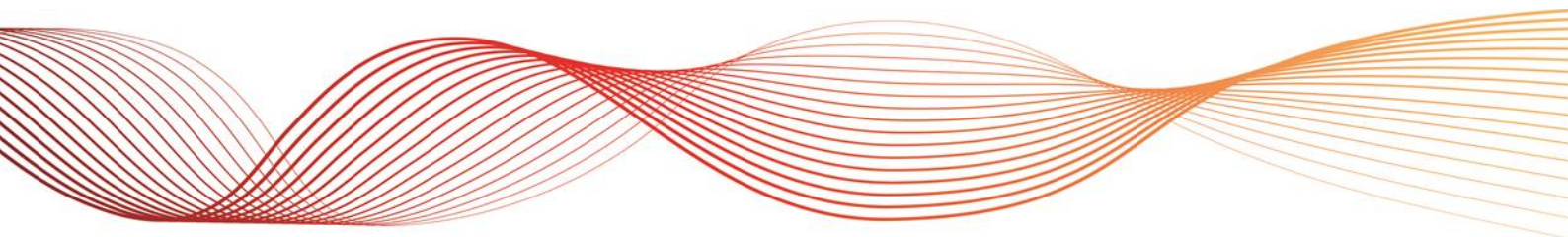




# CONSULTATION PAPER

MATERIAL ISSUES AND PROPOSED INPUTS FOR THE 2017  
NATIONAL TRANSMISSION NETWORK DEVELOPMENT PLAN

Published: **January 2017**





## IMPORTANT NOTICE

AEMO has prepared this document to seek feedback on the 2016 *National Transmission Network Development Plan* (NTNDP), and to set out proposed inputs and material issues for the 2017 NTNDP. This document has been prepared by AEMO as required by clause 5.20.1 of the National Electricity Rules.

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## EXECUTIVE SUMMARY

AEMO has prepared this document to:

- Seek feedback from stakeholders on the 2016 *National Transmission Network Development Plan* (NTNDP).
- Provide information and seek submissions on considerations for the 2017 NTNDP, including:
  - Material issues to be addressed in the planning scenarios.
  - Proposed scope, inputs, and modelling methodology considerations.

AEMO is committed to continually improving its suite of planning publications to better meet stakeholder needs. AEMO respects the expertise of its stakeholders and values all feedback, which is critical in guiding meaningful progress and developing a strategic vision for future grid development. AEMO strives to ensure the NTNDP remains a transparent and valuable information resource that represents a holistic view of the National Electricity Market (NEM) transmission network.

### Material issues to be explored in 2017

AEMO considers the following issues to be material for the 2017 NTNDP:

- Energy and climate policy uncertainty at both federal and state levels of government.
- Uncertainty over the timing and scale of existing coal generation retirement and what new energy sources will replace it.
- The increasing influence of consumer investment trends such as rooftop PV, battery storage, demand side participation, and energy efficiency.
- How to address the emerging technical challenges related to the energy transformation, such as frequency stability and power system strength.
- Uncertainty over how the regulatory framework will change over the outlook period.

Following stakeholder consultation, AEMO intends to consider these issues in the 2017 NTNDP. Many of the identified uncertainties will be captured through scenario modelling.

### 2017 NTNDP scope and scenarios

AEMO intends to build on the scenarios examined in the 2016 NTNDP, rather than develop new scenarios. AEMO proposes to analyse Neutral, Low Grid Demand, and 50% Renewable Generation scenarios in the 2017 NTNDP, and welcomes feedback on this proposal.

### Focus of methodology improvements

In 2017, AEMO intends to consolidate the scope and methodology improvements in last year's NTNDP. There will be more focus on:

- Accurately analysing the potential uptake of large-scale battery storage and distributed energy resources, and their impact on NEM development.
- Interdependencies between electricity and gas infrastructure and demand requirements.
- Assessing benefits of utilising geographically diverse resources.
- Synergies created through multiple interconnectors and routes.
- Extending the planning horizon for the market modelling to reflect longer term trends in the 20 year outlook of the NTNDP.



### Stakeholder feedback and workshop

AEMO plans to hold a stakeholder workshop **on 21 February 2017** to discuss this Consultation. Please email [planning@aemo.com.au](mailto:planning@aemo.com.au) **by 15 February 2017** if you would like to take part in this workshop.

AEMO invites written submissions on this consultation paper **by Friday 17 March 2017**. Please email submissions to [planning@aemo.com.au](mailto:planning@aemo.com.au), or post to Network Planning Group, AEMO, GPO Box 2008, Melbourne, VIC 3000.

Stakeholders who have any additional suggestions on ways AEMO can improve its 2017 NTNDP, other than the topics outlined in this document, should also include these ideas in submissions.



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# 1. STAKEHOLDER CONSULTATION

The 2016 *National Transmission Network Development Plan* (NTNDP)<sup>1</sup>:

- Highlighted the importance of strategically assessing the future needs of the National Electricity Market (NEM) transmission grid.
- Provided an assessment of an appropriate course for the efficient development of the national transmission grid under a range of scenarios.
- Reflected on the evolution of transmission development, with the industry entering a new era for transmission planning.
- Examined how the changing generation mix could impact network development, power system security, and the utilisation of major transmission lines in the next 20 years.
- Proposed a range of possible solutions to effectively manage the power system into the future.
- Identified whether further Network Support and Control Ancillary Services (NSCAS) are required to manage power system security and reliability in the next five years.

High level modelling suggested positive net benefits for potential interconnection developments if competitively priced, including:

- A new interconnector linking South Australia with either New South Wales or Victoria from 2021.
- Augmenting existing interconnection linking New South Wales with both Queensland and Victoria in the mid to late 2020s.
- A second Bass Strait interconnector from 2025, although the benefits were assessed as only marginally greater than the costs.

AEMO is seeking feedback on the 2016 NTNDP to help us improve future NTNDPs to deliver valuable information that supports our stakeholders in operating their businesses. Written feedback is preferred, and we encourage feedback to be incorporated into submissions to this consultation process.

This paper seeks feedback on a number of consultation questions to help scope the 2017 NTNDP, which are laid out in the following chapters. AEMO invites stakeholders to provide written feedback on these questions, or any other comments, by **Friday 17 March 2017**.

Please email written submissions to [planning@aemo.com.au](mailto:planning@aemo.com.au), or post to:

Network Planning Group  
AEMO  
GPO Box 2008  
Melbourne, VIC 3000.

## 1.1 Planning and Forecasting Reference Group

In 2016, AEMO established the NTNDP Technical Working Group to consult with key industry stakeholders and experts throughout the development of the NTNDP.

In 2017, AEMO intends to combine this working group with an equivalent forecasting group to create the Planning and Forecasting Reference Group. The first meeting for this combined group will be held via video conference across the AEMO offices on **Tuesday 21 February 2017** to discuss this Consultation Document in more detail. Please email [planning@aemo.com.au](mailto:planning@aemo.com.au) by **Wednesday 15 February 2017** if you would like to take part in this group.

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<sup>1</sup> AEMO. 2016 *National Transmission Network Development Plan*. Available: <http://www.aemo.com.au/Electricity/Planning/National-Transmission-Network-Development-Plan>.

## 2. STATEMENT OF MATERIAL ISSUES

### PLEASE CONSIDER:

1. **Is the current 20-year time horizon for the NTNDP appropriate? Would a longer-term outlook be more useful for stakeholders and if so, how long? What emissions reduction milestones would be appropriate to model beyond 2030?**
2. **How should the generation outlook address uncertainty over the timing and scale of coal generation retirement, and what new generation will replace it? Should new coal-fired technologies be considered as credible options for future investment?**
3. **Although Distributed Energy Resources (DER) are not currently aggregated to participate in the energy market, how should the potential for aggregated DER be addressed in 2017 modelling?**
4. **Are there other material issues for transmission development, not considered in this section, which you would like to see addressed in the 2017 NTNDP?**

AEMO prepares the NTNDP each year to provide an independent, strategic assessment of an appropriate course for efficient transmission grid development in the NEM over the next 20 years. In doing so, AEMO must consider any material issue that could impact transmission grid development in that time horizon.

There are a broad range of challenges and uncertainties currently facing the NEM. AEMO considers the issues discussed in this section as most material to transmission grid development for the 2017 NTNDP.

### 2.1 Energy and climate policy uncertainty

All studies in the 2016 NTNDP assumed that the NEM achieves at least a proportionate share of Australia's COP21 commitment<sup>2</sup>, as recommended by the Council of Australian Governments (CoAG) Energy Council.<sup>3</sup> The mechanisms to meet the 2030 target have not yet been specified, and the electricity sector's contribution to this target is unknown. The 2017 review of Australia's climate change policies should provide more information on the potential mechanisms that will be applied.<sup>4</sup> Given this review is not expected to be completed before the release of the 2017 NTNDP, AEMO proposes to model the COP21 commitment in the same way as in 2016.

Beyond 2030, the 2016 NTNDP assumed that the trajectory of emissions reduction to meet the 2030 target would continue. Pending government policy on emissions reduction after 2030, AEMO intends to adopt the same approach again in 2017 and would welcome stakeholder feedback on this.

Potential state-based energy policies and targets will also have a material impact on NEM development as they are implemented. Uncertainty over which policies will be implemented, and to what extent, challenges how the industry should model and plan for the future.

The 2016 NTNDP incorporated potential state-based targets into its base case analysis only if the mechanisms to achieve the targets had been specified, such as the Victorian Renewable Energy Target (VRET). AEMO will incorporate other targets into future base case analysis, such as a possible Queensland Renewable Energy Target, after the mechanisms to achieve them are confirmed.<sup>5</sup>

Given the long lead times associated with change in the energy sector, and the scale of industry transformation that is anticipated, the 20-year outlook for the NTNDP may no longer be appropriate.

<sup>2</sup> COP21 refers to Australia's commitment at the Paris 21st Conference of Parties to reduce greenhouse gas emissions by 26% to 28% of emissions below 2005 levels by 2030.

<sup>3</sup> The Council of Australian Governments (CoAG) Energy Council recommended the 2016 NTNDP assume a 28% emissions reduction below 2005 levels by 2030.

<sup>4</sup> Australian Government, 2016. *Review of Australia's climate change policies*. Available: <https://www.environment.gov.au/climate-change/review-climate-change-policies>.

<sup>5</sup> AEMO acknowledges that the Queensland government has released a draft expert report recommending the reverse auction approach is applied to their target for 50% renewable energy by 2030. If the Queensland government adopts a preferred approach to meeting the 50% target, such as the one recommended by the expert panel, AEMO intends to include this in the 2017 NTNDP modelling.

With the NEM evolving so rapidly, the generation mix selected towards the end of the 20-year horizon is highly dependent on assumptions made about the market conditions beyond the planning horizon. In a rapidly evolving market, it is less appropriate for modelling to assume that market outcomes in the last year of the planning horizon will continue unchanged. AEMO therefore proposes to extend its market modelling to 2050, to provide analysis to better support the assessment of investment and planning decisions that may need be made in the 2020s and 2030s. AEMO is keen to understand whether a longer-term outlook would also be of value to stakeholders, and what emissions reduction milestones would be appropriate to apply to such analysis.

AEMO will continue to engage with our stakeholders to derive the most appropriate assumptions to use in the 2017 NTNDP scenarios, while policy decisions are being made by responsible bodies.

## 2.2 Uncertainty over the timing and scale of coal generation retirement and what new generation will replace it

Projected changes to the NEM generation mix are highly uncertain, and largely depend on the decisions of coal-fired generators and the ongoing direction of energy policy.

Whether coal generation is refurbished or replaced will depend on future climate change policy, technological advances, future gas prices, and the level of consumer demand. Investment decisions taken in the next decade could have divergent implications for Australia's energy systems.

To investigate this uncertainty, AEMO examined two projections of coal retirement timing in 2016:

- The 2016 *National Gas Forecasting Report* (NGFR) examined how extending the technical life of some ageing coal plant could result in later coal generation retirements and a lower projection for gas-powered generation (GPG) in the horizon to meet capacity needs. An argument for extending the life of existing coal generation is that it would allow time for other technologies to support intermittent generation in replacing coal generation, rather than relying on new GPG to provide that support. On the other hand, refurbishment of existing coal generation slows the rate of electricity sector reductions in greenhouse gas emissions.
- The 2016 NTNDP examined a pathway of coal generation retirements based on assumed financial viability and announced intentions to close plant at the end of technical life.<sup>6</sup> This resulted in more projected coal fired generation withdrawals post 2030, and a greater projection of GPG to support development of new renewable generation, compared to the NGFR.

The two projections approximately align to 2030 but diverge by 2036, with 10 GW difference in installed GPG capacity, and almost 50% difference in domestic annual gas consumption (excluding LNG).<sup>7</sup>

This signals the uncertainty towards the end of the 20-year horizon, emphasises the need to account for end-effects when assessing the generation mix, as discussed above, and highlights the strong influence that timing of coal retirements could have on investment in the gas industry.

Given the key interdependencies between electricity and gas markets, a strategic development plan requires a consolidated view of both markets over the outlook period, including the availability of gas and gas pipeline/storage infrastructure for electricity generation. A holistic approach to gas and electricity analysis will be applied in the 2017 NTNDP, and AEMO welcomes feedback on this proposal.

Another consideration is the advancement in high efficiency, low emissions (HELE) coal technologies. The Finkel Review<sup>8</sup> specifically sought feedback on the role of low emissions coal technologies such as ultra-supercritical combustion in future, and Ministers Frydenberg and Canavan have declared that clean coal and gas will retain key roles in the national energy mix<sup>9</sup>. In light of this commentary, should new coal generation technologies be considered as credible options in the generation outlook modelling?

<sup>6</sup> AEMO, 2016. *Consultation paper for the 2016 National Transmission Network Development Plan*. Available: <http://www.aemo.com.au/Electricity/National-Electricity-Market-NEM/Planning-and-forecasting/National-Transmission-Network-Development-Plan>.

<sup>7</sup> When LNG is included, the difference between the NTNDP and NGFR projections for annual gas consumption in 2035–36 is about 15%.

<sup>8</sup> <https://www.environment.gov.au/system/files/resources/97a4f50c-24ac-4fe5-b3e5-5f93066543a4/files/independent-review-national-elec-market-prelim.pdf>

<sup>9</sup> <http://www.joshfrydenberg.com.au/guest/interviews.aspx> Fran Kelly interview, 24 January 2017, (or *The Australian*, 24 January 2017).



## 2.3 The increasing influence of consumer investment trends

Section 2.2.3 in the 2016 NTNDP highlighted that the following consumer investment trends could impact the level and profile of grid demand over the next 20 years:

- Rooftop photovoltaics (PV).
- Energy efficiency.
- Behind the meter battery storage.
- Demand side participation (DSP).
- Grid-connected microgrids and standalone power systems.

The scale and impact of these consumer investment trends over the next 20 years is uncertain, and is largely dependent on regulatory changes, government policies, and technological advances. If implemented at sufficient scale, these trends could materially reduce the need for coal and gas generation capacity in future by providing system support services as well as energy.

One factor not incorporated into the 2016 NTNDP projections was the prospect of aggregated DER. Battery storage projections from the 2016 *National Electricity Forecasting Report* were assumed to operate according to a basic charging/discharging profile that aligned with typical dispatch costs in the wholesale market.<sup>10</sup>

Aggregated DER could operate DSP and energy storage projects to specifically target both price spikes in the wholesale market that would directly compete with gas peaking plant, and network constraints to delay network infrastructure development. AEMO intends to incorporate more detailed projections of aggregated DER into the 2017 planning and forecasting publications and would welcome feedback on key factors to consider in doing so, such as the proportion of distributed storage systems that could be aggregated in future.

## 2.4 How to address the emerging technical challenges related to the energy transformation

Recent NTNDPs have highlighted that the role of transmission networks is changing. Networks designed for transporting energy from coal generation centres will need to transform to support large-scale generation development in new areas. Networks will increasingly be needed to facilitate system support services such as frequency and voltage support.

The 2016 NTNDP sought to provide quantitative analysis on some technical challenges associated with the energy transformation, and discussed a range of possible solutions to address them. High level analysis on potential interconnection developments highlighted that further interconnection may deliver fuel cost savings and improve system resilience for consumers.

How these challenges evolve and are addressed remains a material issue that will shape the NEM over the next 20 years. For the 2017 NTNDP, AEMO intends to continue providing quantitative analysis on projected technical challenges, such as frequency stability and system strength, and possible solutions.

AEMO would welcome feedback on whether the analysis of technical challenges and possible solutions in the 2016 NTNDP was useful for stakeholders, and what improvements can be made to the scope of this analysis to deliver greater value.

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<sup>10</sup> AEMO. 2016 *Forecasting Methodology Information Paper*. Available: <http://www.aemo.com.au/Electricity/National-Electricity-Market-NEM/Planning-and-forecasting/National-Electricity-Forecasting-Report>.



## 2.5 Regulatory uncertainty over the outlook period

The rapid changes occurring in our industry are driving a continual evolution of the regulatory framework, and the pace of change is challenging the rate at which regulatory framework can adjust to avoid being a barrier to innovation.

The Australian Energy Market Commission (AEMC) is currently considering a number of rule changes and reviews that will materially impact how the NEM develops over the next 20 years, including<sup>11</sup>:

- Transmission connection and planning arrangements.
- Non-scheduled generation and load in central dispatch.
- Five minute settlement.
- System security market frameworks review.
- Replacement expenditure planning arrangements.
- Contestability of energy services (including demand response and network support).

AEMO will make appropriate adjustments to its analysis as rules are changed. Long-term assumptions on the general direction of some issues, such as tariff structures, are shown in the draft scenario drivers published with this paper.<sup>12</sup> AEMO would welcome feedback on this approach.

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<sup>11</sup> AEMC. *Rules changes*. Available: <http://www.aemc.gov.au/Rule-Changes>.

<sup>12</sup> AEMO. 2017 Planning and Forecasting scenarios – draft. Available: <http://www.aemo.com.au/Electricity/National-Electricity-Market-NEM/Planning-and-forecasting/National-Transmission-Network-Development-Plan>.

## 3. SCOPE AND SCENARIOS

### PLEASE CONSIDER:

#### 5. What scenarios/sensitivities would you like to see examined in the 2016 NTNDP?

### 3.1 Scenario development

Each year the NTNDP assesses the need for transmission development under a range of credible scenarios over a 20-year period, to reflect issues pertinent at the time.

#### 3.1.1 2016 planning and forecasting scenarios

The 2016 *National Electricity Forecasting Report* (NEFR), published in June 2016, produced energy forecasts for three economically consistent scenarios – Neutral, Strong and Weak economies.

The 2016 NTNDP:

- Examined transmission development under the Neutral scenario.
- Adjusted the Weak scenario to create a Low Grid Demand scenario to stress test generation and transmission development under a credible low boundary of grid demand.
- Examined a new 45% Emissions Reduction scenario in which the electricity sector reduced emissions 45% relative to 2005 levels by 2030, based on the Neutral level of demand.

#### 3.1.2 2017 planning and forecasting scenarios

Appendix A shows a high level description of the proposed 2017 planning and forecasting scenarios, which are similar to those examined in 2016. A detailed view of the drivers behind these proposed scenarios has been published with this consultation on AEMO's website.<sup>13</sup>

AEMO intends to only examine Neutral, Strong, and Weak economic scenarios in the 2017 NEFR. The 2017 NTNDP is likely to examine a selection of the scenarios outlined in Appendix A, such as:

- Neutral scenario – the most likely estimate of future demand and NEM development.
- Low Grid Demand scenario.
- 50% renewable generation scenario.

AEMO welcomes feedback on this approach and may adjust the scenarios assessed according to the feedback received. AEMO is particularly interested in feedback on the proposed settings for the 50% renewable generation scenario, including what renewable generation or emissions reduction milestones to apply beyond 2030.

<sup>13</sup> AEMO. 2017 Planning and Forecasting scenarios – draft. Available: <http://www.aemo.com.au/Electricity/National-Electricity-Market-NEFR/Planning-and-forecasting/National-Transmission-Network-Development-Plan>.

## 4. METHODOLOGY CONSIDERATIONS

### PLEASE CONSIDER:

6. What do you think are the key challenges/opportunities for network development in the future, particularly highlighting any that were not identified in the 2016 NTNDP?
7. Do you have any suggestions on how to improve the generation outlook or transmission outlook methodologies for the 2017 NTNDP?

The NTNDP co-optimises two key modelling outlooks:

- The **generation outlook**, which projects the location and timing of new generation additions and withdrawals for each scenario. This outlook focuses on efficient development to meet forecast demand, minimising both total generation and network investment costs over the 20-year planning horizon.
- The **transmission outlook**, which identifies likely congestion points on the main transmission flow paths over the 20-year outlook. These congestion points are heavily influenced by the generation outlook.

AEMO continues to refine the methodologies for both outlooks each year, and welcomes feedback on the methodology considerations for the 2016 NTNDP below.

### 4.1 Generation outlook methodology

AEMO continually develops its methodology to analyse the outlook for existing and new generation. The current methodology is described in the Market Modelling Methodology and Input Assumptions paper on the NTNDP Database.<sup>14</sup>

Current focus areas for improvement include:

- **Development of a new reference year approach:** In 2016, AEMO examined moving from a deterministic to a stochastic approach to developing demand, wind, and solar traces. Such an approach would utilise up to six reference years (2009–10 to 2014–15) to represent the future weather/demand distribution while keeping the correlation between weather and peak demand.

The 2016 NTNDP continued a single reference year approach (2013–14), but AEMO intends to explore the feasibility and materiality of the multiple reference year approach for the 2017 NTNDP, following improvements in its modelling capability.

- **Battery storage:** The 2016 NTNDP included large-scale battery storage as an option for the generation outlook model to choose from when optimising the generation mix, but there were notable drawbacks to the modelling approach:
  - The model only took account of one potential value stream for large-scale battery storage, being from wholesale market arbitrage. Other potential value streams, derived from network support services or ancillary services, were not taken into account.
  - The low granularity and short run marginal cost bidding used in the long-term generation outlook model does not reflect the volatility of the actual wholesale market, and therefore does not accurately reflect the potential arbitrage opportunities that storage could capture.

AEMO will investigate strategies to more accurately model battery storage potential, in consultation with the Planning and Forecasting Reference Group. AEMO welcomes any stakeholder feedback on this topic.

- **Geographic diversity of renewable generation:** The 2016 NTNDP modelling identified that geographic and technological diversity smooths the impact of intermittency and reduces reliance on gas-powered generation (GPG). The modelling also showed that greater interconnection facilitates

<sup>14</sup> AEMO, *NTNDP Database* webpage. Available: <https://www.aemo.com.au/Electricity/National-Electricity-Market-NEM/Planning-and-forecasting/National-Transmission-Network-Development-Plan/NTNDP-database>.

this diversity and delivers fuel cost savings to consumers. AEMO intends to continue working to improve the assessment of solar and wind diversity across the NEM in 2017.

- **Extension of planning horizon:** As previously mentioned, AEMO proposes to extend its market modelling to 2050 to produce a more realistic assessment of possible investment and planning decisions that may need be made in the 2020s and 2030s.
- **Gas and electricity integration:** The 2016 NTNDP highlighted the growing interdependencies between gas and electricity markets. To address this in more detail, AEMO intends to develop an integrated gas and electricity market model in PLEXOS as a major project for 2017, building on research that was completed for AEMO by a Masters student in 2016.

## 4.2 Transmission outlook methodology

The transmission outlook analysis primarily assesses the adequacy of the national transmission grid to reliably support bulk power transfers between supply and demand centres.

Two types of limitations are considered in this analysis to highlight congestion in the network that should be addressed:

- **Reliability limitations** occur if, at the time of regional maximum operational demand, the network does not have enough capacity to meet demand.
- **Economic limitations** are where more expensive generation is dispatched ahead of cheaper generation in order to avoid network overloads.

AEMO intends to continue analysing limitations in this way in 2017.

The 2016 NTNDP highlighted the potential scale of coal generation retirements over the next 20 years and potential need for GPG to support the transition to low emissions generation.

The resulting interdependencies between electricity and gas supply mean that gas transmission infrastructure will also need to be considered in the optimisation of generation and transmission development for the NEM.

## 4.3 Network Support and Control Ancillary Services (NSCAS)

The 2016 NTNDP highlighted that the regulatory framework does not currently allow for the identification and procurement of NSCAS to mitigate non-credible contingencies, but that the South Australian government had proposed a rule change to introduce a sub-category of non-credible events for which AEMO could plan emergency frequency control schemes.<sup>15</sup>

In late December 2016, the AEMC released a draft determination outlining a framework for 'protected events', for which AEMO would be able to take some ex-ante actions to limit their potential consequences.

AEMO also notes that the AEMC's interim report on the System Security Market Frameworks Review<sup>16</sup> suggests that NSCAS could become a means to procure inertia, but further detailed analysis would be required.

AEMO will continue to work with the AEMC on the System Security Market Frameworks Review and other relevant rule change proposals to determine whether any changes to the NSCAS framework, including the NSCAS description and quantity procedure, are required for the 2017 NSCAS assessment.

<sup>15</sup> AEMC, 2016. Emergency under frequency control schemes. Available: <http://www.aemc.gov.au/Rule-Changes/Emergency-frequency-control-schemes-for-excess-gen>. Viewed: 5 October 2016.

<sup>16</sup> AEMC, 2016. System Security Market Frameworks Review: interim report. Available: <http://www.aemc.gov.au/Markets-Reviews-Advice/System-Security-Market-Frameworks-Review#>.

## 5. PROPOSED 2017 NTNDP INPUTS

### PLEASE CONSIDER:

- 8. Are the proposed 2017 NTNDP inputs appropriate, and would you recommend any additions/changes to these assumptions?**

The input data files and assumptions applied in the 2016 NTNDP are included in the NTNDP Database on AEMO's website.<sup>17</sup>

Many of the inputs and assumptions in the NTNDP Database will also apply to the 2017 NTNDP. Some key inputs and updated assumptions for the 2017 NTNDP are proposed below.

### 5.1 Scenarios

Please refer to section 3 above.

### 5.2 Forecasts

The 2017 NTNDP demand trace development will start with the 2017 NEFR forecasts for electricity consumption and maximum demand, which will also include a projection of residential storage uptake. These may then be adjusted according to the focus of the NTNDP scenarios. For example, adjustments may include increasing the levels of energy efficiency or rooftop PV and battery storage penetrations.

### 5.3 Generation

The 2017 NTNDP will consider the existing generation capacity located in the NEM, as listed on the AEMO Generation Information page.<sup>18</sup> It will include partial availability, publicly announced withdrawals, and committed and proposed generation projects, all listed on the Generation Information page.

Similarly to the 2016 report, the 2017 NTNDP will take into account new connection applications when developing the first five years of the generation outlook to accurately reflect potential new developments that could be built in that time.

There will be a cut-off date for the generation information considered in the NTNDP modelling. The cut-off date in 2016 was 14 October, and the 2017 cut-off date will be stated clearly in the published report.

### 5.4 Renewable energy target and carbon price

The legislated Federal Large-scale Renewable Energy Target (LRET) will be applied in the generation outlook model. The model will select the most efficient expansion from existing capacity, new generation, and LRET penalty as legislated. Excess large-scale generation certificates (LGCs) already banked will be used in the market modelling.

The standard lead time for generation projects applied in the generation outlook methodology is three years, but AEMO intends to allow for publicly announced wind generation projects to be built within two years, taking into account the advanced stage of planning that these projects are in before reaching committed status.

### 5.5 Fuel and technology costs

The 2017 NTNDP will apply the same technology cost data for both existing and new generation as in the 2016 NTNDP, updated where appropriate. Most of the technology cost data for the 2016 NTNDP

<sup>17</sup> AEMO. NTNDP Database. Available: <https://www.aemo.com.au/Electricity/National-Electricity-Market-NEM/Planning-and-forecasting/National-Transmission-Network-Development-Plan/NTNDP-database>.

<sup>18</sup> AEMO. Generation Information webpage. Available: <http://www.aemo.com.au/Electricity/Planning/Related-Information/Generation-Information>.



was provided by the 2015 *Australian Power Generation Technology Report*<sup>19</sup> (APGTR), and publicly available information from Australian Renewable Energy Agency (ARENA) solar and battery storage projects. The APGTR report provides a range of generation technology costs out to 2030, and was developed in consultation with leaders from industry, government, consumer groups, and industry associations.

AEMO will monitor market developments for generation technology costs during the year and will seek updates or additional data as considered necessary for the 2017 NTNDP.

Fuel costs for gas and coal were obtained through consultant reports in 2016 that are published on the NTNDP Database. Updated fuel costs will be obtained if required in 2017.

All fuel and technology costs applied in the 2017 NTNDP will be published in the 2017 NTNDP Database.

## 5.6 Transmission network inputs

The 2017 NTNDP modelling will incorporate existing and committed regional transmission network assets as advised by transmission network service providers for each region of the NEM in their 2017 Transmission Annual Planning Reports.

AEMO will continue to engage with non-network service providers to understand how non-network solutions can address the power system challenges highlighted in the 2016 NTNDP.

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<sup>19</sup> *Australian Power Generation Technology Report*, 2015. Available: [http://www.co2crc.com.au/dls/Reports/LCOE\\_Report\\_final\\_web.pdf](http://www.co2crc.com.au/dls/Reports/LCOE_Report_final_web.pdf).

## APPENDIX A. DRAFT PLANNING AND FORECASTING SCENARIOS – HIGH LEVEL DESCRIPTION

	<b>Weak sensitivity (Proposed for 2017 NEFR)</b>	<b>Neutral (most probable) scenario (Proposed for 2017 NEFR and NTNDP)</b>	<b>Strong sensitivity (Proposed for 2017 NEFR)</b>	<b>Low grid demand scenario (Proposed for 2017 NTNDP)</b>	<b>50% renewable generation scenario (Proposed for 2017 NTNDP)</b>
<b>Environmental policy (P)</b>	Significant reduction in carbon emissions sought, partly through improved energy productivity. Electricity sector to meet same reduction target as country overall. No targets set for emissions from domestic gas use.	Significant reduction in carbon emissions sought, partly through improved energy productivity. Electricity sector to meet same reduction target as country overall. No targets set for emissions from domestic gas use.	Significant reduction in carbon emissions sought, partly through improved energy productivity. Electricity sector to meet same reduction target as country overall. No targets set for emissions from domestic gas use.	Very significant reduction in carbon emissions sought, partly through improved energy productivity. Electricity sector to meet same reduction target as country overall. No targets set for emissions from domestic gas use.	Significant reduction in carbon emissions sought, through 50% NEM-wide uptake of renewable generation by 2030, driven by state based policies. Emissions reduction is also partly sought through improved energy productivity. Electricity sector to meet same reduction target as country overall. No targets set for emissions from domestic gas use. State based renewable energy targets, both legislated and aspirational, are all met.
<b>Economy (E)</b>	Lower than expected economic growth - partly driven by lower immigration, but also slower economic growth internationally affecting commodity exports.	Economy transition to an average economic growth over the next 5 years. Population growth average.	Higher than expected economic growth - partly driven by higher immigration, but also a more international oriented scenario focussing more in free trade and international co-operation (e.g. around emission trading)	Lower than expected economic growth partly due to stronger emission reduction targets globally and partly driven by lower immigration.	Economy transition to an average economic growth over the next 5 years. Population growth average. Neutral level of grid demand.
<b>Consumer behaviour/ societal (S)</b>	Status quo: no growth in engagement compared to now. Small proportion of highly engaged consumers. Most others seek stability (fixed tariffs).	Engaged consumers: Retailer/aggregator led “smart future” with major product innovation pushed by industry. Gradual move towards cost-reflective pricing following smart meter roll-out to all households by 2030. Moderate uptake of cost reflective tariffs.	Engaged prosumers: Consumer led “smart future” with a majority of consumers ultimately buying and selling electricity based on short term price signals. Strong move towards cost-reflective pricing following smart meter roll-out to all households by 2025. High uptake of cost reflective tariffs.	Engaged prosumers: Consumer led “smart future” with a majority of consumers ultimately buying and selling electricity based on short term price signals. Strong move towards cost-reflective pricing following smart meter roll-out to all households by 2025. High uptake of cost reflective tariffs.	Engaged consumers: Retailer/aggregator led “smart future” with major product innovation pushed by industry. Gradual move towards cost-reflective pricing following smart meter roll-out to all households by 2030. Moderate uptake of cost reflective tariffs.
<b>Consumer behaviour/ societal (S)</b>	Technology uptake characterised by a hesitant consumer in a weak economy. Consumers seek high returns before investing in PV, storage and energy efficiency.	Technology uptake characterised by a neutral consumer in a neutral economy. Consumers seek moderate returns trigger investments in PV, storage and energy efficiency.	Technology uptake characterised by a confident consumer in a strong economy. Consumers accept lower returns when investing in PV, storage and energy efficiency.	Technology uptake characterised by a confident consumer in a strong economy. Consumers accept lower returns when investing in PV, storage and energy efficiency.	Technology uptake characterised by a neutral consumer in a neutral economy. Consumers seek moderate returns triggering investments in PV, storage and energy efficiency.
<b>Technology (T)</b>	Slower improvement in generation and demand side technology costs	Expected improvement in generation and demand side technology costs	Faster improvement in generation and demand side technology costs	Faster improvement in generation and demand side technology costs	Expected improvement in generation and demand side technology costs