of options should DNSPs consider for DER related investments? Does the Regulatory Investment Test – Distribution (RIT-D) provide the appropriate starting point for this analysis?	Investment decisions should, at their core, have a cost benefit analysis. However, a standard Net Present Value (NPV) approach is becoming more difficult and less reliable for making investment decisions if applied narrowly. There are a growing range of solutions available to networks and customer-driven technological change is meaning that emerging challenges are becoming harder to predict against the long-term interests of consumers. Network businesses are able to cost augmentation, replacement and construction, but are constrained in their ability to quantify the customer driven benefit of energy export for both an individual customer and the wider market such as the benefit of avoided losses from bulk generation replacement and system security etc. Assessment of DER related investments and solutions will also become increasingly granular and Energy Queensland cautions that a RIT-D type approach to increasingly diverse and granular approaches to local DER challenges will become increasingly complex to manage. Different solutions might be required in different areas to suit local network conditions given varying types of DER penetrations. Energy Queensland suggests a broader overarching framework is required to address this inherent variety and granularity of solutions to enable greater levels of DER connections. Planning, scoping and the network development process required to manage DER penetration is different compared to conventional large network improvement projects. One of the key differences is the level of network / customer risk addressed by DER-driven capex from a likelihood and consequence / magnitude perspective, the value associated with connected DER and the locational versus broad based aspects of DER enablement. Typical RIT-D projects address systems with extreme load peaks, exceeding thermal capacity network assets or systems with significant ageing risks. Consequently, the RIT-D requires the proponent to address the risk from an economic and technical perspective. However, DER related capex predominantly addresses the voltage regulation and power quality improvements and through its recommendation increases the hosting capacity of systems for higher penetration of DER. Compared to traditional projects, system security, reliability, quality and affordability will have different dimensions. Another dimension of DER-driven augmentation is that targeting sections of the network by small investment projects is providing long-term improvement of the LV, distribution substation and/or medium voltage (MV) feeder voltage regulation profiles or future conventional (load) and DER customer connections. The enablement of DER is a complex question and the RIT-D may not be a suitable mechanism considering the rapid evolution of our customers' expectations, markets, regulations and technology. Rather, it would be prudent for the AER to consider a broad change to incentive and expenditure

	frameworks to enable a rapid transition to a renewable energy future with a methodology that is fit for purpose and provides opportunity for innovation in addressing network constraints. A prescriptive methodology may not allow for the potential future variability in network constraints.
3 – Sampling and Modelling	
Electricity networks have utilised sampling and modelling techniques to forecast energy demand and consumption for decades. These processes have proven effective for large cohorts of consumers where diversified behaviours can be predicted with sufficient accuracy. Is it reasonable to assume that sampling and modelling techniques will play a part in developing dynamic models of the electricity networks?	While the described methodologies have their part to play in determining the network models, general forecasts of that nature do not have the granularity to manage changing business models. Past behaviour will not always be an accurate indicator of future performance when considering impacts such as cloudy days, battery charge and discharge from either the grid or local generation, and/or electric vehicle use. Past performance and behaviour are also predicated on the previous regulatory, market and technology environment not considering changes such as the introduction of aggregators who may concentrate customer behaviour based on external stimuli such as market prices. Additional monitoring of LV and MV networks on spatial (e.g. distribution transformers and LV feeders) and customer levels is paramount for the future of DER networks as indicated by both AEMO and the AEMC recently. Actual metered power quality data will allow for the validation of network modelling outcomes and increased confidence in augmentation investment decision making, and lead to improved accuracy of network models. Energy Queensland expect to be able to utilise data gained from the National DER register to support the development of these models. To this end, Energy Queensland wishes to highlight the recently published AEMC review paper “Economic Regulatory Framework Review, Integrating Distributed Energy Resources for the Grid of the Future”[4], which emphasises the need for DNSPs to continue to develop business cases for improved modelling and monitoring of their LV networks, particularly in response to challenges caused by the rapid uptake of DER. The DNSPs’ monitoring programs should respond to this need by expanding LV and MV monitoring capacity and acknowledge our involvement in research programs for appropriate monitoring solutions, including managing appropriate network data from a variety of sources such as near real-time network monitors and smart meters with appropriate capability while addressing the current limitations of these solutions.

[4] https://www.aemc.gov.au/sites/default/files/2019-09/Final%20report%20-%20ENERFR%202019%20-%20EPR0068.PDF

	It should be noted that solar PV is not diversified outside of minor variation due to cloud and battery behaviour being largely driven by tariffs and government policy, therefore 'backward-looking' modelling is not necessarily accurate. Additionally, the impact of aggregators and VPPs feeding into the NEM and impacting on the local LV or MV network will not be diversified and cannot be examined through a regression analysis. Furthermore, the expected potential aggregation of active DER by VPPs and aggregators could currently happen with little predictability or visibility of the local network. Further work is required to effectively forecast and manage these increasingly aggregated resources while ensuring local network conditions are managed reliably and safely during such events. Networks will necessarily need to use more sophisticated modelling and analysis techniques based on customer / agent driven scenario-based modelling to predict where issues are likely to emerge. These sophisticated modelling techniques will increasingly leverage machine learning, artificial intelligence and modern data analytics techniques. There is a need to balance transparency and the use of modern data analytics techniques built around network operational challenges. Furthermore, where retail competition exists, network tariffs are decoupled from the retail tariffs, making a determination of behaviour from tariffs alone more challenging. Finally, while diversified behaviour and response will always have a role to play in modelling, as more responsive (energy storage), connected (demand aggregators) and co-incident technologies (PV) are added to networks the impacts of non-diversified behaviour may become a dominant driver for network risks and therefore augmentation. The impacts of these technologies and outcomes are still developing but need to be considered in any investment framework.
4 – Non-Network Options	
Distributed energy resources are, by definition, located at the end of the electricity network. Typically networks have less visibility of this part of the network. What approaches or information is reasonable to assess whether DNSPs have considered purchasing the necessary information from metering or DER data providers rather than building their own assets and systems?	Energy Queensland suggests that DER can be located at any point on the DNSP's network, not only at the end of distribution feeders. Specifically, Energex and Ergon Energy are connecting a large number of medium sized solar systems to our MV networks. However, clusters of DER at the end of especially weak and 'constrained' LV and/or MV feeders cause more problems and require specific attention. As noted earlier, it is critical to have visibility of our networks and connected DER. For the most effective planning of capex for DER networks and potential emerging DSO scenarios, network and customer monitoring should be balanced to compensate and support each other. From a capex perspective, installation of advanced network and customer power quality monitoring devices is considered as augmentation expenditure (augex) investment. However, in reality, the installation of this equipment does not involve the construction of new assets and systems or an

	increase to the capacity of existing plants, and is therefore does not arguably constitute augex expenditure. The business case for data analytics is largely independent of the valuation of DER and should not form part of the DER valuation methodology. Networks will need visibility of power quality information for a range of network operational requirements and therefore such information will be required for reasons in addition to DER. Furthermore, consideration should be given to local availability of data, cost, cyber security, reliability, accuracy, granularity and suitability of the data as well as privacy.
5 – Policy and Standards	
The optimisation of DER can be improved through many different approaches. Factors such as tariff reform, connection standards, energy efficiency standards, etc. can greatly impact the way that DER operates on the network and impact on network performance. How should these options be integrated with the developments of network DER proposals?	Tariffs, policies, connection standards and energy efficiency standards, all form part of the solution for DER integration. However, the time scales of these issues are medium to long term. Tariffs commonly take years from implementation to mass customer adoption and there is significant risk that the timing of adoption of tariffs and the customer behaviour in response, may not coincide. Such uncertainty and complexity will need to be addressed by networks to properly assess challenges associated with customer driven adoption of DER, including behavioural responses to different price signals and increasingly diverse customer needs. While these all form part of the responses to DER integration, they are all slow responses and can be subject to external influences that impact their ability to deliver outcomes. While connection standards are required to enable DER integration, they are not an economic assessment tool. Rather, the standards themselves are designed to ensure safe and stable parallel operation of DER connected to the distribution network. The connection standards address a number of technical, regulatory and safety obligations for DER to ensure all our customers and field crew are able to access a safe network. Care should be taken to utilise the most appropriate fit-for-purpose mechanisms for enabling customer connection of DER. Energy Queensland will continue to contribute to industry work exploring these issues through engagement on programs such as the AEMC and ARENA led DEIP which is considering how to explore such challenges. In all of this work Energy Queensland is committed to delivering improved outcomes for customers while delivering affordability, reliability and safety to the levels expected by our customers and communities.
6 – Cost Benefit Analysis	
Project justifications will require detailed analysis on the costs and benefits of each option. Many of these benefits	Energy Queensland is of the firm view that no additional financial burden should be placed onto all customers to address expenditure related to the use of DER which they may not benefit from.

may be external to the DNSP's cost base, and may accrue directly to DER users. What level of analysis is required?	Furthermore, we suggest there should be an effective balance between administrative effort and transparency. For example, many initial steps for addressing voltage issues involve a small amount of operational work, which when accrued across a DNSP's distribution area could represent a larger amount, though be quite cost effective in aggregate. We suggest that any framework should be multidisciplinary, targeting long-term proactive benefits for customers, safety risks, networks and improved network planning and operational processes. In particular, while some of these categories may not have a clear financial value, they do have an evident importance for more effective management of DER and our network. Detailing the benefits to consumers for market interactions such as early retirement of generation or the benefit of a reduction in market rates is largely outside the scope of a DNSP. Accordingly, Energy Queensland suggests consideration be given to an approach similar to the Value of Customer Reliability, but in terms of a cost of lost generation. These issues are being explored partly through the AEMC and ARENA led DEIP with several solutions ranging from deep connection charges and targeted price signals to broad two-way pricing methodologies and potential flexible connection arrangements. This highlights the uncertainty of what the operating model may look like in the future and the complexity of defining future analysis needs today.
7 – Customer Benefit	
With DER being able to provide services across the electricity supply chain, how should DNSPs identify and value customer benefits? These benefits can include reliability outcomes, increased export potential, greater access to energy markets, access to network support services, etc. Should a common approach to valuing consumer exported electricity be established?	While a value of reliability is already defined, the value of generation, and the value (and opportunity cost) of export are not clearly defined. For example, if a new connection wants to connect to an already at-capacity distribution transformer, consideration could be given to the value in: - allowing export and replacing the transformer; - denying export for any further connections; - allowing a dynamic export with the installation of additional monitoring and/or control equipment; or - allowing export but thereby giving negative reliability and power quality consequences to other network users. Without a consistent value for energy export or defined availability for export or clear network access requirements, it is difficult to determine the most economic or equitable outcome. Any consideration of

	the value of DER must take into account the equity of the methodology and perverse outcomes, avoiding issues such as cross subsidies that are already embedded in the energy supply chain. A DNSP's traditional response model is typically reactive, responding to issues following customer complaints, appliance damage, identified issues from network modelling, and post-event recording. Energy Queensland's aim is to move from a reactive to proactive response model and address existing and emerging network issues that adversely affect safety and quality of supply before safety is impacted, equipment damage occurs, or customers become aware of the issue. However, this aim may be predicated on forecast future uptake and customer expectations rather than traditional historic measures. Adding to this, a real value of customer and network benefits from distribution of electricity back to the grid will give another customer-oriented dimension in cost-benefit analysis. To this end, Energy Queensland supports the proposal to establish a common approach to valuing (including a methodology to cost network investments to support) customer exported electricity as part of the future DER investment analysis.
8 – Options Value	
Noting the technological rate of change and the typical asset life of 65 years of many network assets, it is important to test whether current research could provide a more efficient option in the near future. Should an assessment of emerging alternative approaches be a requirement for DER forecast expenditure? Should there be an 'options value' placed on this?	Deferring expenditure through an NPV analysis is well understood. Notwithstanding, balance must be sought in ensuring the best technical outcome while enabling additional DER connection. The 'cost' of being unable to connect additional DER (or to allow additional export) must also consider the principles of equity and fairness for all customers who pay for the associated network services. We consider the inclusion of an option value to be appropriate provided there is a clear mechanism which is not overly burdensome. Assessment of DER related investments and solutions will also become increasingly granular and Energy Queensland cautions that a RIT-D type approach to increasingly diverse and granular approaches to local DER challenges will become increasingly complex to manage. Different solutions might be required in different areas to suit local network conditions given varying types of DER penetrations. Energy Queensland suggests a broader overarching framework is required to address this inherent variety and granularity of solutions to enable greater levels of DER connections. Network businesses also require the flexibility to participate in trials to identify potential solutions. Solutions to manage increasing levels of DER are currently emergent and still being trialled and explored. There is currently no agreed analytics-driven methodology. Some degree of optionality will be important as this is worked through. Augmentation is one option and will be applied to some degree with other (sometimes still emerging and yet to be validated) techniques. However, some application of optimisation will be needed to avoid inefficient augmentation (e.g. uncoordinated

	aggregation of DER driving localised network investment). Market regulators have already identified these issues at the transmission level through rule changes such as the Coordination of Generation and Transmission Investment and Renewable Energy Zones etc. While not of the same magnitude, similar issues arise on the distribution networks, albeit in larger volumes. The AER rightly acknowledges the uncertainty related to emerging DSO models. Energy Queensland notes the following AEMO/ENA OpEN Frameworks which identify no-regrets capabilities which are required regardless of future models and should be explored by industry: • define network visibility requirements and network export constraints emerging as a result of increased DER; • define communication requirements for operating envelopes; and • establish an approach and technology required for operating envelopes to be applied.
9 – Shared Learning and Systems	
The development of common platforms, communication standards and shared systems may reduce the overall cost and complexity of facilitating DER. Should DNSPs need to show how they have considered options that leverage shared learning, common standards and common systems to provide efficient solutions, and that they have consulted and implemented learnings from prior works and trials across the NEM?	While Energy Queensland is supportive of aligning standards and shared learning and is heavily involved in the development of the national ENA network connection guidelines (which include Technical Guidelines for Basic Micro Embedded Generation (EG) Connections, Technical Guidelines for LV EG Connections, National DER Grid Connection Guidelines), AS4777, and others, it is not clear how this would be succinctly demonstrated as part of an expenditure proposal that does not place an administrative burden on network businesses. Prior to placing this burden on DNSPs it should be necessary to clearly state the cost benefit analysis for the marginal increase that may be created for any additional regulatory requirements placed on DNSPs considering many are being undertaken regularly on a voluntary basis.
10 – Rail Gauge Outcomes	
As a corollary to the above questions, it will be increasingly important for the industry to work together to provide customer outcomes that are consistent across the NEM (or with international standards if applicable). What approaches or information is reasonable to show that any DNSP-specific communication protocols, interfaces, connection standards, etc. will not lead to increased cost and complexity for consumers and industry providers?	Energy Queensland recognises the complexity in this question and suggests there is no simple answer, especially in an environment where standards may not exist due to forming markets. The rate of change in the DER market is considerably faster than the time required for development and adoption of standards. As such, network businesses must weigh the growing network risk while waiting for a standard against pushing ahead to ensure future risks are managed without a national standard in place. Notwithstanding, Energy Queensland strongly supports national standards, as demonstrated through our long history of participation in a range of standard bodies and noted in our response above.

	There are also risks associated with communications technology transition where networks have a sunk cost (such as Audio Frequency Load Control) and the rapid change of the communications technologies themselves. Due to the many competing issues in this space and the need to enable clear market direction, we suggest that DNSPs demonstrate participation in appropriate standards bodies such as Australian Standards, International Standards, Power Systems Modelling Reference Group and participation in other industry groups such as ENA working groups and the Council on Large Electric Systems in French Conseil International des Grands Reseaux Electriques, and provide industry consultation opportunities or fair market warning through publishing the preferred standard to be adopted.