Australian Institute for Progress

Implications of a 50% renewable energy policy on Queensland's energy sector

Prepared for: The Australian Institute for Progress

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Summary

A 50% by 2030 renewable energy target has been extensively modelled by the Australian Energy Market Operator in their 2016 annual National Transmission Network Development Plan (NTNDP) update.

The AEMO modelling shows that to achieve a 50% generation mix by 2030:

- a combination of closing existing coal generation and increasing renewable generation is required.
- 1400MW (Stanwell Corporation's Tarong plant near Kingaroy) will need to close by 2018/19, 1460MW (the Stanwell plant near Rockhampton) also will need to close by 2026/27.
- 560MW (two of Gladstone Power Station's 280MW units) is expected to be withdrawn in 2020-21 and another 280MW unit (a third unit in the same power station) in 2028-29.
- Most of the shortfall in generation is expected to be made up by rooftop solar PV, with only small gains in gas, large-scale solar and hydro.

A 50% by 2030 renewable energy policy has a number of implications:

- Closing down the Tarong and Stanwell power stations, as well as three of Gladstone's six generation units will cause job losses in Kingaroy, Rockhampton and Gladstone – all areas with unemployment rates already above the state average.
- Coal-fired electricity generation has a higher capacity factor to renewable generation. Transitioning from coal to renewables can cause localised system weakness because of the lower power factor in areas with high penetration of renewables.
- When the 50% renewable policy is in full force, the risk of state-wide blackouts will become a real risk for up to 15% of the year – the equivalent of the combined months of January and February each year;
- Uncontrollable state wide blackouts will become likely for up to 3% of the year – equivalent to 11 days a year, presumably over the state's hottest days in summer;
- AEMO's primary solution to avoid local or state-wide blackouts, is through investing in additional network infrastructure, which will increase costs to consumers;
- Network companies (Energex and Ergon Energy) may hasten their transition to demand based charging, which will reduce opportunities for households to minimise their electricity bills through rooftop solar PV. Under demand-based charging, 42% of residential customers in South East Queensland are expected to be worse off and experience substantial "bill shock."
- The progressive closure of Tarong, Stanwell and half of Gladstone Power Station will increase costs for large business and industrial customers in North and Central Queensland, due to increased transmission losses. Such increases in energy costs would lead to wide-scale industrial exit (in the case of minerals processing and manufacturing), reduce capacity to provide services (in the case of hospitals or

universities) or will pass costs through the economy to the end consumer (in the case of ports or local governments).

- The total cost of retiring and rehabilitating Stanwell, Tarong and half of Gladstone Power Station is estimated to cost $63.3 million by 2030.
- The Queensland Government risks losing its entire dividend stream from its energy GOCs due to loss of income form Stanwell Corporation and a need to write-down redundant network assets.
- The Queensland Government may be exposed to a number of other financial risks, such as higher CSO payments under the Uniform Tariff Policy and higher costs to run government agencies – including hospitals, schools, ports, water distribution and local government facilities – across Queensland.

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Introduction

This report was commissioned by the Australian Institute for Progress (AIP), a think tank based in Queensland. The AIP contributes to debate by enabling the publication of discussion and policy papers, conducts seminars, participates in forums, and the media.

A focus area for the AIP is the future cost and reliability of Queensland and Australia's energy supply.

This report was commissioned to analyse what a 50% renewable energy generation mix by 2030 is expected look like and explore the implications (and their magnitude) for consumers, generators and the Queensland Government.

Jonathan Pavetto, the author of this report, is an energy sector economist with years' experience advocating exclusively for the consumer. Jonathan's work has always been focused on understanding the impact different policy and regulatory decisions will have on the end consumer, while also advocating for reforms to substantially lower electricity prices.

Jonathan was the founder and spokesperson for the Alliance of Electricity Consumers which successfully challenged Energex and Ergon Energy's 2015-20 Regulatory Proposals and exposed deliberate market manipulation (late re-bidding) by Queensland's government-owned electricity generators.

Note on AEMO's analysis:

The primary source of information in this report is the AEMO NTNDP 2016 report.

The "low-growth" model has been used in this analysis, as it best describes the current outlook for the Queensland economy and consumer sentiment. This scenario is still within the credible boundary of grid demand and reflects forecasting prepared by the state's network operators.

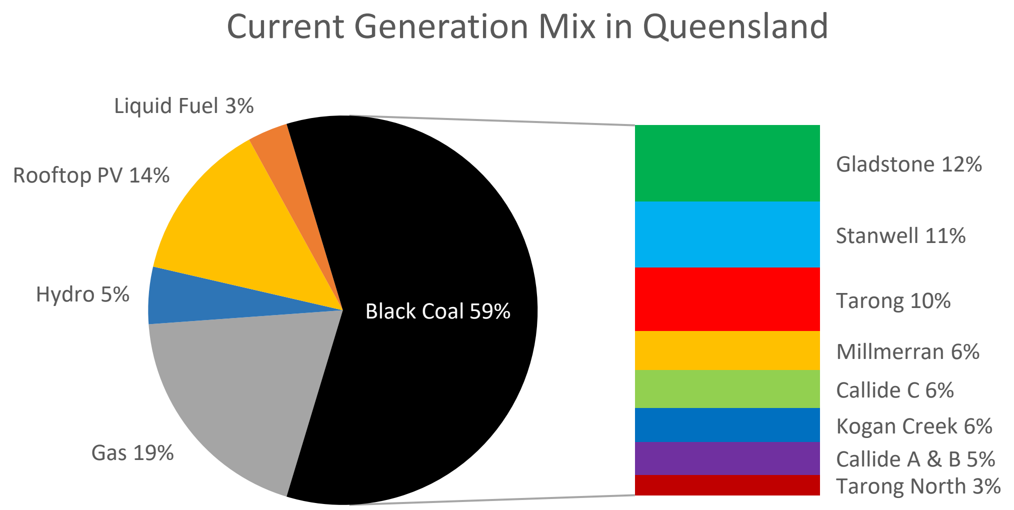
None of AEMO's scenarios incorporates a feedback loop that accounts for consumer response to price changes.[i] This means demand reduction may be faster than anticipated in the AEMO report, hastening the retirement of existing coal fired generation assets.

Electricity generation in Queensland

Generation source

Queensland currently has an installed generation capacity of around 13,770 megawatts (MW). This generation capacity is primarily made up of stationary coal-fired generators, complimented by gas (Open-Cycle Gas Turbine and Combined-Cycle Gas Turbine), hydro and rooftop solar PV.

Although 19% of Queensland's available generation is from renewable sources, the state's electricity supply is heavily reliant on black coal for electricity generation.



Source: Presentation of information found in business.qld.gov.au[ii] and AEMO's 2016 Generation and Transmission Outlooks

Ownership of generation assets

The Queensland Government owns a majority of the state's electricity generators, through Stanwell Corporation and CS Energy.

The table below shows major electricity generators in Queensland.

Name	Type	Operator	Ownership	Capacity (MW)
Gladstone	Coal	NRG Gladstone Operating Services (CS Energy)	Public/private partnership	1680
Stanwell	Coal	Stanwell	QLD Gov	1460
Tarong	Coal	Stanwell	QLD Gov	1400
Millmerran	Coal	Millmerran Operating Co	Private	852
Callide C	Coal	IG Power/Callide	50% QLD Gov	840
Kogan Creek	Coal	CS Energy	QLD Gov	744
Callide B	Coal	CS Energy	QLD Gov	700
Darling Downs	Gas	Origin Energy	Private	644
Braemar 2	Gas	Arrow Energy	Private	519
Braemar	Gas	Braemar Power Project Pty Ltd	Private	504
Wivenhoe	Hydro	CS Energy	QLD Gov	500
Tarong North	Coal	TN Power	QLD Gov	443
Mt Stuart	Gas	Origin Energy	Private	423
Oakey	Gas	ERM Power	Private	282
Yabulu	Gas	RATCH-Australia Townsville	Private	242
Yarwun	Gas	RTA Yarwun	Private	154
Condamine	Gas	Queensland Gas Company	Private	144
Kareeya	Hydro	Stanwell	QLD Gov	88
Roma	Gas	Origin Energy	Private	80

Source: Presentation of information found in business.qld.gov.au[iii]

Generation location

The geography of Queensland's electricity generation is also an important feature of the state's electricity market.

All of the state's existing baseload coal generation is located in Central and Southern Queensland.

Electricity generated from these locations is transported across Queensland via the state's transmission network.

Source: Excerpt of interactive map from business.qld.gov.au

A 50% renewable generation target

The Queensland Government Policy

The Queensland Government's Powering Queensland Plan includes a commitment to a 50% renewable energy target by 2030.[iv] This policy has also been incorporated into the platform of the Australian Labor Party.[v]

The Labor policy document claims:[vi]

> *"The renewable energy and energy storage industries present an enormous economic opportunity of the next several decades. More investment in renewable energy will lead to:*
>
> - *more jobs for Australians*
> - *lower power bills for families and small business*
> - *reducing pollution and decarbonising our economy."*

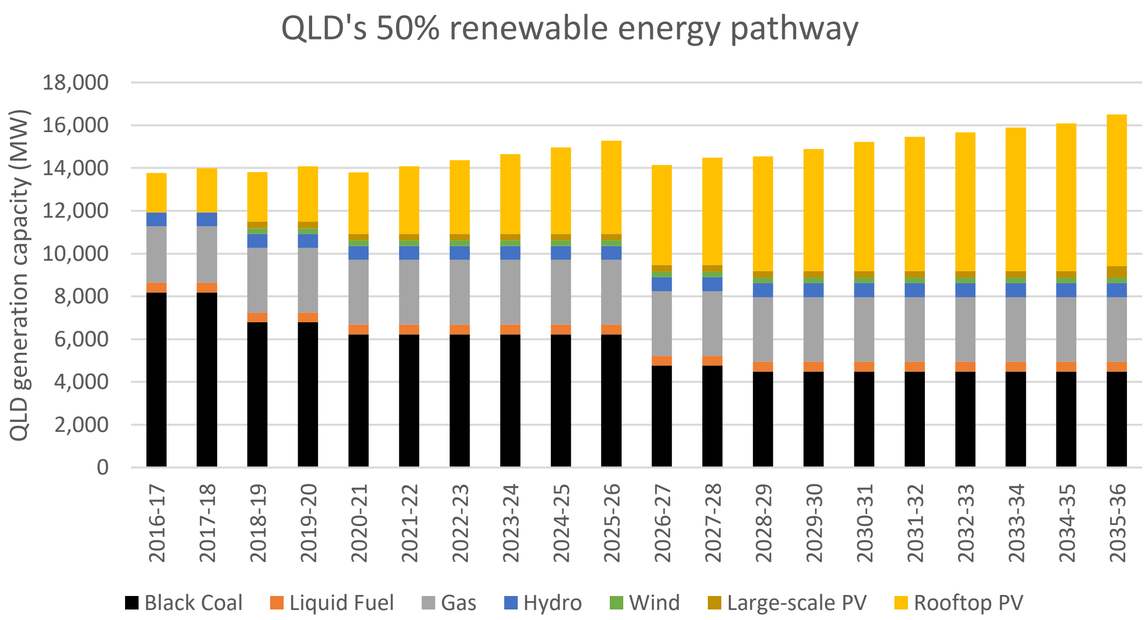
Modelling the path to a 50% renewable generation market

The Australian Energy Market Operator (AEMO), Australia's independent energy markets and power systems operator, has modelled the impact of a proposed 50% renewable energy by 2030 plan on the state's electricity generation sector. This analysis was conducted as part of AEMO's annual National Transmission Network Development Plan (NTNDP) update.

AEMO describes its NTNDP reporting in the following way:

> "The *National Transmission Network Development Plan* (NTNDP) is an independent, strategic assessment of an appropriate course for efficient transmission grid development in the National Electricity Market (NEM) over the next 20 years. This assessment balances reliability, security, and cost considerations while meeting emissions reduction targets." [vii]

The AEMO analysis shows the 50% renewable pathway can be achieved by 2030. [viii]

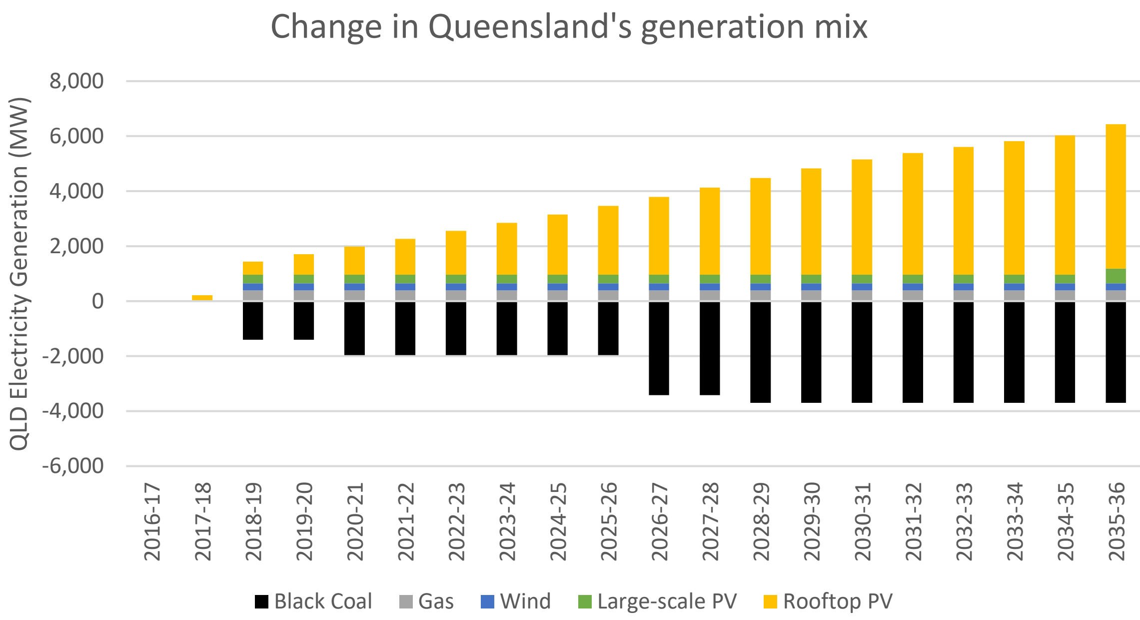


Source: AEMO NTNDP dataset

Change in QLD's generation mix

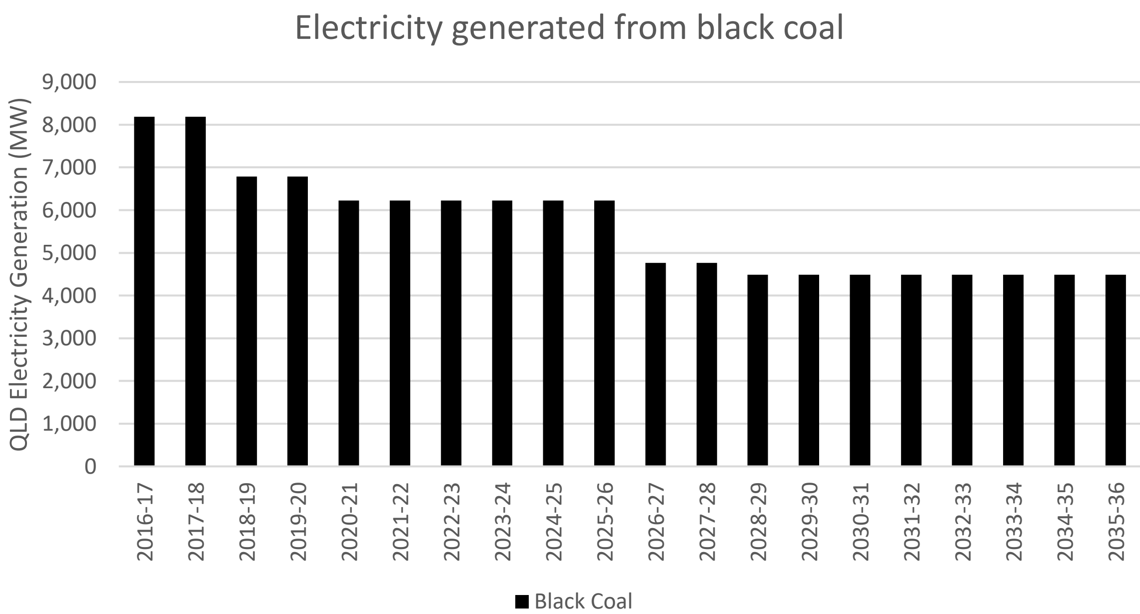
The AEMO modelling shows that the 50% target is achieved through a change in Queensland's generation mix. Existing coal-fired generation would need to be retired and replaced with the introduction of new gas, wind, large-scale PV and rooftop PV.

Rooftop PV is the primary source of new electricity generation in the AEMO model.



Source: AEMO NTNDP dataset

The AEMO analysis shows a staged reduction in electricity generated form black coal to meet the 50% renewable target.



Source: AEMO NTNDP dataset

Implications of a changing generation mix

Loss of local jobs from retirement of existing power stations

Matching the AEMO analysis with the state's existing generator fleet allows for the identification of the retirement timeline for existing coal-fired power stations, if the Queensland Government is to achieve its 50% renewable energy goal.

Timetable for retirement of black coal assets (MW)

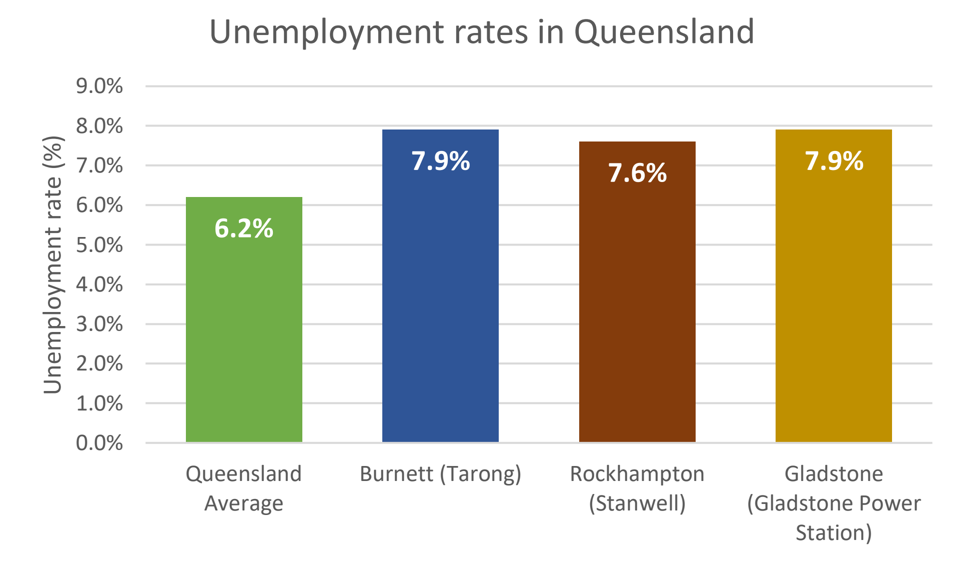
	2017-18	2018-19	2019-20	2020-21	2021-22	2022-23	2023-24	2024-25	2025-26	2026-27	2027-28	2028-29	2029-30	2030-31
Projected capacity	8,186	6,786	6,786	6,226	6,226	6,226	6,226	6,226	6,226	4,766	4,766	4,486	4,486	4,486
Proposed reduction	-	1,400	-	560	-	-	-	-	-	1,460	-	280	-	-

Source: AEMO NTNDP dataset

This timetables shows:

- 1400MW (Stanwell Corporation's Tarong plant near Kingaroy) will need to be retired by 2018/19;
- 1460MW (the Stanwell plant near Rockhampton) also will need to be retired by 2026/27;
- 560MW (two of Gladstone Power Station's 280MW units) is expected to be withdrawn in 2020-21; and
- Another 280MW unit (a third unit in the same power station) in 2028-29.

Closing these power stations will have a direct impact on employment opportunities in their local communities that are already experiencing above-average unemployment.[ix]



Source: Queensland Government Statistician's Office- regional profiles (SA3 – Rockhampton, Gladstone, Burnett)

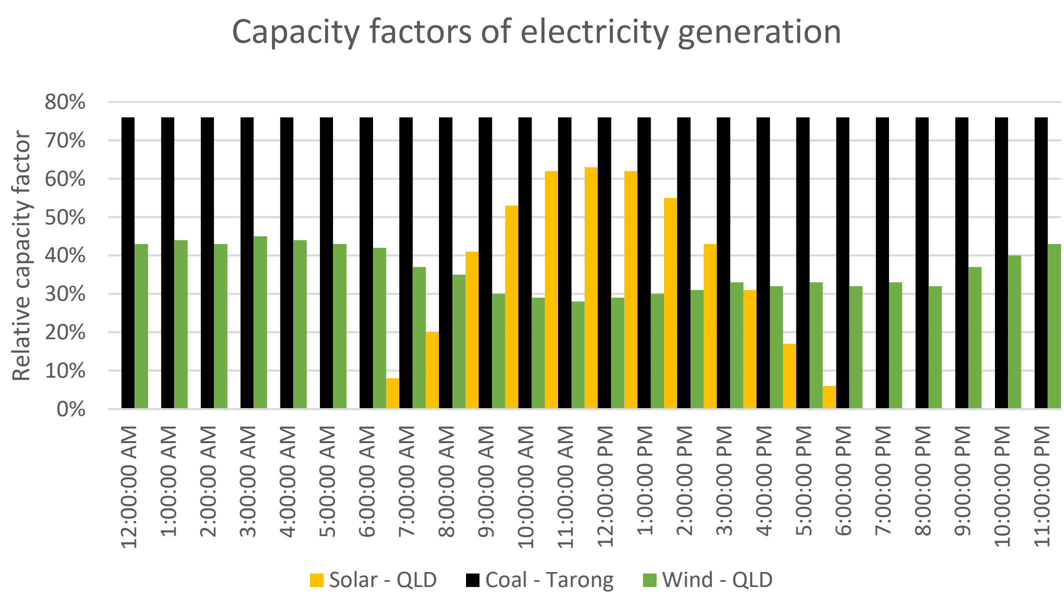
Increase in system weakness – risk of blackouts

Capacity factor

All power plants do not run 100% of the time. The relative capacity factor of an electricity generator determines how much electricity can be produced from the generator's nameplate capacity. Some of the key determinants of capacity factor include required maintenance and availability of fuel source (i.e. coal, wind, sunlight, water).

The net capacity factor of a power plant is the ratio of its actual output (GWh) over a period of time, to its potential output (MW) if it were possible for it to operate at full nameplate capacity continuously over the same period of time.

Coal-fired generators have had the highest capacity factor in all states, except for Tasmania and Northern Territory (who principally rely on hydro and gas respectively).[x] Wind turbines or solar farms generally have low capacity factors given the intermittency of the electricity they produce. Renewable generators may be capable of producing electricity, but its "fuel" (wind, sunlight or water) may not be available.



Source: AEMO NTNDP dataset and Stanwell Annual Report 2016-17[xi]

Localised system weakness

In its 2016 NTNDP report, AEMO has identified that areas with a high penetration of renewable energy may face localised system weakness (risk of blackout) under a 50% renewable energy policy.

> System strength is projected to materially decline across the NEM, particularly in areas of high inverter-connected generation, such as:
>
> - Much of South Australia, western Victoria, and Tasmania.
> - Emerging local areas of poor network strength in New South Wales and Queensland, where a high concentration of renewables is anticipated by 2035–36.[xii]

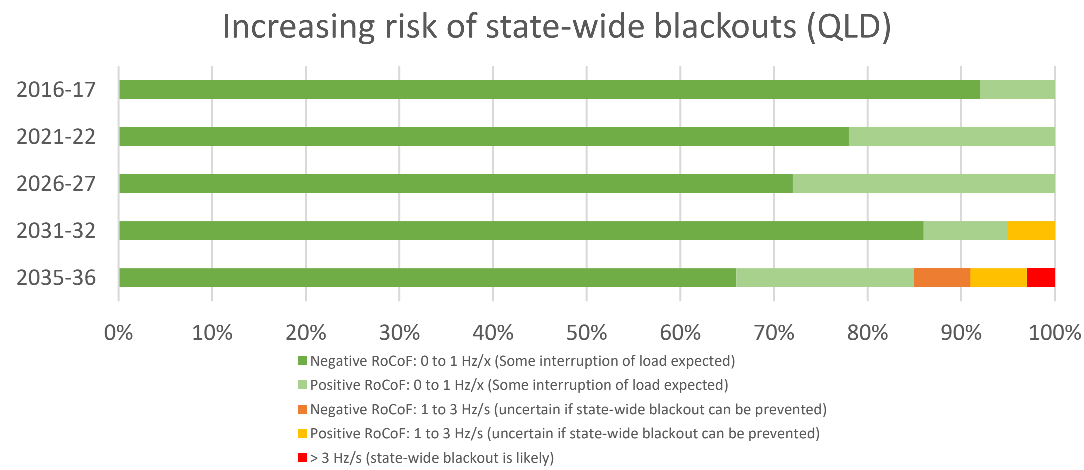
Risk of an unavoidable state-wide blackout

The introduction of lower capacity factor renewable units would result in a lower capacity for the entire system to generate the same volume of energy.

Coupling the withdrawal of "dispatchable" synchronous coal generation with the increase in production of variable, non-synchronous renewable energy, the whole electricity system will become weaker and susceptible to shocks (localized or state-wide blackouts) in the event of the loss of the state's interconnector.

AEMO's NTNDP 2016 report analyses the risk of unavoidable state-wide blackouts with a changing generation mix. It shows that:

- An increasing amount of interruption of load is to be expected as existing coal capacity is withdrawn and replaced with rooftop PV;
- When the 50% renewable policy is in full force, the risk of state-wide blackouts will become a real risk for up to 15% of the year – the equivalent of the combined months of January and February each year; and
- Uncontrollable state wide blackouts will become likely for up to 3% of the year – equivalent to 11 days a year, presumably over the state's hottest days in summer.



Source: Data aggregated from AEMO NTNDP Report

As AEMO outlines in their 2016 NTNDP report:

> This analysis suggests that Queensland may eventually be vulnerable to a state-wide blackout, upon the non-credible loss of QNI. However, this is not projected until late in the outlook period (associated with significant retirement of coal-fired plant).[xiii]

In Queensland, if the interconnector fails, the state will become separated from the rest of the NEM, and will no longer have access to the synchronous generation from other regions (such as NSW or VIC). This means Queensland's high reliance intermittent renewable generation could be exposed, causing state-wide blackouts similar to the 2016 system-wide failures in South Australia.

Increased costs for consumers

Introduction of demand tariffs for residential customers

The deeper and broader penetration of rooftop PV, as outlined in the AEMO forecasts, will cause problems for the state's networks, as they try to recover costs from consumers.

Under existing charging models, where customers are charged based on consumption, greater penetration of rooftop solar PV will radically increase prices for those residential customers without rooftop solar PV and business customers. This occurs as there are fewer GWhs of grid-delivered energy to "recover" the total allowed revenues for the networks, set by the Australian Energy Regulator (AER).

To overcome this challenge, networks can be expected to expedite the introduction of demand based tariffs. These tariffs charge customers on their maximum monthly instantaneous demand (MW), not their consumption of energy (kWh).

Moving to demand tariffs will have two likely outcomes:

1. 42% of residential consumers in South East Queensland are expected to experience "bill shock" – up to 20% increases in electricity costs – due to their current consumption patterns;[xiv] and
2. Residential consumers will not realise all of their expected financial benefit from installing rooftop solar PV, because they will now be charged on their maximum demand, not consumption. This may in turn limit the adoption of rooftop solar PV and increase the difficulty of reaching the QLD Government's 50% renewable target.

The likely result of both of these outcomes will be the large-scale installation of batteries, which would enable residential consumers to remove themselves from the grid and to avoid the networks' demand charges. This may in turn increase the demand charges for all other customers remaining on the grid, as the network companies continue to recover their revenue allowances set by the AER.

Transmission losses will be punitive for customers in Central and Northern Queensland

Under AEMO's forecast retirement of Tarong, Stanwell and 50% of Gladstone Power Station's generation capacity, electricity consumers requiring synchronous baseload power in the state's north will need to purchase electricity from generators in Southern Queensland or from interstate.

For residential and small business customers, these costs can expect to be absorbed into the Queensland Government's Community Service Obligation (CSO) to regional consumers.

Large business and industrial customers – such as hospitals, universities, airport, mines, abattoirs, ports, factories, mills, local governments and foundries who rely on synchronous "baseload" electricity generation – will be required to pay for the higher transmission losses.

For example, Kogan power station near Chinchilla may be the nearest generator a large energy user in Townsville may be able to purchase power from – even though it is over 1000 km away. Such increases in energy costs, due to increased transmission losses, would lead to wide-scale industrial exit (in the case of industry), reduce capacity to provide services (in the case of hospitals or universities) or pass costs through the economy to the end consumer (in the case of ports or local governments).

This issue was also specifically identified in the AEMO report as a projected 'economic limitation' in Queensland.[xv]

AEMO solution of increased interconnectivity

As outlined in AEMO 2016 NTNDP report, a solution to the increased network weakness caused from renewable energy's non-synchronous generation is for greater network interconnectivity.[xvi]

This solution may reduce the risk of unavoidable local or state-wide blackouts, but it comes with a cost that will ultimately be passed on to the energy consumer through network charges.

Increased costs to the Queensland Government

Costs incurred in retiring/rehabilitating generation assets

In analysis prepared for AEMO's 2016 NTNDP report, ACIL Allen has identified the cost of retirement/rehabilitation of Queensland's electricity generators at $15,000/MW.[xvii]

The total cost of rehabilitating/retiring Stanwell, Tarong and three of Gladstone's generators by 2030 is $63.3 million.

- $ 21.5 million to retire Tarong in 2018-19;
- $ 9 million to retire two units in Gladstone in 2020-21;
- $ 27.3 million to retire Stanwell in 2026-27; and
- $ 5.5 million to retire an additional unit of Gladstone in 2028-29.

Lower dividends from GOCs

Stanwell Corporation has traditionally provided substantial pecuniary benefits to the Queensland Government. In 2016/17 the company's NPBT was $525,598.[xviii]

It remains unclear what impact the closure of Tarong and Stanwell will have on Stanwell Corporations' balance sheet, but it can be assumed benefits accrued to the Queensland Government would significantly fall following the retirement of the company's two primary income generating assets.

Further, the Queensland Government may also need to consider writing down some of the value of the state's transmission and distribution networks to avoid the "network death spiral" of accelerated investment in distributed generation, like rooftop solar PV.[xix] In a submission to the Queensland Productivity Commission's 2016 inquiry into electricity prices, Synergies Economics presented modelling that showed a $5 billion write-down of Energex and Ergon Energy's Regulated Asset Base (RAB) – which would reduce network costs – would not enable the companies to pay a dividend.[xx]

Other financial risks

Other financial risks to the Queensland Government, such as an increase in the CSO payable under the Uniform Tariff Policy due to higher costs from increased transmission losses and higher network charges as demand-based tariffs are introduced, are not well understood and require further investigation.

In addition, further investigation is required around the impact of the 50% renewable policy on the cost of running government agencies – including hospitals, schools, ports, water distribution and local government facilities – across Queensland.

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[i] Australian Energy Market Operator 2016, National Transmission Network Development Plan,' page 21.

[ii] *Electricity Generation,* Business in Queensland, accessed 14 November 2017, <https://www.business.qld.gov.au/industries/mining-energy-water/energy/electricity/queensland/generation>

[iii] *ibid*

[iv] *Powering Queensland Plan,* Department of Energy and Water Supply, accessed 14 November 2017, <https://www.dews.qld.gov.au/electricity/powering-queensland-plan

[v] *Renewable Energy,* Australian Labor Party, accessed 14 November 2017, <http://www.alp.org.au/renewableenergy>

[vi] *ibid*

[vii] Australian Energy Market Operator 2016, National Transmission Network Development Plan,' page 3.

[viii] *2016 GENERATION AND TRANSMISSION OUTLOOKS*, Australian Energy Market Commission, NTNDP Database, accessed 14 November 2017, <http://www.aemo.com.au/Electricity/National-Electricity-Market-NEM/Planning-and-forecasting/National-Transmission-Network-Development-Plan/NTNDP-database>

[ix] Australian Government Department of Employment, *Small Area Labour Markets Australia*, various editions

[x] Australian Energy Council 2017, *Capacity Factors, Understanding the Misunderstood*, accessed 14 November 2017, <https://www.energycouncil.com.au/analysis/capacity-factors-understanding-the-misunderstood/>

[xi] Stanwell 2017, Annual Report, page 8.

[xii] Australian Energy Market Operator 2016, National Transmission Network Development Plan,' page 6.

[xiii] *Ibid,* page 58

[xiv] Energex 2016, Tariff Structure Statement, Submitted to the Australian Energy Regulator, page 63.

[xv] Australian Energy Market Operator 2016, National Transmission Network Development Plan,' page 38.

[xvi] *Ibid,* page 28.

[xvii] ACIL Allen 2016, *Fuel and Technology Cost Review*, NTNDP Database, accessed 14 November 2017, <http://www.aemo.com.au/Electricity/National-Electricity-Market-NEM/Planning-and-forecasting/National-Transmission-Network-Development-Plan/NTNDP-database>

[xviii] Stanwell 2017, Annual Report, page 37.

[xix] Mike Sandiford 2014, 'Has the death spiral for Australia's electricity market begin?' *theconversation.com,* accessed 14 November 2017, <http://theconversation.com/has-the-death-spiral-for-australias-electricity-market-begun-28581>

[xx] Queensland Productivity Commission 2016, 'Final Report, Electricity Pricing Inquiry,' page 137.