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Submitted by email to: ISP@aemo.com.au

Dear Craig

Consultation on the first Integrated System Plan – Input to Modelling Approach

TransGrid welcomes the opportunity to work with AEMO to the develop the first Integrated System Plan.

TransGrid is the operator and manager of the high voltage transmission network connecting electricity generators, distributors and major end users in New South Wales and the Australian Capital Territory. TransGrid's network is also interconnected to Queensland and Victoria, and is instrumental to a national electricity system that allows for interstate energy trading.

TransGrid supports the development of the first Integrated System Plan. The Plan will provide a long-term, strategic and nationally-coordinated approach to connect renewable energy resources, maintain system security and deliver lowest possible energy costs. This was a key recommendation of the Independent Review into the Future Security of the National Electricity Market (the 'Finkel Review'). TransGrid supports AEMO's role in leading the development of the Integrated System Plan, given its role as the National Transmission Planner, and an independent and expert body.

Australia is in the midst of an energy transformation. This is characterised by:

- changing consumer expectations and greater demand-side participation;
- the requirement to reduce greenhouse gas emissions in accordance with Australia's international commitments;
- significant technological advancement; and
- the progressive retirement of existing thermal generators.

Over the coming decades, transmission systems will need to be substantially transformed, as power supply shifts from traditional to renewables-based generation. Considering the scale of the change required, the Finkel Review observed that[1]:

> *"Incremental planning and investment decision making based on the next marginal investment required is unlikely to produce the best outcomes for consumers or for the system as a whole over the long-term or support a smooth transition. Proactively planning key elements of the network now, in order to create the flexibility to respond to changing technologies and preferences has the potential to reduce the cost of the system over the long term"*

[1] See *Independent Review into the Future Security of the National Electricity Market: Blueprint for the Future*, June 2017, Page 123

TransGrid considers that the decision-making processes and regulatory frameworks that currently drive the incremental development of generation and transmission infrastructure are unlikely to deliver the transformative change required across the National Electricity Market, and therefore welcomes the development of a fit-for-purpose approach. New regulatory frameworks that recognise and implement the Plan are required, and the way in which these will interact with existing transmission planning processes must be resolved.

TransGrid understands that AEMO is seeking initial stakeholder feedback on the modelling approach ahead of more detailed feedback on other aspects of the paper. As such, this submission is focused on providing feedback to the proposed modelling approach and the first two consultation questions posed by AEMO in its consultation paper released on 22 December 2018.

TransGrid generally supports the modelling approach proposed by AEMO and the material questions that are to be addressed during the development of the Integrated System Plan, subject to our comments which are attached. We do not propose any additional questions to be addressed.

We appreciate the opportunity to comment and look forward to working with AEMO further on this important project. If you would like to discuss this submission, please contact Fiona Orton, Future Grid Manager, on 02 9284 3746.

Attachment A – Response to Consultation Questions

1.1 The material questions the ISP seeks to address are as follows. Are there any other questions the ISP should address?

1.1.1 What is the best way to achieve the policy objectives of affordable, reliable, secure power and meeting emissions targets?

TransGrid agrees with the Finkel Review's conclusion that a proactive and strategic approach is required to coordinate the development of electricity generation and transmission infrastructure as the National Electricity Market (NEM) transitions to a low-emissions future. The Integrated System Plan is the vehicle to identify efficient investment in generation and transmission, ensure identified projects are robust across different potential futures and prioritise their development accordingly.

Considering the scale of the power system transformation that will be required over the coming decades, a coordinated jurisdictional planning process that will provide a platform for the most efficient generation development, underpinned by economic analysis, is imperative to achieving the National Electricity Objective and emission reduction targets. It will play an essential role in aligning market signals with long-term system requirements, facilitating future investment, and achieving an affordable, reliable and decarbonised energy supply.

By contrast, and as identified in the Finkel Review, a continuation of the status quo is unlikely to achieve all of these policy objectives. There are several reasons why the existing market-led approach to generation planning is unlikely to deliver the most reliable and lowest-cost outcome for consumers, including:

- The regulatory frameworks that currently facilitate investment in transmission typically require new generation to lead network expansion, creating a 'chicken and the egg' dilemma: new generation projects in high-quality renewable energy zones cannot be committed without transmission access, but proactive transmission expansion is not supported. That is, investors will only commit to generation once they have assurance of a network they can reasonably connect to, and which will provide sufficient capacity for them to deliver their generation (i.e. they will not be 'constrained off').
- There is a misalignment of incentives between generation and transmission. Generators are currently incentivised to develop renewable projects near existing transmission lines, where connection costs are lowest, despite often not being in areas with highest-quality resources. Connecting into lower-voltage systems (such as at 132 kV, 66 kV or 33 kV) is lower cost for generators, yet these systems are less able to support intermittent generation. The system costs of inefficient location of renewable investments are ultimately borne by consumers.
- Transmission systems in many areas are becoming increasingly congested, and as new connections occur, new and existing renewable generators face growing risks of being constrained at certain times (raising the unit cost of the generation they can deliver to consumers). The risk of congestion from competing generation projects is visible to TNSPs and the network operator, but less so to prospective generators. This can result in over-investment in under-utilised assets, as well as generators with access to high-quality resources being crowded out by those accessing lower-quality resources closer to load centres.
- Major transmission investment can be achieved at lowest cost due to economies of scale. For example, the cost of installing a 500 kV transmission line to connect a new renewable energy zone is around double the cost of a 330 kV line, but delivers around three times the capacity.

1.1.2 What are the least-regret generation and transmission developments which are most robust to different futures?

TransGrid supports the use of a least-regrets (and benefits-maximising) assessment framework in the development of the Integrated System Plan. In preparing this framework, consideration should be given to:

- Economic efficiency: Generation and transmission developments that give rise to the lowest overall system cost, and deliver the lowest unit cost of energy to consumers over the short- and long-term.
- Robustness: Developments that deliver net benefits to consumers under several future scenarios and sensitivities, including those with the highest likelihood.
- System resilience: Developments that improve the system's ability to further integrate intermittent renewables and withstand shocks (such as infrastructure outages and the withdrawal of thermal generation units from the market at short notice), for example through diversity of energy supply technologies, geographic spread, the provision of ancillary services and the removal of single points of failure.
- Emission reductions: Developments that facilitate a progressive reduction in greenhouse gas emissions from the NEM, consistent with Australia's national targets and international commitments, and which can also accommodate a 'ratcheting up' of ambition over time (as envisaged in the UNFCCC Paris Climate Accord).
- Reliability: Developments that enable the NEM to meet a defined reliability standard.
- Optionality: Developments that establish the option to support further investments in the power system as required under different future scenarios. For example, transmission developments which facilitate future network linkages and the establishment of a 'meshed network', and which can support the development of wind, solar and/or other energy resources depending on the relative economics of technologies in the future.

Such a framework will enable the appropriate navigation of uncertainty in planning for the future energy system, and will minimise the risks of significant over-build, under-build, stranded assets and higher than necessary consumer costs. TransGrid recommends that the Integrated System Plan include projects for which development can be staged over different time horizons (the next five years, five to ten years, ten to twenty years, etc.). This will minimise the capital at risk for each stage, and preserve optionality to cater for different futures.

TransGrid has published its view of the least-regret generation and transmission developments for New South Wales in its Transmission Annual Planning Report 2017.

1.1.3 Could large-scale renewable generation in targeted zones provide an efficient solution for future power system development, and what storage and transmission investment would be needed to support such an outcome?

TransGrid supports the establishment of renewable energy zones as a way to provide an efficient solution for future power system development. Our preliminary analysis shows that there are renewable energy zones in New South Wales where the benefits of connecting high-quality renewable resources to the electricity market (where renewable generators operate at higher capacity factors, and therefore deliver lower energy unit costs to consumers) more than outweigh the cost of the transmission investment to the zone. This is supported by analysis from Bloomberg New Energy Finance which indicates that wind and solar farms in the highest-quality resource areas can generate electricity at around half the unit cost of those in lower-quality resource areas[2].

[2] Considered on a LCOE $/MWh basis. Briefing by Quong, L. (2017) '2Q 2017 Australia REC Market Outlook', BNEF

1.1.4 What is the optimal balance between a more interconnected NEM, which can reduce the need for local reserves and take advantage of regional diversity, thereby more efficiently sharing resources and services between regions, and a more regionally independent NEM with each region self-sufficient in system security and reliability?

The Integrated System Plan should identify and assess competing solutions including regional generation and firming capacity, and increased interconnection, to identify the overall solution with the least cost to consumers. TransGrid notes that under different scenarios, different combinations of generation and transmission assets are likely to be required.

1.1.5 To what extent could aggregated load shifting and price-responsive load management, made available through investment into distributed energy resources (DER), reduce the need for large-scale generation and transmission development to replace the existing generation fleet as it reaches end of life, while maintaining power system reliability and security?

The extent to which distributed energy resources (including generation, storage and demand response) will be deployed and coordinated in the future is a significant area of uncertainty, with many organisations (in Australia and overseas) currently assessing the potential of these technologies to deliver benefits to consumers, networks and wholesale markets. Large scale demand-response already delivers market and system benefits, and has the potential to play a greater role in future. In the *Electricity Network Transformation Roadmap*, Energy Networks Australia and CSIRO forecast that by 2050 around 30-50% of electricity generation could be sourced from DER. However even under this high uptake scenario, a significant amount of large-scale generation will be required.

TransGrid supports AEMO testing a range of DER and demand-response scenarios in the development of the Integrated System Plan, and in cases where these technologies offer a cost-effective alternative, they should be included in the Plan. TransGrid also notes that there are segments of energy demand that may be challenging for DER to meet in the near future regardless of cost, including industrial and commercial applications with high energy density needs, and densely populated urbanised areas with high demand relative to rooftop area.

1.1.6 What is the optimal balance between the lowest-cost pathway and having the optionality to ramp up new development if required by circumstances, such as earlier than expected generator retirements, lower than expected DER uptake/orchestration, or higher than expected development of renewable generators?

As outlined in question 1.1.2, TransGrid supports the use of a benefits-maximising framework for assessing potential developments under the Integrated System Plan. In some circumstances, trade-offs may be required between the least-cost pathway (based on modelled benefits), and solutions that offer other benefits, such as robustness, optionality or system resilience. It is important that such other benefits are taken into account to arrive at a 'least regret' outcome, particularly given the certain retirements of traditional generators in the future.

The Integrated System Plan should seek to identify the renewable energy zones and transmission developments that are expected to deliver the lowest consumer energy costs, while also providing a view of the potential costs and benefits of alternative options, such as would be required under the various scenarios and sensitivities.

1.2 The scenarios the modelling will use to inform the ISP are outlined in Section 1.4. Recognising the time limitations to produce the first ISP in mid-2018, are these suitable scenarios to address at a high level? Should these be expanded in more detailed for future ISPs?

TransGrid supports the use of a central case, in conjunction with 'bookend' scenarios representing the upper and lower bounds of credible outcomes for large-scale generation and transmission planning. In finalising these scenarios, TransGrid recommends the following:

- The proposal to hold several DER-related variables, such as technology costs and uptake rates as 'neutral' across all scenarios does not suitably reflect the uncertainty surrounding the role of these technologies in the future energy system (see also question 1.1.5). For appropriate 'bookend' values, TransGrid recommends that the 'slow change' scenario be changed to include strong uptake of solar PV, distributed batteries and energy efficiency (resulting in less need for large-scale generation and transmission development) and the 'fast change' scenario be changed to include weak uptake of DER and energy efficiency (resulting in greater need for large-scale generation and transmission development).
- State-based renewable energy policies including VRET, QRET, and other mechanisms proposed for other regions, are subject to change over time. TransGrid supports accounting for these targets beyond 2020 in the 'fast change' scenario, but focusing the central scenario to provide an independent view on the NEM-wide generation and transmission developments that will meet the national emissions reduction target and maintain security and reliability at the lowest cost to consumers.
- It is important to consider scenarios in which the electricity sector needs to reduce its greenhouse gas emissions more quickly than the rest of the Australian economy, taking into account the role it can play in facilitating the decarbonisation of other sectors (e.g. transport) and the relative maturity of low emissions generation technologies currently available. The Integrated System Plan should propose a staged pipeline of development projects that can be progressed in the event that renewable energy supply needs to increase more quickly than under the central scenario.
- Modelling outcomes are likely to be particularly sensitive to assumptions made around the retirement of existing thermal generators. For the central case, TransGrid supports the use of 50-year schedule of retirements presented in Figure 4 of the consultation paper. However, slower and faster retirement schedules should also be tested, as either scenarios or sensitivities.