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THE UNIVERSITY OF SYDNEY
Sydney Environment Institute

Renewables & rural Australia

Appendix 1: REZ Transmission networks

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A report by the Sydney Environment Institute and Australia Institute.

A.1 CWO REZ AND RE DEVELOPMENT PROFILE

The Central West Orana REZ, chosen for the national pilot REZ, combines two REZ candidates from the 2018 ISP: Central New South Wales Tablelands and Central-West New South Wales.[1]

Distinct to Wellington region is the existing grid connection capacity. There are 66kV, several 132 kV lines and a relatively new 330 kV circuit connection around Wellington, which, in turn, connects to the strong links between the big consumption loads of Sydney, Newcastle and Wollongong and several coal power stations (*see Figure A.1 Central West network*) (TransGrid 2020). Currently, six proposed or operational solar and two wind farms are located near this relatively close connection to the consumption loads of NSW, and therefore the strong part of the NSW grid.[2] The existing substations, which are most often the connection points to the grid for the wind and solar farms, are marked with blue/red/orange points in the TransGrid network map. The colour of the symbol refers to the voltage capacity of the substation, which is determined by the overhead line it is connected to. While the voltage capacity isn't directly linked to the *available* capacity of the grid connection itself, in general "larger" substations have more capacity to start with, and conglomeration of projects especially around Wellington substation would indicate connection capacity availability.

The 330 kV circuit is one of the only options where the main transmission lines towards Sydney are not already congested during peak demand.[3] The existing transmission capacity for hosting new generation was estimated as high as 1000 MW in 2018 ISP (AEMO 2018b, p. 18). Even after some projects started construction, it was still estimated in the draft 2020 ISP (AEMO 2019b, p. 18) that there was 700 MW capacity left. The situation is rapidly changing, since Transgrid estimated in 2020 that only 100 MW of spare capacity currently remains[4] and that the Central West area will also have material congestion problems if all connection applications are realised (see Table A.1. for capacity estimates).[5]

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[1] (2020) *2020 ISP Appendix 5: Renewable Energy Zones*, p.11

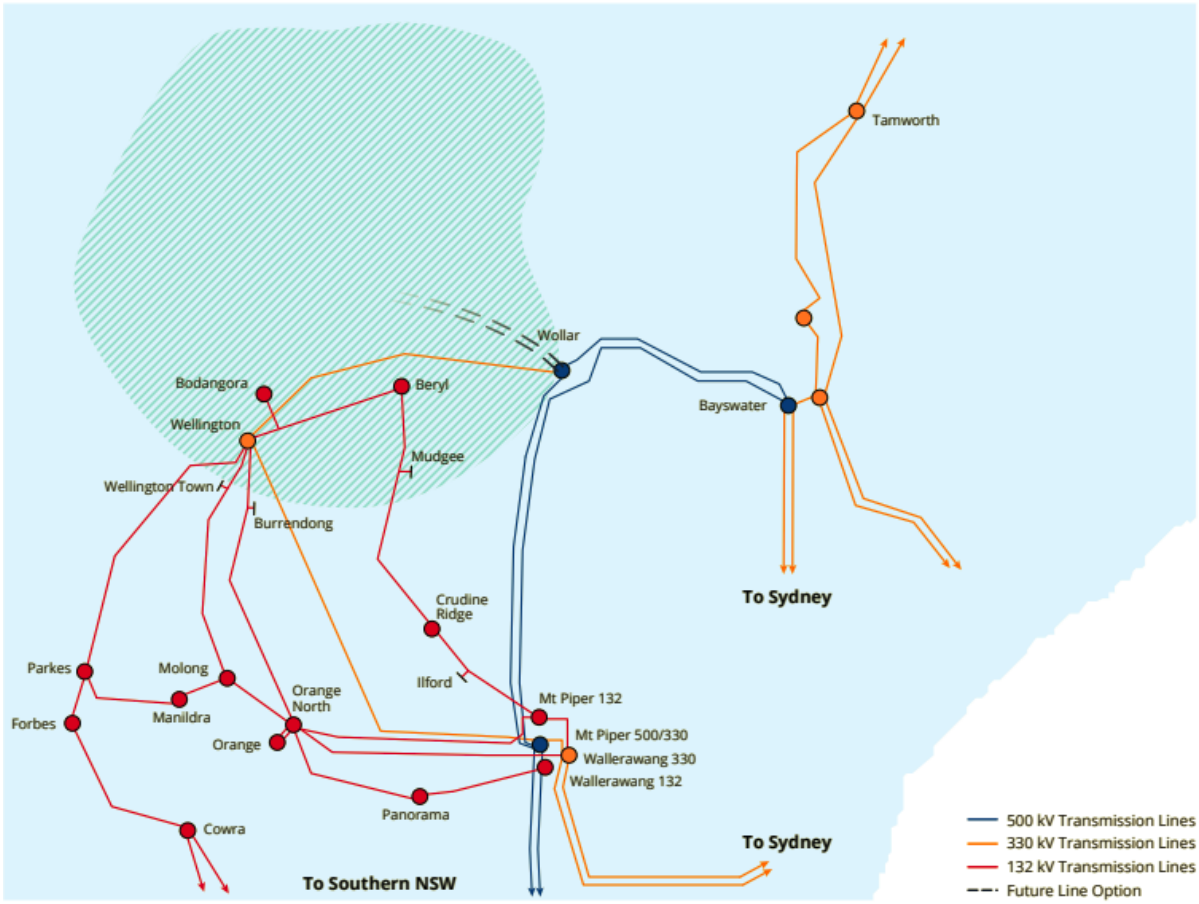
[2] In 2016 Transgrid identified possible new connection points for regional NSW, and the substations with highest available capacity were Wellington, Tamworth in New England and Darlington Point / Griffith in South-West. Of all identified eight locations, Wellington and Tamworth are closest to Sydney, and Wellington is part of recognised renewable energy resources of Central-West area. See https://www.transgrid.com.au/what-we-do/business-services/Infrastructure/Documents/Connection%20Opportunities%20Fact%20Sheet.pdf

[3] The existing shared transmission capacity between southern NSW and major load centres is heavily utilised at times of peak demand. See NSW Electricity Strategy (p. 17) and Transgrid (2019, p. 7), https://energy.nsw.gov.au/sites/default/files/2019-11/NSW%20Electricity%20Strategy%20-%20Final%20detailed%20strategy_0.pdf
https://www.transgrid.com.au/what-we-do/Business-Planning/transmission-annual-planning/Documents/2019%20Transmission%20Annual%20Planning%20Report.pdf

[4] Transgrid 2020, New South Wales Transmission Annual Planning Report, https://www.transgrid.com.au/what-we-do/Business-Planning/transmission-annual-planning/Documents/2020%20Transmission%20Annual%20Planning%20Report.pdf

[5] The only other area in NSW with similar existing transmission capacity – and recognised renewable energy potential – is the Southern Tablelands area Southern Tableland area has excellent wind resources and hosts large portion of the existing wind farms in NSW (see Figure X in Chapter 3), but has also significant community opposition for any new developments, which has been recognised by AEMO (2018b: 20, 2019b, p. 238).

Figure A.1 : Central West network and indicative Central-West Orana REZ



Source: TransGrid 2020, p. 28

In addition to good grid connection capacity, the existing and forecasted "marginal loss factors" (MLFs) near Wellington have been comparably low encouraging for new generation. MLFs are assigned by AEMO for all generation units inside the NEM and they typically indicate how much capacity there is in the network (how "congested" it is) and how favourably generation is located compared to consumption. The MLFs are calculated yearly and are related to the current open access regime in NEM. Basically, an older project has no protection against newcomers in the same connection point, and accumulating number of projects connecting to the same line can impact all the projects negatively by limiting the amount of usable capacity. For some projects in NSW the credited production has been as low as 75–80 % of the actual production (e.g. Broken Hill Solar Farm) (AEMO 2019c: 21-23). In Wellington area, however, the MLFs are still manageable and the credited generation is around 95 %[6], which generally should not significantly impact the project's financial viability. The uncertainty of long-term production opportunities is a frequent complaint of the investors operating in the Australian market (see e.g. Clean Energy Investor

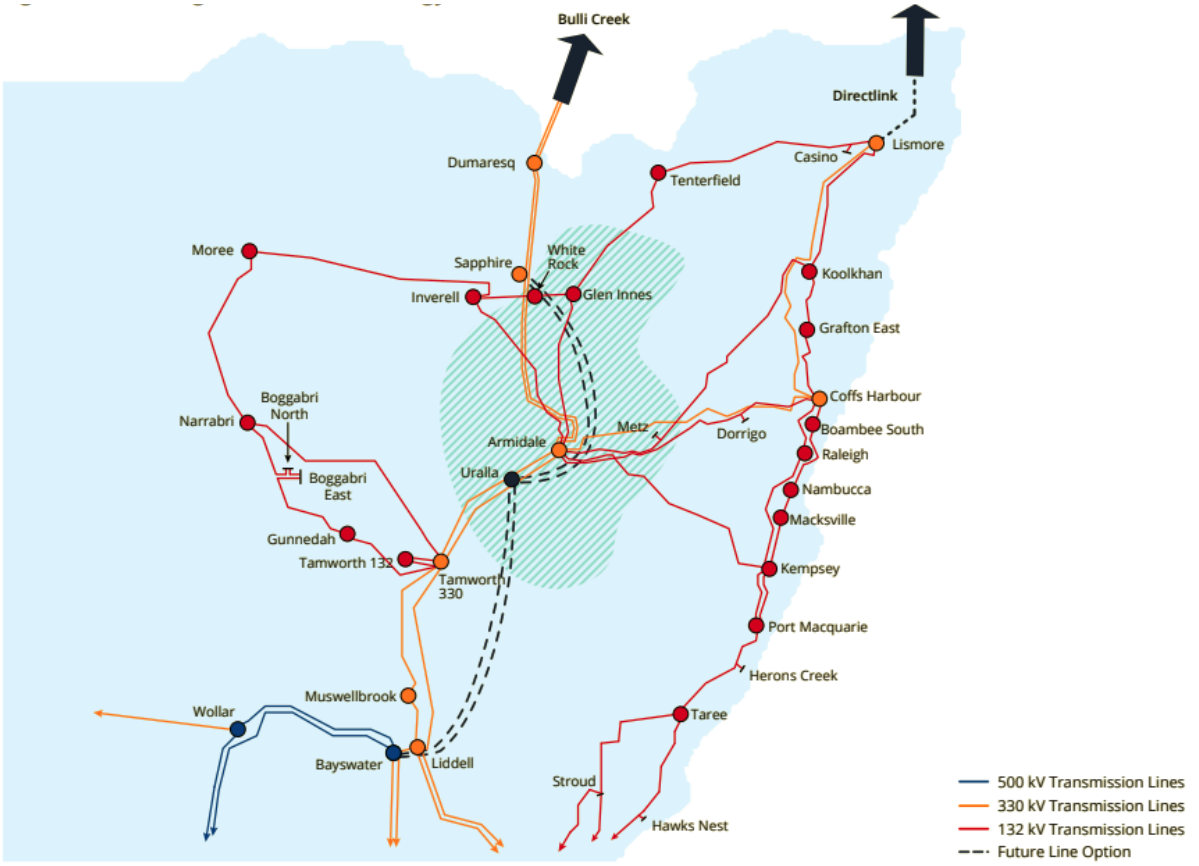
[6] AEMO 2020. Regions and Marginal Loss Factors: FY 2020-21. The MLFs for NSW generators are on pages 18–21. https://aemo.com.au/-/media/files/electricity/nem/security_and_reliability/loss_factors_and_regional_boundaries/2020-21/marginal-loss-factors-for-the-2020-21-financial-year.pdf?la=en

Group's recent submissions to AEMC)[7]. The REZ development and the new EII Act are designed to address this issue by allowing NSW Government to build more transmission capacity, and grant – and importantly also refuse – access to the new infrastructure.

A.2 NE REZ AND RE DEVELOPMENT PROFILE

According to AEMO (2020, p. 24), whereas most of North West NSW is mainly a solar zone, the New England tableland is predominantly a wind zone. Currently, NE REZ has a significantly smaller existing network capacity compared to CWO REZ. AEMO (2020, 23) estimates only 300 MW of existing usable capacity, that can be potentially upgraded in several phases to 5000 MW. Notably, there is already a substantial number of connection applications to Transgrid from the larger Northern NSW area, exceeding the possible grid upgrades (see Table A.2 for different capacity and spare network capacity estimates).

Similar to CWO REZ, the NSW Government lists good natural resources, investment interest and strong existing grid as reasons for selecting NE REZ. New England also has potential sites for pumped hydro development and some proposals have recently received pre-investment funding from the Emerging Energy Program (NSW Government 2020). Mount Oven Pumped Hydro project is the highest priority energy storage project, designed to support new renewable generation in the NE REZ with 600MW storage.



[7] https://www.aemc.gov.au/sites/default/files/documents/rule_change_submission_-_erc0294_-_clean_energy_investor_group_-_20210121.pdf

Figure A.2: New England network and indicative New England REZ
Source: TransGrid 2020, p. 29

The area has several existing high-voltage power lines, which importantly include the existing QLD-NSW interconnector (QNI) and the plan for the QNI Upgrade between Bulli Creek and Bayswater substations (see Figure A.2). While the transmission in the REZ is already congested towards the main loads (Sydney-Wollongong-Newcastle area)[8], there are several possibilities to increase the current capacity ranging from virtual transmission with batteries, technical improvements to existing infrastructure and a new link between Liddell and Tamworth, all considered as a part of the QNI Upgrade (Transgrid 2020). The distance to Liddell and other retiring coal power stations (= the strong links to main loads) from the REZ is relatively short and the whole QNI Upgrade has been identified as a committed ISP project. [9]

Not surprisingly in New England as in CWO REZ, the built and proposed large-scale projects are mainly located near the existing grid and substations, which are marked as red/orange/blue dots in Figure A.2. The size of the projects is somewhat larger compared to CWO REZ, though there are also some mid-scale solar projects (5-25 MW) planned or already built.

A.3 ESTIMATES OF NEW GENERATION CAPACITY: CWO AND NE REZ

REZ resource estimates, network capacity estimates and statistics of different agencies at different times vary as the tables below show. Estimates seem to trend upwards over time, and the most recent projections from TransGrid's 2020 connection applications for CWO REZ show the existing projects, though some still in very early stages of planning, already exceed most estimates.

Table A.1. Estimate of new generation capacity (Central West Orana)

AEMO 2018 ISP - Spare network capacity	Central West: 100 MW Central NSW Tablelands: 1000 MW
AEMO 2018 ISP Estimated resources *Note: Central West Orana is partly on two separate REZs in 2018 ISP; Central West and Central NSW Tablelands*	Central West: Solar: 3750 MW (C) Wind: 1420 MW (C)
	Central NSW Tablelands: Solar: 3000 MW (D) Wind: 1600 MW (B)

[8] See NSW Electricity Strategy (p. 17) https://energy.nsw.gov.au/sites/default/files/2019-11/NSW%20Electricity%20Strategy%20-%20Final%20detailed%20strategy_0.pdf

[9] The other link to Queensland shown on Figure A.2, Directlink ,is a privately funded 180MW transmission line owned by a transnational energy investment company, Energy Infrastructure Investments Pty Ltd (https://www.aer.gov.au/system/files/Directlink%20-%20Attachment%2014-2%20-%20Pricing%20Methodology%20-%20January%202019.pdf)

AEMO 2020 ISP Network capacity considerations	+3000 MW (by 2022)
AEMO 2020 ISP Estimated resources	Solar: 7200 MW (C) Wind: 3000 MW (C)
NSW Government 2018 REZ plan	+3000 MW (goal by mid 20s)
Transgrid 2020 connection applications ("Central NSW")	Solar: 9095 MW Wind: 3895 MW Battery storage: 1800 MW
Transgrid 2020 available capacity outside already signed connection agreements	100 MW

Table A.2. Estimate of new generation capacity (New England)

AEMO 2018 ISP - Spare network capacity	300 MW (called Northern NSW Tablelands REZ)
AEMO 2018 ISP Estimated resources	Solar: 1750 MW (D) Wind 3660 MW (B)
AEMO 2020 ISP Network capacity considerations	Stage 1: +3000–4000 MW Stage 2: +4000–5000 MW
AEMO 2020 ISP Estimated resources	Solar: 3500 MW (C) Wind 7400 MW (C)
NSW Government REZ plan	+8000 MW (no timeframe yet)
Transgrid 2020 connection applications ("Northern NSW")	Solar: 8190 MW Wind: 4612 MW Hydro: 600 MW
Transgrid 2020 available capacity for Northern NSW outside already signed connection agreements	400 MW