# Expanding NSW-QLD Transmission Transfer Capacity

**QNI PADR Stakeholder Webinar**

**Friday 25 October 2019**

# Presenter Introductions

## TransGrid

Andrew Kingsmill – *Manager, Network Planning*

## Powerlink

Julian Thomas – *General Manager, Network Portfolio*

## HoustonKemp Economists

Tom Graham – *Senior Economist*

## Ernst & Young

Clare Giacomantonio – *Director, Power & Utilities*

# Agenda

1. Project Overview
2. Credible Options
3. NPV Results
4. Market Modelling Overview
5. Market Modelling Outcome – benefits and sensitivities
6. Questions
7. Next Steps – submissions by 15th November 2019

# Project Overview

- TransGrid and Powerlink are jointly undertaking a Regulatory Investment Test for Transmission (RIT-T) to assess the technical and economic feasibility of expanding NSW – QLD transmission transfer capacity.
- A Project Specification Consultation Report (PSCR) was published on 22nd November 2018.
- A Project Assessment Draft Report (PADR) was published on 30th September 2019, a detailed Market Modelling Report was published on 11th October 2019.
- The PADR confirms the 2018 ISP recommended QNI group 1 option (uprating the Liddell to Tamworth lines and installing new dynamic reactive support at Tamworth and Dumaresq and shunt capacitor banks) delivers the greatest expected net benefits of all options considered.

# Stakeholder Consultation

- Powerlink provided its Customer Panel with an overview of the RIT-T and held a focused engagement workshop in December 2018.
- TransGrid and Powerlink held a PSCR webinar in early February 2019 to help explain the assessment and seek stakeholder's view. Formal submissions were subsequently received.
- Prior to, as well as after, receiving submissions, we held a number of joint meetings with interested parties in order to clarify their submissions.
- In July 2019, the AER released a guidance note proposing a refined focus on small near-term options for QNI expansion in this RIT-T, followed by consideration of larger medium-term options in a subsequent RIT-T.
- We have briefed the Powerlink and TransGrid Customer Panels on this refined focus and presented at Transmission Network and Annual Planning Forums in September 2019.

# Submissions to the PSCR

- Seven formal submissions have been published on our websites and the remainder have requested their submissions be kept confidential.
- There are six broad topics that commented on

The potential for grid-connected battery systems to address the near-term need

Two BESS options have been assessed: a new ‘modest’ BESS (40MW) and re-scoped larger BESS (200MW)

Potential non-network options

Two network support BESS and a renewable project (withdrew in August 2019) have been considered.

Additional variants for near-term network options

There is no driver to address congestion on lines between Tamworth and Armidale (as a variant to Option1A) due to a lack of committed generation developments at this point of time.

TransGrid and Powerlink have considered a submission from Smart Wires proposing a series compensation option. This option has been assessed and is not considered to be a sufficiently proven technology for this application

# Submissions to the PSCR

Additional options or increasing transfer capacity in the medium-term

Medium-term options for expanding transfer capacity will be subject to a separate RIT-T process. TransGrid and Powerlink will take into account the points made in submissions in the subsequent process.

Alignment with the latest ISP and ESOO assumptions

PADR assessment is based on the planning and forecasting assumptions that have been consulted on by AEMO in the context of the 2020 ISP and the most recent assumptions that were available by early August 2019.

Other modelling assumptions

- System Strength requirements are not materially different across options
- Four scenarios modelled include a range of generator retirement dates
- Slow change scenario amended and excluded VNI and developments related to Snowy 2.0
- We have considered the effects of transmission line outage due to upgrade as a sensitivity.
- We have adopted a real, pre-tax discount rate 5.9% as the central assumptions and tested the sensitivity using 2.85% and 8.95%

# Key developments since the PSCR

- **This PADR focuses on options for increasing NSW-QLD transfer capacity in the near-term, ahead of the planned retirement of the Liddell power station in NSW.**
- **Two new credible options for near-term investment have been developed and assessed.**
  - A ‘modest’ 2 x 40MW / 20MWh battery energy storage system (BESS); and
  - A refinement of the delivery, costs and capabilities of the original, larger, BESS options proposed in the PSCR (which is now assumed to be a 2 x 200MW/100MWh system)
- **The market modelling assumptions have been updated to align more closely with those to be used for the 2020 ISP, which were consulted on by AEMO during early 2019.**
  - Renewable Energy Zone (REZ) modelling;
  - Generation technology cost projections;
  - Newly committed generation; and
  - Coal and gas fuel cost projections.

# Key developments since the PSCR

- **The slow change scenario has been amended to exclude both the Victoria to NSW interconnector upgrade and developments related to Snowy 2.0 (i.e. Snowy 2.0 generation, HumeLink and KerangLink).**
- **AGL announced on 2nd August 2019 that it plans to defer the retirement of three of Liddell's four units until April 2023. A sensitivity has been included to investigate the effects of this deferred staged retirement.**
- **Consistent with the guidance regarding expediting a near-term solution, the AER has proposed to adopt an expedited process for considering whether the ultimately preferred near-term option satisfies the RIT-T as part of the contingent project approval process.**

# Summary of six credible options for increasing NSW-QLD transfer capacity in the near-term

| Option description | Indicative total transfer capacity (MW)^ | | Estimated capex ($m) |
|---|---|---|---|
| | Northward | Southward | |
| **Incremental upgrades to the existing network to increase transfer capacity** | | | |
| Option 1A – Uprate Liddell to Tamworth lines and install new dynamic reactive support at Tamworth and Dumaresq and shunt capacitor banks | 690 | 1,120 | 175 |
| Option 1B – Uprate Liddell to Tamworth lines only | 570 | 1,070 | 34 |
| Option 1C – Install new dynamic reactive support at Tamworth and Dumaresq and shunt capacitor banks | 480 | 1,120 | 142 |
| Option 1D – Sapphire substation cut into line 8C and a mid-point switching station between Dumaresq and Bulli Creek | 480 | 1,110 | 45 |
| **Grid-connected battery systems** | | | |
| Option 5A – Small BESS (2 x 40MW / 20MWh) | 520 | 1,110 | 110* |
| Option 5B – Large BESS (2 x 200MW / 100MWh) | 680 | 1,270 | 461* |

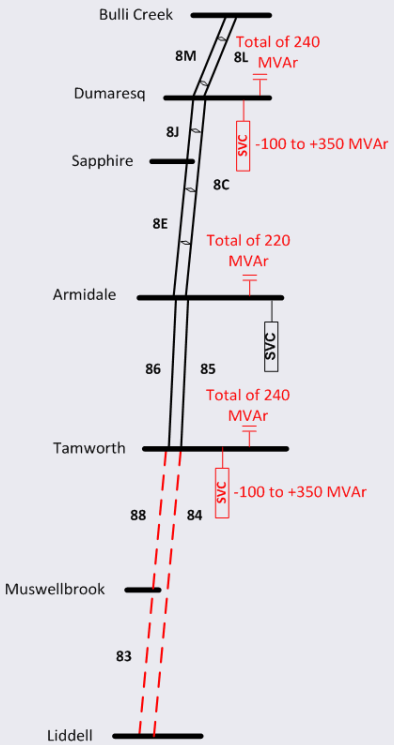
*^ The transfer capacities shown in this table are indicative for one operating state only (summer, daytime and medium demand). Without the upgrade option, the indicative northward transfer is 480MW and southward transfer is 1,070MW.*

** These are the assumed upfront capital and reinvestment costs for these two options*



Powerlink QUEENSLAND TransGrid

# Option 1A – Uprate Liddell to Tamworth lines and install dynamic reactive support




## Lines

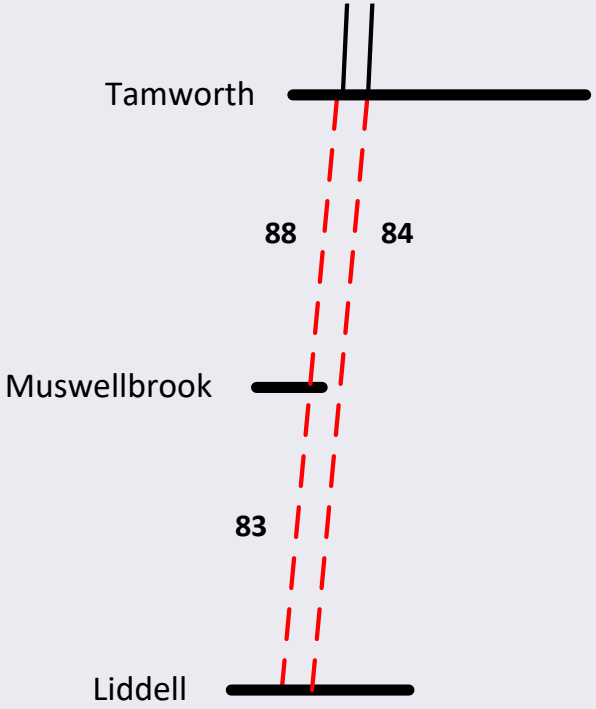
- Line 83, 84 and 88 uprated from 85°C design operating temperature to 120°C.

## Substation

- Dumaresq
  - -100 – 350MVAr SVC
  - 2 x 120MVAr Capacitor Banks
- Armidale
  - 2 x 50MVAr Capacitor Banks
  - 120MVAr Capacitor Bank
- Tamworth
  - -100 – 350MVAr SVC
  - 2 x 60MVAr Capacitor Banks
  - 120MVAr Capacitor Bank

**Estimated capital cost $175 million**

# Option 1B – Uprate Liddell to Tamworth lines only

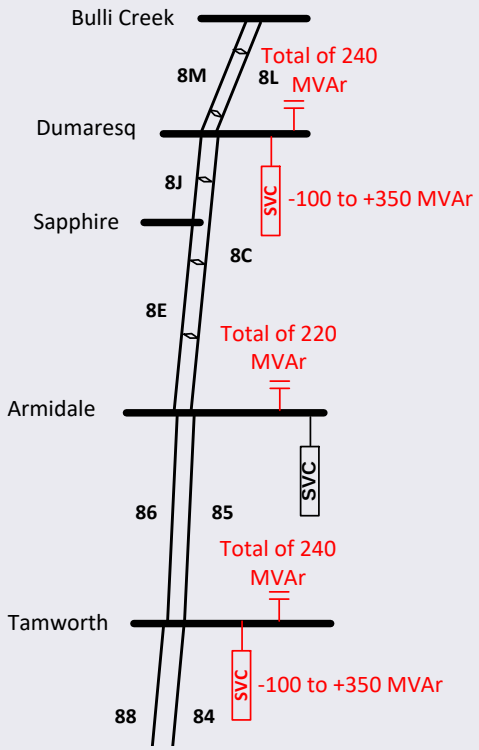



**Lines**

- Line 83, 84 and 88 uprated from 85°C design operating temperature to 120°C.

**Estimated capital cost $34 million**

# Option 1C – Install new dynamic reactive support at Tamworth and Dumaresq and shunt capacitor banks

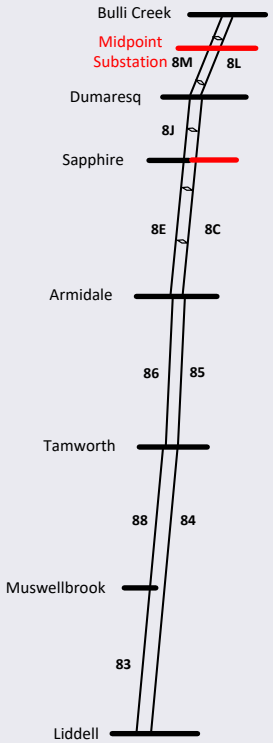



## Substation

- Dumaresq
  - -100 – 350MVAr SVC
  - 2 x 120MVAr Capacitor Banks
- Armidale
  - 2 x 50MVAr Capacitor Banks
  - 120MVAr Capacitor Bank
- Tamworth
  - -100 – 350MVAr SVC
  - 2 x 60MVAr Capacitor Banks
  - 120MVAr Capacitor Bank

**Estimated capital cost $142 million**

# Option 1D – Sapphire substation cut into line 8C and a mid-point switching station between Dumaresq and Bulli Creek

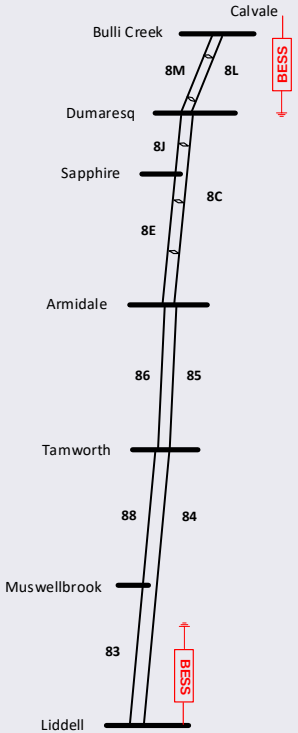



## Substation

- Establishing a new mid-point switching station between Bulli Creek – Dumaresq 330kV
- Cutting Line 8C (Armidale – Dumaresq 330kV) into the existing Sapphire substation

**Estimated capital cost $45 million**

# Option 5A – Small-scale BESS




## Calvale Substation

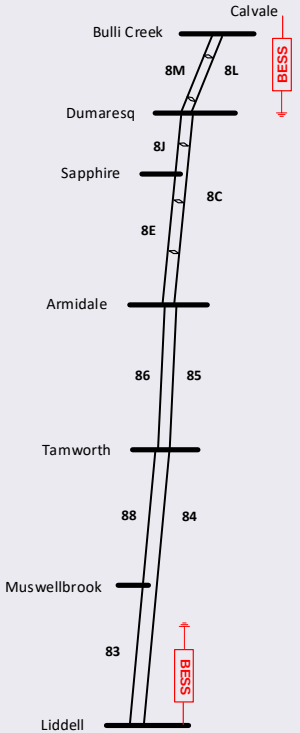
- 40MW / 20MWh Battery
- HV Transformer and connecting bay equipment
- Special Protection Scheme (SPS)

## Liddell Substation

- 40MW / 20MWh Battery
- HV Transformer and connecting bay equipment
- Special Protection Scheme (SPS)

**Estimated capital cost $110 million**

# Option 5B – Larger-scale BESS




## Calvale Substation

- 200MW / 100MWh Battery
- HV Transformer and connecting bay equipment
- Special Protection Scheme (SPS)

## Liddell Substation

- 200MW / 100MWh Battery
- HV Transformer and connecting bay equipment
- Special Protection Scheme (SPS)

**Estimated capital cost $461 million**

HOUSTONKEMP
Economists

# Expanding NSW-QLD Transmission Transfer Capacity

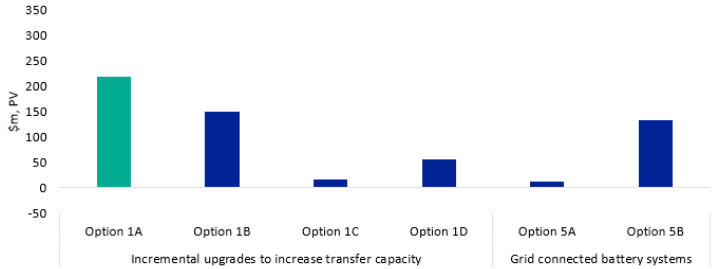
RIT-T PADR NPV results – TransGrid and Powerlink webinar

25 October 2019

# Option 1A is the preferred option in all scenarios

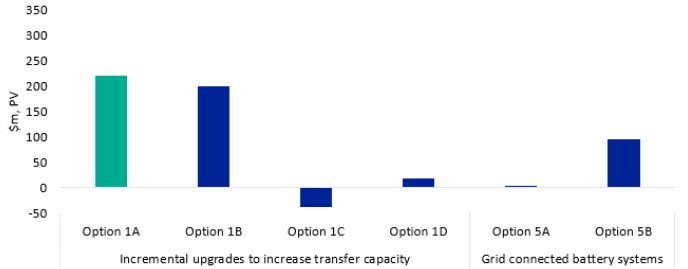
**Neutral**

Summary of the estimated net market benefits — FIGURE 6



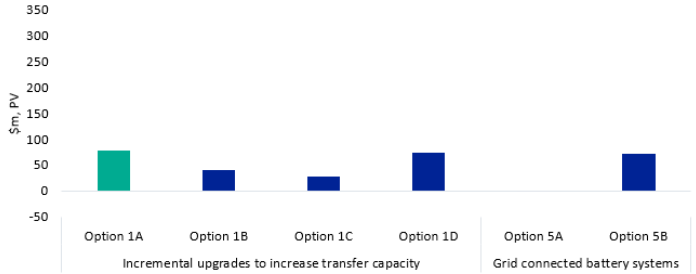

**Neutral + low emissions**

Summary of the estimated net market benefits — FIGURE 10



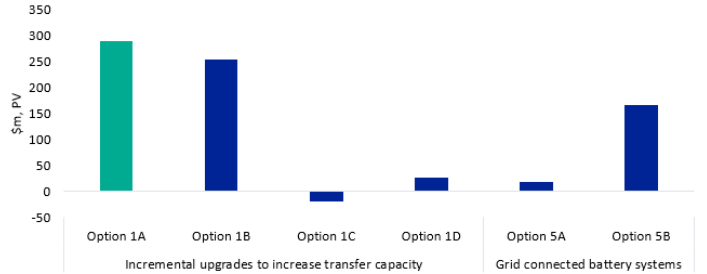

**Slow change**

Summary of the estimated net market benefits — FIGURE 13



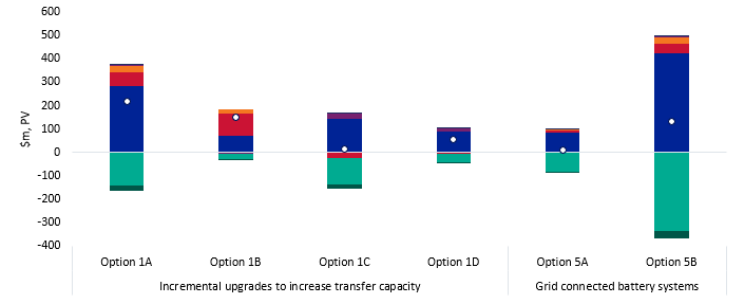

**Fast change**

Summary of the estimated net market benefits — FIGURE 16

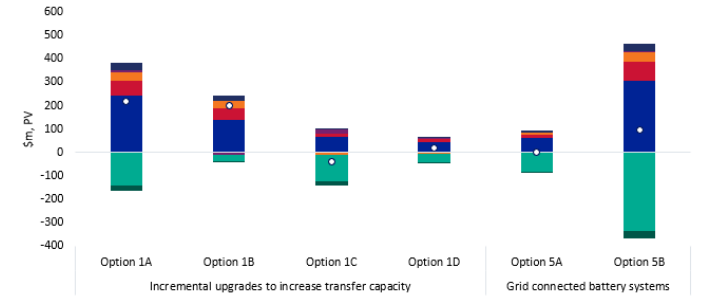


# Avoided/deferred generator and storage costs are the greatest source of market benefits

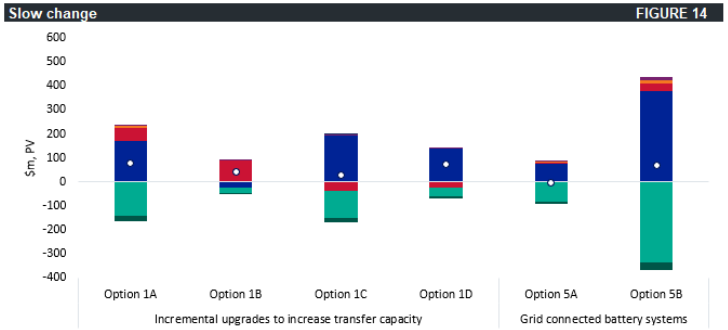
Neutral FIGURE 7



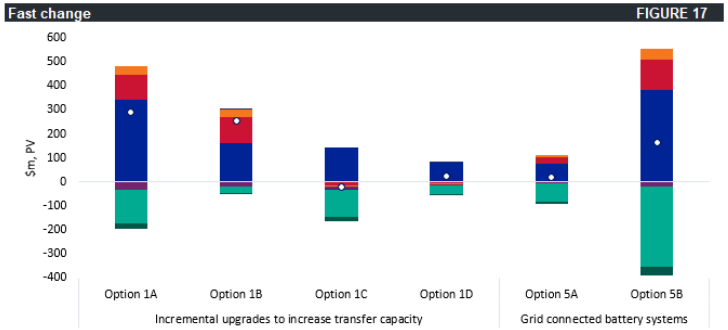

Neutral + low emissions FIGURE 11




Slow change FIGURE 14



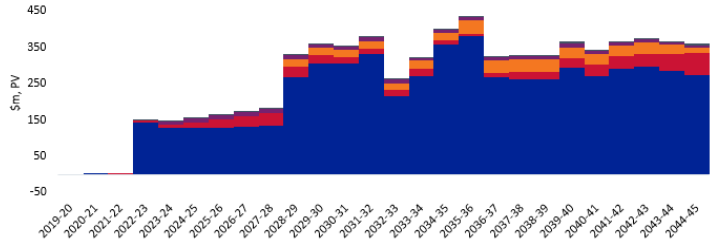

Fast change FIGURE 17



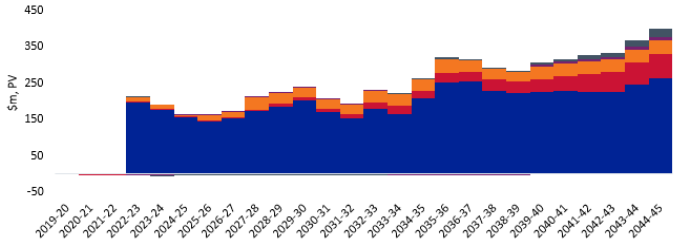

- Avoided/deferred generator and storage capex and opex (exc. fuel costs)
- Avoided REZ transmission capex
- Avoided voluntary load curtailment
- Transmission opex
- Avoided fuel costs
- Avoided unserved energy
- Transmission capex
- NPV

# Benefits are driven by retirement of thermal plants

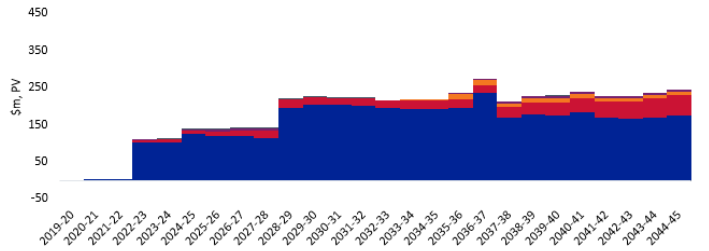
Neutral Option 1A Cumulative, PV FIGURE 8



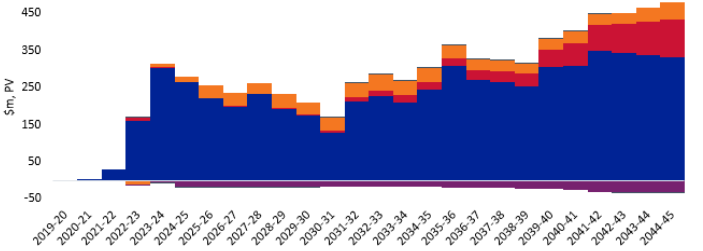

Neutral + lov Option 1A Cumulative, PV FIGURE 12




Slow change Option 1A Cumulative, PV FIGURE 15




Fast change Option 1A Cumulative, PV FIGURE 18




- Avoided/deferred generator and storage capex and opex (exc. fuel costs)
- Avoided REZ transmission capex
- Avoided voluntary load curtailment
- Avoided fuel costs
- Avoided unserved energy

# Expanding NSW-QLD transmission transfer capacity: PADR market modelling

TransGrid & Powerlink webinar

25 October 2019

Building a better working world

# Methodology

- Least-cost NEM generator expansion model which follows the RIT-T guidelines published by the AER.
- Modelling conducted at hourly time-sequential granularity utilising a least-cost planning model that solves dispatch intervals for 25 years (FY2020-21 – FY2044-45) simultaneously.
- Solution minimises cost of supply to meet demand and other constraints
  - Generation of each plant and charging and discharging of storage.
  - Commissioning new plant installed ‘linearly’.
  - Fixed thermal retirement schedule for existing plant.
- Model utilises eight years of historical data for site-specific wind and solar availability and demand shape.
- NSW represented by four zones (NNS, NCEN, CAN, SWNSW) and QLD by two zones (SQ, CQ) with intra-regional limitations and dynamic loss-equations.
- February 2019 AEMO Planning and Forecasting input assumptions, with updates to REZ modelling to reflect recent 2020 AEMO ISP assumptions.

# Summary of gross market benefits (all relative to Base case)

Table 13

| Option | Neutral | Neutral + low emissions | Fast change | Slow change |
|---|---|---|---|---|
| 1A | $379m | $382m | $451m | $240m |
| 1B | $179m | $230m | $284m | $71m |
| 1C | $146m | $94m | $112m | $159m |
| 1D | $95m | $59m | $67m | $115m |
| 5B | $499m | $462m | $532m | $438m |

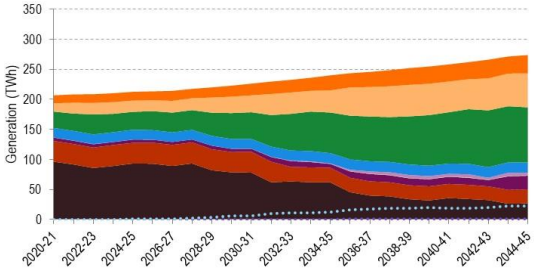
Real June 2019 dollars discounted to 2019-20

- The benefits net of upgrade option costs were not considered in EY modelling and are discussed in the associated PADR report.

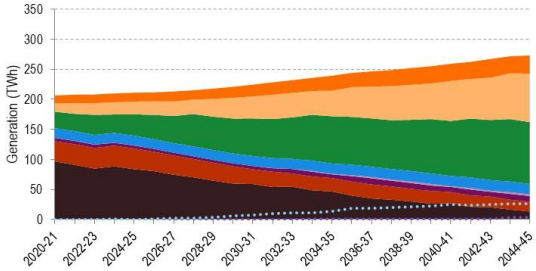
# Scenario outcomes without an upgrade - generation

## Neutral

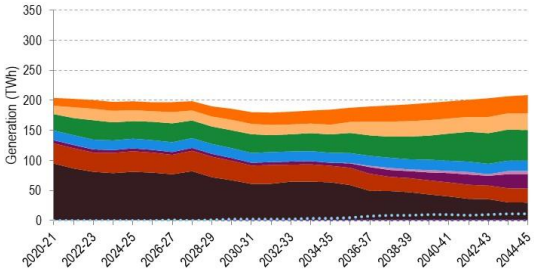
Figure 10



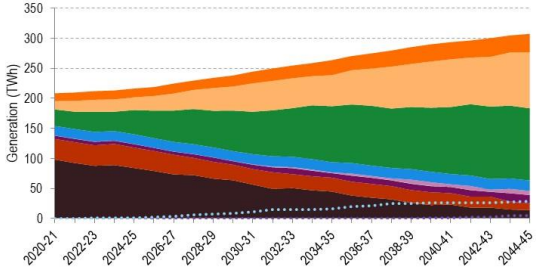

## Neutral + low emissions




## Slow change




## Fast change

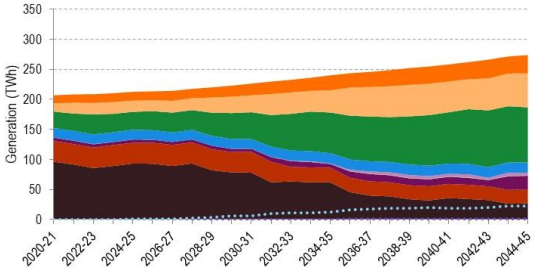



Black Coal
Brown Coal
CCGT
Gas - Steam
OCGT / Diesel
Hydro
Wind
Solar PV
Rooftop PV
LS Battery
PSH

# Scenario outcomes without an upgrade - generation

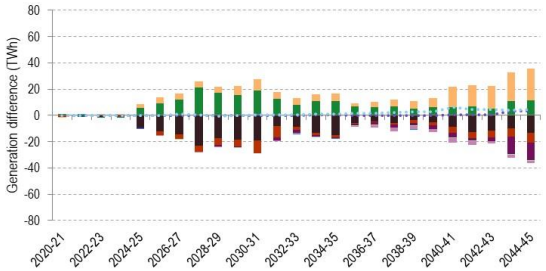
## Neutral

Figure 10



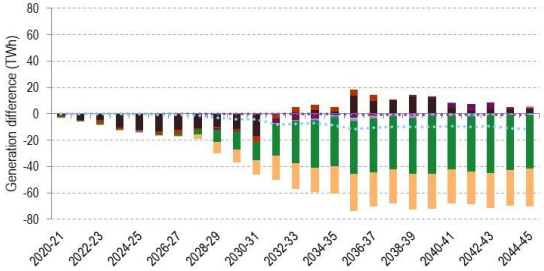

## Neutral + low emissions (relative to Neutral)

Figure 13



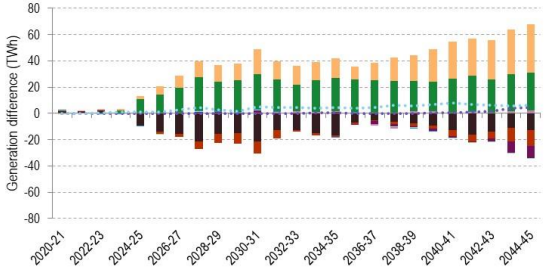

## Slow change (relative to Neutral)

Figure 19




## Fast change (relative to Neutral)

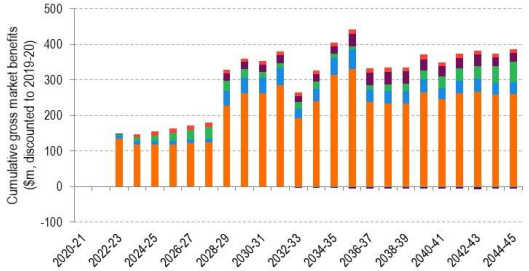
Figure 16




# Annual gross market benefits – Option 1A

## Neutral

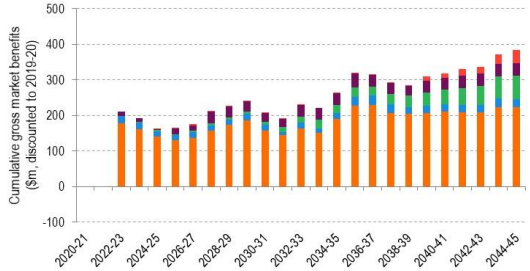
Figure 21




$379m

## Neutral + low emissions

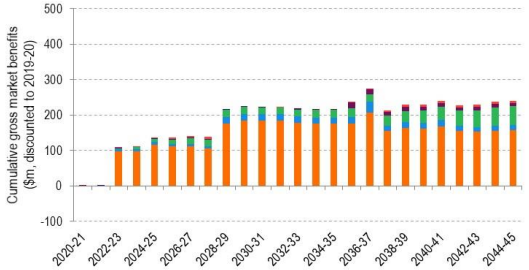
Figure 26




$382m

## Slow change

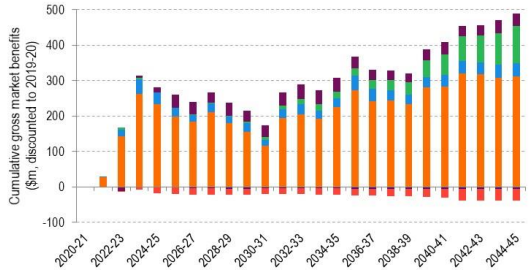
Figure 34




$240m

## Fast change

Figure 30



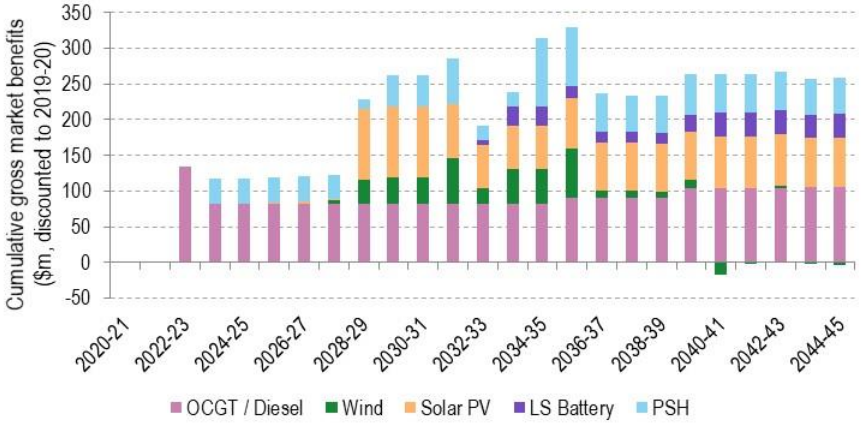

$451m

CAPEX FOM Fuel VOM REZ Expansion USE & DSP

# Deferred and avoided capacity drives large capex benefits

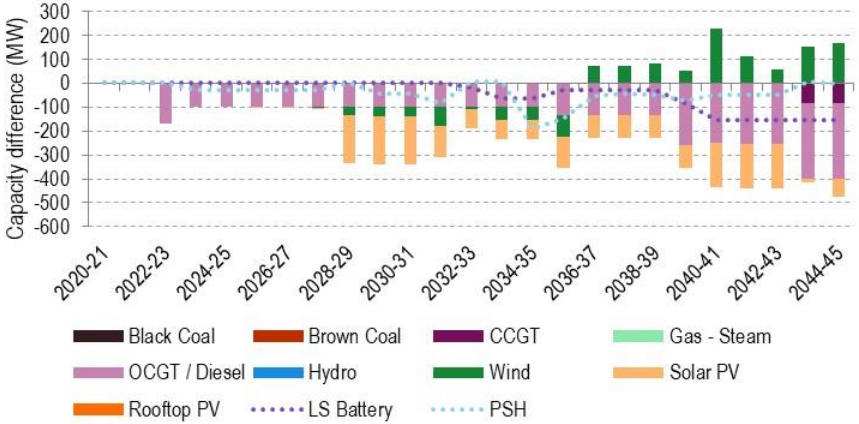
## Capex benefit by technology

Option 1A, Neutral




## Capacity difference by technology

Option 1A, Neutral



# What drives 2022-23 benefit?

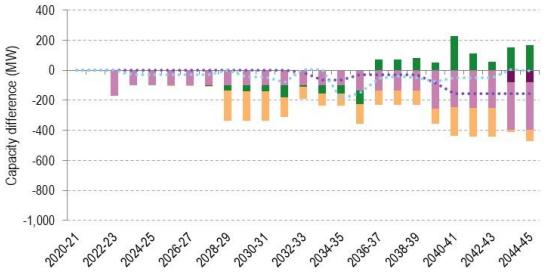
- Avoided capex from reduced new capacity required in NCEN

| | | Neutral | Neutral + low emissions | Fast change | Slow change |
|---|---|---|---|---|---|
| Base Case | OCGT | 513 MW | 282 MW | Starts 2020-21<br>142 MW by 2022-23 | 138 MW |
| | Solar | - | 133 MW | 297 MW | - |
| | PSH | - | 111 MW | 403 MW | - |
| Option 1A | OCGT | 342 MW<br>171 MW less | 161 MW<br>121 MW less | 106 MW by 2022-23<br>36 MW less | 15 MW<br>123 MW less |
| | Solar | - | 80 MW<br>53 MW less | 349 MW<br>53 MW more | - |
| | PSH | - | 104 MW<br>7 MW less | 270 MW<br>133 MW less | - |
| Cumulative benefit | Capex | $133.9m | $177.2m | $142.8m | $96.6m |
| | Total | $147.1m | $207.6m | $154.2m | $109.1m |

# What drives benefits?
# Capacity difference between Option 1A and Base case

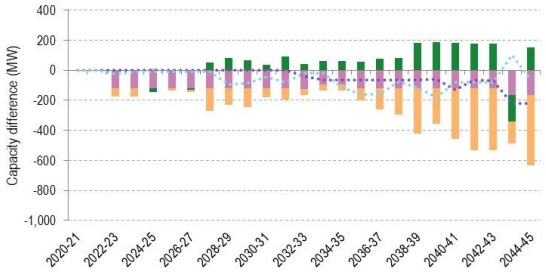
## Neutral

Figure 22



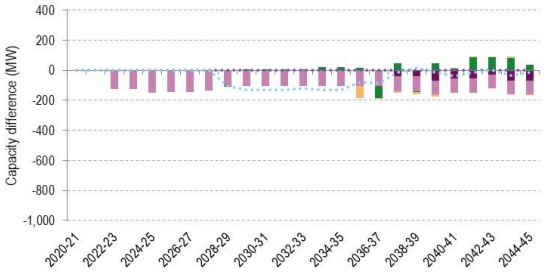

## Neutral + low emissions

Figure 27




## Slow change

Figure 35

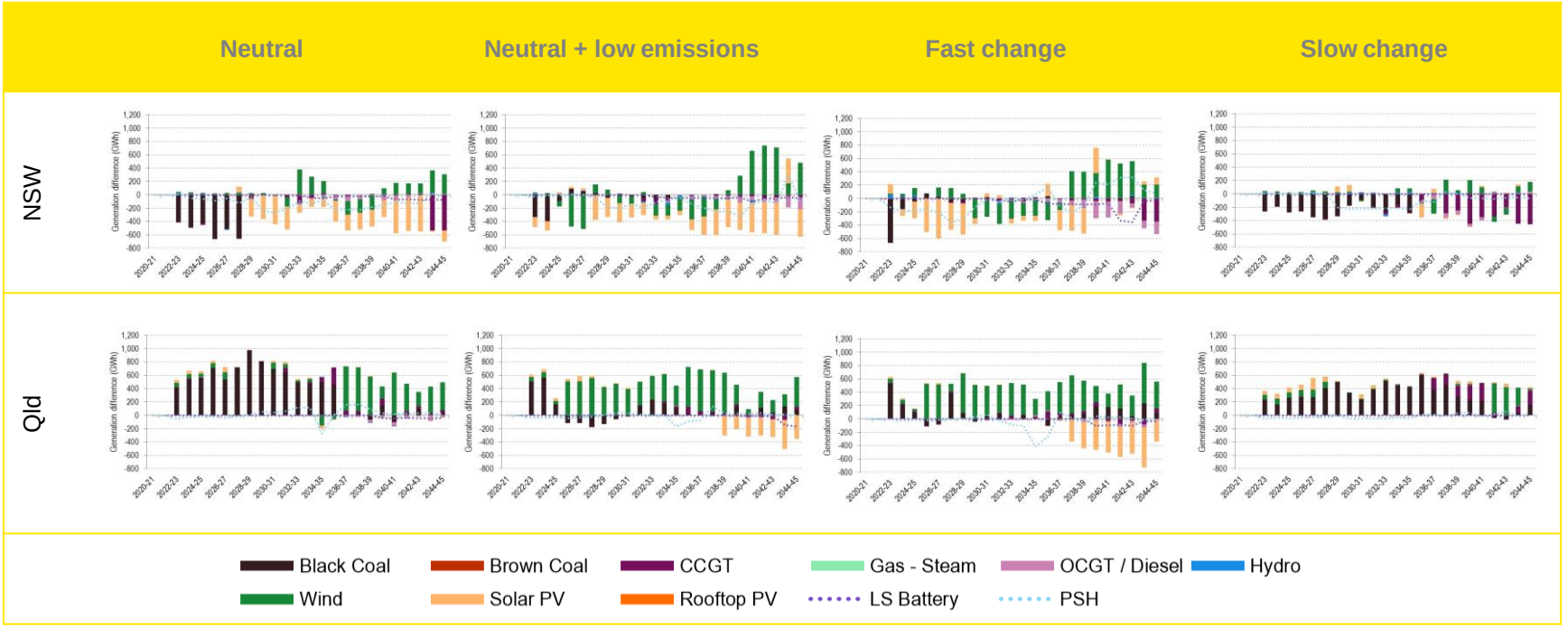



## Fast change

Figure 31


# What drives benefits?
# Generation difference between Option 1A and Base case

- Queensland generation displaces NSW generation in all scenarios.



# Option 5B

- Trends across years and scenarios are similar with Option 1A and 5B.
- Benefits start similarly in 2022-23 with avoided capex in NCEN of similar magnitude.
- Over time, Option 5B gross capacity benefits quickly exceed those of Option 1A.
- This is due to larger limit increases along a longer flow path CQ-SQ-NNS-NCEN.

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# Questions

# Next steps

- TransGrid and Powerlink will publish the answers to today's questions on our respective websites
- In accordance with the Rules, TransGrid and Powerlink are now seeking submissions from Registered Participants, AEMO and interested parties on the preferred option presented, and the issues addressed, in the PADR
- Please email your submissions to regulatory.consultation@transgrid.com.au on or before Friday, 15 November 2019
- TransGrid and Powerlink will use best endeavours to publish the PACR as guided by the AER's indicative timetable for this QNI stage 1 RIT-T by mid December 2019
- Any subsequent RIT-Ts required for expanding the transmission transfer capacity between NSW and Queensland will be informed by the 2020 ISP anticipated to be published mid next year