CLIMATE ENERGY FINANCE

APPENDIX TO

The Lights Stay On:
NSW Electricity Plan 2023-2030

CEF modelling shows on-schedule closure of Eraring & Vales Point Power Stations is entirely doable with accelerated transition

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About Climate Energy Finance

Climate Energy Finance (CEF) is an Australian based, Australian funded think tank established in 2022 that works pro-bono in the public interest on mobilising capital at the scale needed to accelerate decarbonisation and the energy transition consistent with the climate science.

We conduct research and analyses on global financial issues related to the energy transition from fossil fuels to clean energy, as well as the implications for the Australian economy, with a key focus on the threats and opportunities for Australian investments, regional employment and value-added exports. Beyond Australia, CEF's geographic focus is the greater Asian region as the priority destination for Australian exports, particularly India and China. CEF also examines convergence of technology trends in power, transport, mining and industry in accelerating decarbonisation. CEF is independent, works with partners in the corporate and finance sector, NGOs, government and the climate movement, and is philanthropically funded.

About the Author - Tim Buckley

Tim Buckley, CEF's founder, has 35 years of financial market experience covering the Australian, Asian and global equity markets from both a buy and sell side perspective. Before founding CEF as a public interest thinktank in 2022, Tim founded the Australia and Asian arms of the global Institute for Energy Economics and Financial Analysis in 2013 and was Australasian Director until 2022.
Prior to this, Tim was a top-rated equity research analyst over 2 decades, including as head of equity research in Singapore at Deutsche Bank; MD and head of equity research at Citigroup for 17 years; and head of institutional equities at Shaw & Partners. From 2010-2013, Tim was co-MD of Arkx Investment Management, a global listed clean energy investment start-up jointly owned with Westpac Bank. Tim is widely recognised as an expert on Australian and international energy transition and the accelerating shift of global capital to decarbonisation, and is a sought after commentator and advisor.

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Important information

Appendix A: Major NSW Renewables Investors

The investor landscape in renewable energy infrastructure – transmission, solar, wind and batteries, across NSW is a who's who of Australian and global investors, illustrating there is zero shortage of capital to build the $320bn of new grid and generation capacity required for Australia. The pipeline of generation project proposals has reached a staggering 200GW across Australia, with individual groups Brookfield/Origin Energy and Twiggy Forrest's Squadron Energy each aspiring to build out 20GW, while Macquarie Group, ACEN, Iberdrola, Spark Renewables, Arkx Energy, Energy Estates and AGL Energy have big aspirations.

And Australia's superannuation majors have a $3.5 trillion capital pool that is growing rapidly, meaning with a tweaking of the YFYS rules, [1] they will play a significant patient capital role as well.

We profile just some of the leading NSW investors.

ACEN Australia

ACEN Australia, acquired UPC Renewables Australia and became a wholly owned subsidiary of ACEN, the listed energy platform of the Ayala Group of the Philippines, has 1GW capacity worth US$1bn in construction across Australia, and more than 8 GW capacity in the development pipeline. ACEN has 4,200 MW of attributable capacity from owned facilities in the Philippines, Vietnam, Indonesia, India and Australia, and an aspiration to be the largest listed renewables platform in Southeast Asia, with a goal of reaching 20 GW of renewables capacity by 2030.

ACEN officially opened the 400 MW stage 1 New England Solar Farm near Uralla – in the NSW Government's New England REZ, in the state's northeast in March 2023, supported by a 20-year Long Term Energy Service Agreement (LTESA), as part of the NSW Government's first renewable energy and storage auction. Phase 2 construction expected in 2024 to take the project to 720 MW (936 MW_{dc}). [2]

A 50MW/1-hour BESS is also under construction co-located with the New England Solar Farm with financial support from the NSW Government's Emerging Energy Program. June 2023 saw the BESS scope expanded to 1,400MW/2,800MWh with a total cost estimated at $1.3bn. [3]

The 400 MW (520 MW_{dc}) Stubbo Solar and 200MWh BESS Project in the NSW Central Orana Renewable Energy Zone is ACEN Australia's second project, which was granted Development Consent in June 2021 by the NSW Government's Department of Planning and commenced construction in late 2022 across 1,000ha. The Stubbo solar project also secured 20 year LTESAs as part of the NSW Government's first renewable energy and storage auction. [4]

Other ACEN Australia project proposals in NSW include the 600 MW Birriwa Solar near Dunedoo within the NSW Government's Central-West Orana REZ, the 800 MW Valley of the Winds wind farm near Coolah within the Central West REZ, Aquila Wind near Mount Aquila in the Dubbo Regional Council and the 800 MW 12 hours Phoenix Pumped Hydro 35km west of Mudgee within the NSW Government's Central-West Orana REZ, with permitting expected by 2025.

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[1] Climate Energy Finance, Five Urgent reforms to boost Australia's climate finance, June 2023
[2] Ecogeneration, New England Solar project: Largest solar farm in NSW opens, 17 March 2023
[3] ACEN Media Release, New England Solar battery storage increased to bring greener energy for NSW, 31 May 2023
[4] ACEN Media Release, ACEN Australia secures two long term energy service agreements for its solar projects in NSW Government's first renewable energy and storage auction, 1 May 2023

AGL Energy

Total Australian investment required of up to $20 billion to add up to 6 GW of renewable and 6 GW of firming assets by end of 2035 to align with the replacement capacity for Bayswater (to close 2030-2033) and Loy Yang A in Victoria by 2035; with a development pipeline as of June 2023 of 5.3 GW with the expectation of deploying $3-4bn by 2030 – to be funded from a combination of AGL's balance sheet, offtakes and via partnerships.

As the first zero emissions infrastructure project developed in-house for many years, AGL expects its 50 MW / 50MWh Broken Hill battery as anticipated operational in 1QFY2024. [5] AGL is also constructing the Torrens Island battery (250 MW) in South Australia.

March 2022 saw AGL announce plans for Phase 1 of a 500 MW /2,000 MWh Liddell BESS aiming for FID by FY2024 and commissioning by end 2025 at a capex of $763m.

Muswellbrook Pumped Hydro feasibility underway with partner Idemitsu on 250-400 MW 8-hour storage targeting FID by FY2026.

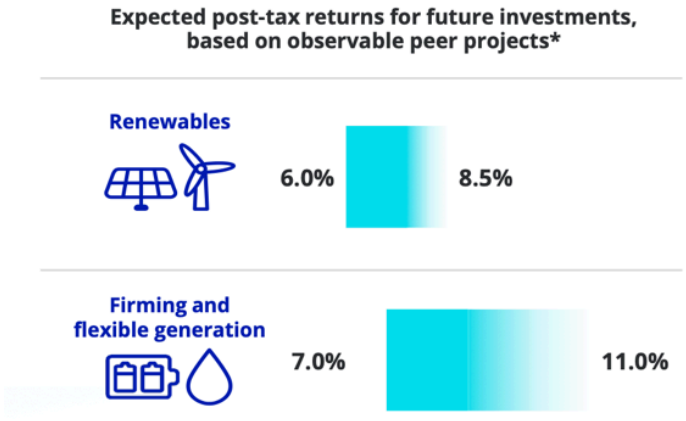
AGL has a yet to be clarified involvement in Ark Energy' 350-450 MW Bowmans Creek windfarm in Muswellbrook, NSW (refer below).

In NSW, AGL is also evaluating a 500 MW / 4-hour duration Tomago battery and a yet to be firmed up 500 MW wind / 200+ MW solar and 400+ MW battery proposal in southern NSW.

AGL has the Silverton Wind Farm of 200MW in operation since 2017 at Broken Hill, but with scope to expand this to 1,000 MW with Project Approval for 282 turbines and Concept Approval for a further 316 turbines.

AGL is also focussed on developing a business model of "Energy as a Service" (EaaS), using microgrids and driving electrification and decarbonisation by leveraging its 4.3 million customer accounts, with 199 MW of decentralised assets under orchestration, +44% vs 1HFY2022.

Figure A1: AGL's Expected post tax project returns for future zero emissions investments



Note: Returns estimated using comparable companies with similar cashflow risk characteristics and where available, comparable transactions.

Source: AGL Energy, AGL Investor Day Presentation, 16 June 2023

[5] AGL Energy, AGL Investor Day Presentation, 16 June 2023

AGL / Future Fund / QIC - Tilt Renewables

August 2021 saw the creation of the Tilt Renewables Australia by Powering Australian Renewables Fund –a consortium of AGL Energy, QIC Global Infrastructure Fund and the Australian Government's Future Fund. Tilt Renewables targets to have 7 GW of renewables assets operational by 2030.

Tilt has the 396 MW Rye Park Wind Farm located to the north of Yass, NSW, on the edge of the Southern Tablelands under construction since 2021, with 19 of the 66 6.0 MW turbines complete as of June 2023.

The 962 MW Liverpool Range Wind Farm was approved by state and Federal governments in 2018. But Tilt, which acquired it in 2019 from Ark Energy, is now proposing 1.3 GW. The project is located 370 km north-west of Sydney, between Coolah and Cassilis townships.

Alinta Energy

Alinta Energy, owned by Chow Tai Fook Enterprises HK, owns power stations across Australia, including the 502 MW open cycle gas Braemar Power Station in Queensland, the 380 MW open cycle gas Wagerup Power Station in Western Australia and the Loy Yang B lignite 1,070 MW power station in Victoria. Alinta has achieved 860 MW of its 2025 target of 1.5 GW of renewable generation and energy storage capacity across WA, Victoria and Queensland. [6]

Amp

Amp is a global renewable energy project developer with financial backing from Carlyle Group. Amp Australia commenced operations in Australia in 2017 and has 8 projects across South Australia and NSW with a 1.52GW portfolio of utility scale solar (including 160MW in NSW), plus energy storage, green hydrogen and ammonia project proposals under consideration.

Amp has developed the 119MW Hillston Sun Solar Farm in SW NSW, with construction completed July 2022.

Atmos Renewables

Atmos Renewables is a specialist in clean energy generation established in 2020, building and operating a portfolio of renewable energy generation assets. Atmos currently own interests in 14 large-scale renewable assets across Australia with 1.6GW gross exposure (0.9GW net equity share). Atmos Renewables is owned by Igneo Infrastructure Partners (AuM US$16bn), a specialist global investment management firm with over 25 years' experience in infrastructure, and part of the First Sentier Investors Group.

In NSW Atmos owns the 132MW Nevertire Solar Farm, near Warren in north west NSW, which was part of Atmos' June 2022 acquisition of Elliott Green Power Limited, building on its acquisition of John Laing's 514MW (209MW net) renewables portfolio in March 2021.

[6] Alinta Energy, Large Scale Renewable Projects

BlackRock US's Akaysha Energy

August 2022 saw BlackRock Real Assets fund acquire Akaysha Energy with a $700m investment, gaining a portfolio of 7 battery development proposals across Australia. [7]

October 2022 saw Akaysha win the NSW EnergyCo tender for the right to build and own the WSB.

June 2023 saw Akaysha Energy raise $500m from infrastructure funds, including $100m from the CEFC, towards the $1bn cost of building the 850MW/1,680MWh Waratah Super Battery at the site of a shuttered power station at Lake Munmorah, NSW. Construction began in May 2023 and completion is scheduled for 2025 ahead of the closure of Eraring coal fired power plant. [8]

Akaysha Energy is also building the $600m 200-400MW/1,600MWh Orana BESS on a 10ha site near Wellington, adjacent to TransGrid's 330kV zone substation in the Central West Orana REZ, NSW with the EIS under exhibition now and the BESS due to be operational 2025. The Orana BESS will support capacity in the Central-Orana REZ. [9]

Brookfield / Origin Energy

Origin Energy (under takeover by Canada's Brookfield Asset Management, with support from Singapore-based investment giants Temasek and GIC) has proposed an Australian portfolio of $30bn on 14GW of new wind, solar and storage to be built across Australia over the coming decade. [10]

Origin acquired the proposed 450 MW Yarrabee Solar Farm project from Reach Solar in April 2022. [11] The proposal has a second phase to double the site up to 900MW. The 2,600 ha site is part of the larger 11,260 ha Yarrabee Park cropping operation and when developed, will be one of NSW's largest solar farms, located in the South-West REZ. Planning approval was secured planning approval from the NSW Government in December 2018 and allows for a 25MW battery energy storage system.

The 300 MW Dapper Solar Farm is a proposed to be built at a 720 ha site purchased in December 2021 35-km south of Dunedoo in NSW's Central-West Orana Renewable Energy Zone, along with a proposed battery storage system.

April 2023 saw Origin Energy confirm a $600m investment to develop the 460MW 2-hour Eraring battery with construction due to commence July 2023 and completion expected 4QCY2025. Phase 2 could see this expanded to 700MW and 4-hour duration. [12]

Origin Energy has also done feasibility studies on expanding its existing Shoalhaven PHS facility to add additional long duration storage.

Origin Energy also has the 60 MW Yanco Solar Farm proposal near Leeton, acquired from ib vogt in August 2022, which received NSW Minister planning approval back in July 2020.

[7] Renew Economy, BlackRock makes $700 million investment in Australian battery storage, 31 May 2023
[8] Renew Economy, World's biggest asset manager eyes more batteries, offshore wind and small solar, 30 June 2023
[9] Renew Economy, BlackRock makes $700 million investment in Australian battery storage, 31 May 2023
[10] Renew Economy, New Origin owner may outspend Andrew Forrest in Australia's biggest renewables play, 7 June 2023
[11] Origin Energy, Origin acquires large-scale solar farm development project in NSW, 28 April 2022
[12] Origin Energy, Origin approves construction of large-scale Eraring battery, 20 April 2023

June 2023 saw Origin Energy acquire a 5% stake in Allegro Energy of Newcastle, NSW and agree to pilot a long duration Redox Flow Battery at Eraring power station. The initial pilot of 100kW/800kWh is due to be commissioned late 2024 and could then be expanded to 5MW/60MWh. [13]

Brookfield separately owns the Spanish based solar developer, X-Elio has a pipeline of other solar projects including the 90 MW solar farm with 25 MW / 25 MW-hour (MWh) of battery storage Forest Glen solar farm near Dubbo in NSW.

Origin owns the 240MW Shoalhaven PHS project. Located in Kangaroo Valley, NSW, 160km southwest of Sydney, the existing Shoalhaven PHS station was constructed in 1977 and consists of 240MW of combined generation and pump capacity across two sites. Origin is looking to almost double the power station's generating capacity with the installation of one additional 235MW generating unit. The new generating unit would be located within an underground power station cavern 300 meters below the surface. Existing pipeline easements, water storage facilities and high voltage substation would be used for this expansion, meaning no new dams or powerlines are required. With the support of the ARENA, Origin completed a full feasibility assessment which concluded the project was technically feasible. During the assessment Origin also completed geotechnical investigations to confirm the underground conditions. This work included an Environmental Impact Assessment (EIS) for proposed geotechnical works. This EIS was approved by the NSW Department of Environment and Planning in November 2019. Higher than anticipated pricing estimates from construction contractors meant Origin did not submit the Shoalhaven expansion for consideration in the Long-Term Energy Service Agreements (LTESAs) funding application process in February 2023. The Shoalhaven expansion project remains an advanced development option and Origin continues to take steps to secure the necessary environmental and regulatory approvals and will re-test pricing at a future opportunity when economic and market factors may have changed.

China's Canadian Solar

NASDAQ listed Canadian Solar of China owns the 146MW Gunnedah Solar Farm, located near Gunnedah, NSW, which completed construction in May 2022.

Canadian Solar also has the 189MW Suntop Solar Farm is located near Wellington, south of Dubbo, NSW saw construction completed November 2021.

EnergyAustralia

EnergyAustralia's parent, Hong Kong-listed CLP Group, is yet again assessing a partial exit of its Australian gas and electricity generation and retailing assets, with the latest suggestion being that Macquarie Group will acquire a 50% stake. [14]

EnergyAustralia owns the end of life 1,480 MW Yallourn lignite coal power plant in Victoria (due for planned closure in 2028), and the 1,400 MW NSW coal power plant at Mount Piper, and the 435 MW Tallawarra gas power plant in the Illawarra, NSW and 450 MW Jeeralong gas power plant in Morwell, Victoria, and 510 MW Newport, Victoria gas power plant, plus 235 MW at Hallett, SA.

[13] Origin Energy, Origin acquires interest in Newcastle's Allegro Energy and agrees to long duration storage, 28 June 2023
[14] AFR, Macquarie leads chase to buy big stake in EnergyAustralia, 19 June 2023

EnergyAustralia has been slow to build out a firmed renewable generation capacity, but does have the 30 MW / 30 MWh Ballarat BESS and 25MW / 50MWh Gannawarra Tesla Powerpack BESS in Kerang, both in Victoria.

Energy Australia has proposed a 500MW/2,000MWh BEAA adjacent to its Mount Piper coal-fired power plant.

Edify

Edify is an Australian renewable energy project developer, retaining equity stakes and offering asset management and maintenance services. Edify has built a number of BESS,

Edify built the co-located Riverina and Darlington Point Battery Energy Storage Systems in NSW, which total to a combined 150MW/300MWh battery system using Tesla Megapacks before selling a majority stake in May 2022 to Federation Asset Management, with debt financing supplied by CBA, Westpac and DNB, and supported by a PPA with EnergyAustralia. This sits alongside the 333MW Darlington Point Solar Farm in the Riverina, NSW, commissioned in 2020 with a capacity factor of 23%, sold to Octopus Investments.

Edify is currently developing the Peninsular Solar Power Station, with a proposed 130MW of solar and 100MW BESS, Forbes, in the Central West Orana region of NSW, with construction due to commence in 2023, with a construction timeframe of 18 months and a projected LCOE of <A$50/MWh.

September 2022 saw Edify appointed to as a provider of system support services to the 300MW Murray River REZ by the Victorian State Government via the development of the 125MW Koorangie Energy Storage System in North West Victoria due for commissioning in 2025.

Enel of Italy

Enel has 574MW of renewable infrastructure projects across six sites in Australia.

In NSW, Enel has the $200m Quorn Park Hybrid Project, which has received NSW government development approval and is due to commence construction in late 2023, consisting a 96MW solar farm and a 20MW/40MWh BESS near Parkes.

Energy Estates

Energy Estates is a developer and adviser of large scale energy transition projects, focused on accelerating decarbonisation.

Siemen's Winterbourne wind proposal is stage I of a multi-stage Walcha Energy Project proposal to build 4GW of wind, solar and several options for a 300MW / 8-12 hour PHS on the edges of the Walcha plateau around the Dungowan Dam by Energy Estates and MirusWind, who founded this proposal back in 2003.. It is located in the southern half of the New England REZ with generation potential equivalent to 15% of NSW's electricity demand. This includes the 600MW Salisbury Solar Farm.

Energy Estates is involved in the Hunter Central Coast Offshore Energy, a 1.65GW floating wind technology project to be located off the coast of the Hunter - Central Coast region of NSW.

And Energy Estates is working with its technology partner, Hydrostor, to employ proprietary Advanced Compressed Air Energy Storage (A-CAES) at the Silver City Energy Storage Centre at the Perilya Potosi Mine, Broken Hill to provide long duration energy storage enabling direct replacement of fossil generation, deferral of costly transmission investments and greater integration of renewable generation as electricity grids across the world decarbonise. This proposal is 200MW/1,550MWh.

ENGIE of France

France's ENGIE owns energy retailers Simply Energy and has 1.1GW of gas power plants across Australia, and a 2GW pipeline of solar, wind and BESS projects.

ENGIE has proposed the 420MW Hills of Gold Wind Farm near Nundle, NSW that received its IPC Determination in 2QCY2023 and is expecting the DPE to make their recommendation to the NSW Independent Planning Commission (IPC) in 3Q2023.

ENGIE also has a 1,900 MW capacity wind-solar Plains Renewable Energy Park proposal, including a BESS of up to 400 MW / 1.6 GWh, positioned within the South-West REZ and the 120MW Silverleaf Solar Farm, Narrabri NSW.

Equis Development

Equis is actively pursuing infrastructure development and investment across Australia, Japan and South Korea, with major shareholdings held by the Abu Dhabi Investment Authority and Canada's Ontario Teachers Pension Plan Board. Formed in 2019 through the restructure of the Equis business model from a funds management business to an infrastructure asset development company.

Equis has waste-to-energy, BESS, offshore wind (in Australia in partnership with SSE plc UK, and in Korea with Korea Wind Corporation), biomass, solar and onshore wind projects in development across Australia, Korea and Japan. Equis is currently developing 39 renewable energy and battery storage projects in Australia with an estimated investment cost of A$6.5 billion, including BESS proposals of 1.9GW/5.2GWh across Victoria, South Australia, NSW and Queensland.

Equis has proposed the 300MW/1200MWh Calala BESS 6km southeast of Tamworth. The BESS has a battery energy storage capacity of up to 300MW and discharge capacity of four hours, so up to 1,200MWh, connected to the 330kV Tamworth Substation. The project will help meet NSW's future electricity demands. The BESS will create 475 full times jobs during construction and 5 during operations as well as funding community programs. [15]

November 2022 saw Equis take control of the $1.9bn 1,200MW/2,400MWh Melton Renewable Energy Hub in Melbourne, which is set to reach FID in September 2023. [16] This BESS could be expanded to 8 hours storage, illustrative of the rapidly scaling up of ambitions and BESS duration. [17]

[15] Equis, Calala, New South Wales, About the project
[16] AFR, Equis powers ahead with $1.9b Melbourne Renewable Energy Hub, 17 November 2022
[17] AFR, This ex-Macquarie banker sold his last firm for $7.5b. Here's his next bet, 6 July 2023

Federation Asset Management

May 2022 saw Sydney based infrastructure asset investor Federation Asset Management acquire from Edify Energy a majority interest in the co-located Riverina and Darlington Point Battery Energy Storage Systems, which total to a combined 150MW/300MWh battery system. This acquisition provided the seed asset for the Sustainable Australian Real Asset fund (SARA), a pure play Australian energy transition fund managed by Federation. [18] EnergyAustralia has market control of two of the three independent, but co-located projects for at least 10 years.

FRV

Saudi's Abdul Latif Jameel Energy's Australian arm - FRV Services Australia (FRV), owns and operates the 90 MW Sebastopol solar farm in Wagga Wagga, NSW.

FRV's Australian portfolio includes the 125 MW Lilyvale Solar Farm in Queensland, the 106 MW Winton Solar Farm in Victoria, and the 70 MW Goonumbla Solar Farm in NSW. The company has also achieved financial close on the 115 MW Metz Solar Farm, NSW and continues to develop the 300 MW Walla Walla Solar Farm, NSW. It owns nine projects in Australia in total, saying it has developed close to 800MW (DC) of solar capacity here.

Global Power Generation (GPG) Naturgy Group

Global Power Generation (GPG) Naturgy Group set up with Kuwait Investment Authority has the Crookwell 3 wind farm in the NSW Southern Tablelands planned for 50MW, approved in October 2020 and due online in 2024, building on the 91 MW Crookwell 2 project completed in 2018. [19]

GMR Energy

Gaw Maoneng Renewables (GMR) took a majority stake in renewables developer Maoneng in 2022 after an equity injection from Gaw Capital Partners, a HK private equity firm (AuM US$36bn). [20]

GMR has a BESS pipeline of 1.9GW across six projects in Australian, include the 240MW/480MWh Mornington BESS in Victoria and the Gould Creek BESS in South Australia, both of which have received Development Application approvals.

GMR has three BESS proposals in NSW where development approval has been applied for, as well as the 550MWac Merriwa Solar Farm and a 400MW 4-hour BESS in the Upper Hunter Shire Council area, NSW. [21]

Goldwind Australia

China's Goldwind Australia has seven wind farms (including the 175MW White Rock Wind farm in Glen Innes, NSW) and 2 solar farms in operation across Australia, plus two Victorian projects under

[18] ESDNews, Federation acquires majority stake in Riverina batteries, 3 May 2022
[19] Global Power Generation (GPG) Naturgy Group, Crookwell 3 wind farm
[20] Energy Storage, Maoneng gets investment to fast track some of Australia's biggest battery projects, 20 October 2022
[21] Renew Economy, Massive big battery and solar farm proposed for NSW coal country, 2 May 2022

construction at Stockyard Hill Wind Farm and Moorabool Wind Farm, as well as the Clarke Creek Wind and Solar Farm in Queensland.

Goldwind has the 275MW Coppabella Wind Farm approved by the Planning Assessment Commission on 30 March 2016 and having signed a commercial agreement with Transgrid for connection in November 2020, the proposal is at the pre-construction phase 30 km west of Yass, NSW. [22] The project is expected to employ 150 staff during the construction phase, and up to 15 permanent ongoing maintenance employees once operational. Coppabella Wind Farm is approved for up to 75 wind turbines that will produce 900GWh pa. May 2023 saw Goldwind secured a Long-Term Energy Service Agreement (LTESA) for the Coppabella Wind Farm. The LTESA provides the project with a series of options to enter energy offtake contracts with a NSW government entity, at a pre-agreed price. This follows participation in the inaugural competitive tender process run by AEMO Services, allowing full construction of the wind farm expected to commence in late 2023. [23]

Iberdrola of Spain

Iberdrola is one of the largest renewable energy infrastructure project developers in Eastern Australia.

In NSW, Iberdrola has the 113 MW Bodangora Wind Farm near Wellington, which has been operational since 2019, and the 141 MW Capital Wind Farm near Bungendore, operational since 2010, with the proposed 144MW Capital 2 Wind Farm, with a Staging Plan (under Condition A13 of the Development Approval) lodged with the DPIE in March 2018. The Capital East Solar Farm 1 and 2 are co-located at Capital Wind Farm. The 48 MW Woodlawn Wind Farm 20 km north of Bungendore has been operational since 2011, causing much visual angst to certain Australian climate luddite politicians. March 2022 saw construction start on the 145MW Flyers Creek Wind Farm, 20 km south west of Orange NSW, with construction completion due in July 2023.

For firming, in NSW Iberdrola in 2019 acquired the 123 MW Smithfield Open Cycle Gas Turbine (OCGT), a 123 MW gas peaker located in Western Sydney as well as the 50MW/75MWh Wallgrove Grid Battery for use in the energy and Frequency Control Ancillary Services (FCAS) markets under an agreement with TransGrid for a period of 10 years from commissioning. The Wallgrove Grid Battery project is owned and operated by TransGrid, and designed and constructed by Tesla using Tesla Megapacks.

Iberdrola has the 245 MW_{DC} Avonlie Solar Farm in Narrandera, NSW, which received Department of Planning approval in August 2019 and was completed in 2022.

[22] Coppabella Wind Farm
[23] Goldwind, Coppabella wind farm project successful in inaugural AEMO Services tender, 2 May 2023

Igneo's CleanPeak / CPE Renewable Investment Unit Trust

CPE Renewable Investment Unit Trust (CPERI) develop, own and operate multi-utility behind-the-meter assets. The CPERI portfolio includes three operational multi-utility sites as well as 30 operational, or under construction, rooftop solar and battery assets for commercial and industrial clients. Once construction is completed, the portfolio will have 29.5MW of solar capacity, 33.4MWh of BESS and 79.8MW of thermal capacity.

CleanPeak to provide customised & effective energy solutions for businesses across the country. Our portfolio consists of over 50 MW of committed solar, 35 MWh of battery projects, 70 MW of utility solar projects under development and microgrids providing energy and thermal services for more than 1,000,000 sqm of floorspace. One example is the Arnott's Huntingwood, Sydney development of 5MW of rooftop solar and 15MWh of committed energy storage capacity. Another is the 40MW Wangaratta solar farm for completion by end 2024 with a 80MWh battery stage 2 proposal. Another is the 1.6MW rooftop solar and 2MWh energy storage at Campbelltown Mall, Sydney built in 2020, one of 25 shopping centres owned by Charter Hall. Another is the UTS Central Park Precinct, Sydney – a development with 2.2 MW of gas generators, 22.2 MW of chillers, 12 MWt of hot water, and a high & low voltage electricity network supporting the mission to eliminate the use of natural gas in the precinct.

Korea Zinc's Ark Energy

Alongside Korea Zinc's Sun Metal green zinc refinery in Townsville, Korea Zinc acquired Epuron Australia in May 2022, giving it a development pipeline of 4.8GWs of renewable energy projects, and integrating it into Ark Energy, which has expanded to now involve the ownership and development of 10 large scale wind farms including four in NSW that are now in operation, and three in NSW and three in Queensland that are in pre-construction or under construction.

Ark has 350-450 MW 56-turbine Bowmans Creek windfarm in Muswellbrook, NSW (with association with AGL), with a proposal for Resident owners of a dwelling within 3.3 km of an installed wind turbine eligible for a Neighbour Agreement or to participate in the project's Neighbour Benefit Program (within 3.3-5km), as well as $215,000 pa payment into a community fund. [24]

Ark also has the 400-500MW Burrendong Wind Farm proposal for Lake Burrendong in the Central-West Orana REZ and 300MW Doughboy Wind Farm of 50-60 turbines 40km east of Armidale, NSW.

Arkx Energy also has the 412MW Richmond Valley Solar proposal at Myrtle Creek, NSW.

[24] Ark Energy, Bowmans Creek Wind Farm

Lighthouse BP

Lighthouse BP owns the 200MW Wellington Solar Farm and the 107MW West Wyalong Solar Farm in NSW.

In NSW Lighthouse BP has the 750MW Sandy Creek Solar Farm & BESS near Dunedoo, 425MW Wellington North Solar Farm, 400MW_{DC} Gundary solar and 550MW_{DC} Goulburn River Solar Farm in its development pipeline.

Macquarie Group: Australian Renewables

Macquarie Group's Macquarie Asset Management's Green Investment Group (GIG) has a 16 GW global portfolio of renewable energy infrastructure assets and a development pipeline of 30 GW across 25 markets.

In 2022 Macquarie separated out its 15 GW pipeline of global offshore wind assets into a separate entity, Corio Generation, [25] which has been involved in half the offshore wind developments across the UK. Working in Japan in partnership with Iberdrola of Spain to develop 6 offshore wind farms of 3.3 GW total capacity, and working in South Korea in partnership with TotalEnergies of France to develop offshore wind farms of 2.3 GW total capacity In Australia, Corio manages the 1.5 GW Great Southern Offshore Wind Farm project off the Bass Coast Shire in Gippsland, Victoria, supported by a $16m of Victorian government funding. [26]

Macquarie Group has had a long association with battery storage, managed primarily through its Eku Energy business with a global portfolio of 4 GWh across the UK, Australia, Japan and Taiwan. Eku partnered with ENGIE of France and Fluence in commissioning the 150 MW/150 MWh Hazelwood BESS in June 2023. [27]

March 2023 saw Eku and Shell Energy partner reach the financial investment decision to deliver the 200MW / 400MWh Rangebank BESS in Cranbourne, Victoria, with commissioning due late 2024. [28]

April 2023 saw Eku partner with the ACT Government for the 250 MW / 500 MWh Big Canberra Battery project. With an estimate capital cost of $300-400m, this facility will be developed, built, and operated by Eku Energy with construction starting in late 2024 with completion expected in 2025. The battery project has a key objective of supporting the electricity grid during network outages, particularly in peak periods when the electricity grid can be under significant stress. [29]

Macquarie Group is also exploring options to acquire a strategic stake in climate laggard EnergyAustralia to leverage its customer-base to enable deployment of firmed renewable energy capacity. [30]

July 2023 saw Eku partner with European developer Renera Energy to build over 1GW of battery storage projects in Italy. [31]

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[25] AFR, Macquarie spins out offshore wind assets into new company, 3 March 2022
[26] MAM GIG, Great Southern Offshore Wind Farm, 23 November 2021
[27] Eku Energy, Historic moment in Australia's energy transition as Hazelwood Battery Energy Storage System is commissioned, 14 June 2023
[28] Eku Energy, Macquarie Asset Management's Green Investment Group and Shell Energy to deliver large-scale battery project in Melbourne, 31 March 2023
[29] Eku Energy, Eku Energy partner with ACT Government to deliver the Big Canberra Battery, 13 April 2023
[30] AFR, Why Macquarie is taking a look at EnergyAustralia, 19 June 2023
[31] Renew Economy, Macquarie's Eku to develop more than 1GW of battery storage in Italy, 13 July 2023

Neoen Energy of France

Founded in 2008, Neoen is the leading French independent producer of renewable energy and a major player on the world stage, with total capacity in operation or under construction of 6.6 GW and we are aiming for more than 10 GW by 2025, with the ambition to reach 20 GW by 2030.

Neoen Australia has 2.1GW of operating renewable energy assets, including in NSW the 150MW Coleambally solar farm, the 36MW Griffith Solar Farm and 66MW Parkes Solar Farm, all in operation.

Neoen is pursuing plans to build a Thunderbolt Energy Hub that involves a proposed 380 MW wind farm (stage I of 192 MW) near Tamworth in the New England REZ. [32]

Neoen is also building the stand-alone 100 MW /200 MWh Capital Battery in Canberra, which reached financial close in October 2022, with debt supported by the CEFC and Infradebt, and an 7-year 70MW virtual battery contract with AGL Energy. Neoen also has the 500 MW / 1,000 MW Great Western BESS.

Octopus Investments Australia

Part of the wider Octopus Group, founded in the UK in 2000, with a global portfolio AuM of $15bn.

Octopus Investment has Australian AuM of $1bn and 2.3GW of energy assets in construction and operation, including Australia's largest solar plant, the 333MW facility in Darlington Point, NSW.

The Blind Creek Solar Farm and BESS is a development-stage project near Bungendore, in NSW, with a capacity of up to 350MWac of solar and 300MW/600MWh of storage. It is proposed to connect to a strong area of the transmission network, into the existing 330kV line between the major load centres of Sydney, Canberra and Snowy Hydro. The vision is a unique Community Benefit Sharing Scheme that will contribute $330 per MW per year to the local community.

Petronas of Malaysia - Gentari Sdn Bhd

February 2023 saw Gentari acquire Wirsol Energy Australia, with integrated solar and BESS capability, comprising 422 MW in operation and 765 MW potential capacity in projects under development, as part of Gentari's global ambition to build 30-40 GW by 2030. [33] Wirsol has the 400 MW Buronga energy station in Wentworth, NSW and 230 MW Maryvale Solar and 125MW/375MWh BESS projects under development within the Central-West Orana REZ, NSW.

Renewable Energy Systems (RES) UK

Owns renewable energy projects across Australia, including the 100MW Springdale Solar Farm development near Sutton, NSW, as well as the 106MW Taralga Wind Farm near Taralga, NSW.

[32] Renew Economy, Neoen adds Thunderbolt project to massive wind and solar pipeline in New England, 9 March 2021
[33] Wirsol Energy, Gentari completes acquisition of Wirsol Energy Australia, 16 March 2023

RATCH Australia

Ratch owns the 227 MW Collector Wind Farm between the towns of Collector and Gunning, NSW, which has been operating since 2021. Iberdrola Australia has a PPA for 60% of output till 2030.

Shell Energy

January 2023 saw Shell Energy acquire the rights to develop the 500MW/1000MWh Wallerawang 9 Battery at the site of the former Wallerawang coal power plant. Shell also has the 500MW/1,000MWh Wellington NSW BESS in partnership with AMPYR Australia.

Spark Infrastructure

Spark Infrastructure was acquired in 2021 by a North American consortium led by private equity giant Kohlberg Kravis Roberts (KKR) and also owns a 49% stake in Victorian distribution network companies Powercor and CitiPower, 49% of South Australia's SA Power Networks, and a 15% stake in NSW transmission company Transgrid, which is building the NSW side of Project EnergyConnect, a new link from South Australia.

Spark Infrastructure's Spark Renewables unit has proposed to build up to a 1GW Mallee wind farm near Buronga, alongside a 350MW/700MWh BESS across 43,324 ha in the South West REZ connecting into Project EnergyConnect. [34] January 2023 saw the scoping report submitted to DPE.

Spark Infrastructure has also proposed a second massive 2.5GW Dinawan Energy Hub of 1.5GW of wind, 1.0GW of solar and 500MW/1,000MWh battery storage hub in the South West REZ of NSW, with a $1.8bn phase I of 1.0GW and $2.45bn phase 2 of another 1.5GW. Scoping Studies were submitted to the NSW DPE in November 2022. [35]

Spark Renewables owns the operational 100MW Bomen Solar Farm near Wagga Wagga, and in 2022 proposed a phase 2 extension to add another 60MW solar.

February 2023 saw Spark Renewables propose a 500MW Wattle Creek Energy Hub wind and solar project with up to a 350MW/700MWh BESS on the University of Sydney's Arthursleigh property, located in the NSW Southern Tablelands near Marulan.

Sparks Renewables is also progressing the 160MW Mates Gully Solar Farm with a 150MW/300MWh BESS 30km east of Wagga Wagga, NSW.

March 2023 saw Spark Renewables, Simply Blue Group and Subsea7 partner to pursue floating offshore wind development in in the Hunter and Illawarra regions of NSW. [36]

[34] Renew Economy, Spark unveils new plans for giga-scale wind farm and big battery, 12 August 2022
[35] Spark Renewables, Dinawan Energy Hub project Scoping Reports submitted, 16 November 2022
[36] Spark Renewables, Spark Renewables, Simply Blue Group and Subsea7 partner to pursue floating offshore wind development in NSW, 22 March 2023

Squadron Energy

Andrew Forrest's Squadron Energy is one of Australia's leading renewable energy firms that develops, operates and owns renewable energy assets in Australia with 1.1 GW of renewable energy in operation across 5 wind farms and an Australian development pipeline of 20GW. Squadron acquired 75% of Windlabs and CWP Renewables in 2022.

The 270 MW Sapphire Wind Farm is located 18km west of Glen Innes, in the New England region of northern NSW. Commissioned in 2018 with a 32% capacity factor, it is the largest operational wind farm in the state and has helped the ACT Government meet its target of 100% renewables in 2020 by providing a long term power purchase agreement. The Sapphire Battery is a 30MW / 30MWh (lithium-iron phosphate) battery development located next to the 270 MW Sapphire Wind Farm.

The 180 MW_{AC} Sapphire Solar Farm is approved to be located alongside Sapphire Wind Farm in the New England region of northern NSW.

The 134 MW Crudine Ridge Wind Farm is located 45km south of Mudgee. The wind project became fully operational early in 2022.

Squadron operates the 244 MW Bango wind farm 30km north of Yass, NSW, completed early 2023 with an expected 35% capacity factor. Bango the third largest operational wind farm in NSW and became fully operational in 2023.

Squadron's 414 MW Uungula Wind Farm has received approval for the construction of up to 93 wind turbines and associated infrastructure located 14km east of Wellington, NSW.

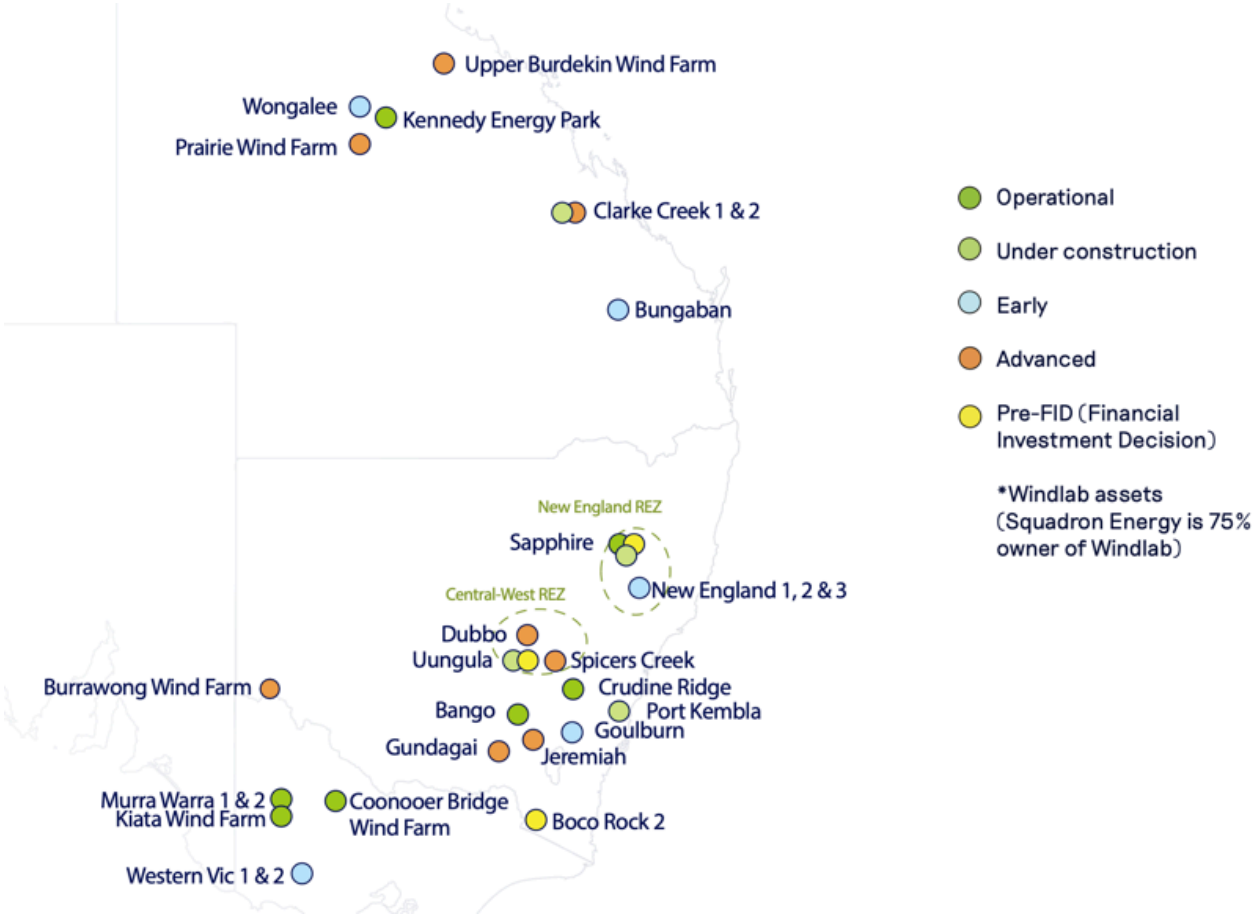
Beyond this, Squadron has the proposed 700 MW 117 turbine Spicers Creek Wind Farm located north east of Wellington, NSW. The Project received Secretary's Environmental Assessment Requirements (SEARs) on 6 May 2022.

The proposed Boorolong Wind Farm is 20km north-west of Armidale, within the New England Renewable Energy Zone (REZ).

The proposed 400 MW Jeremiah Wind Farm is located 25km east of Gundagai, NSW. The proposed wind project currently comprises 65 wind turbines and battery energy storage. The Project received SEARS on 23 September 2021.

The proposed Spicers Creek Wind Farm is located on Wiradjuri Country, west of Gulgong and north east of Wellington, within the Central-West Orana Renewable Energy Zone. The proposed wind project currently comprises up to 117 wind turbines and battery energy storage.

Figure A.1: Squadron Energy's Renewables Portfolio



Source: Squadron Energy

Windlab (75% Squadron Energy and 25% Federation Asset Management)

Windlab has a portfolio of 1.1GW of renewable energy assets with another 7.75GW under development. Windlab was first established to commercialise world leading atmospheric modelling and wind energy assessment technology, developed by Australia's premier scientific research institute, the CSIRO. Windlab has been involved in Australia's largest wind far, the $850m 453MW Coopers Gap Windfarm at Cooranga, Queensland and the pioneering 206MW Collgar windfarm in WA completed in 2011.

Windlab manages a portfolio of five Australian wind and solar farms, including the 132MW Nevertire Solar Farm, near Warren in north west NSW, which was acquired by Atmos Renewables in June 2022 from Elliott Green Power Limited, with operations that commenced in May 2020.

In NSW, Windlab has proposed the 107 wind turbine 750MW Burrawong Wind Farm near Balranald, in the proposed South-West Renewable Energy Zone (SW REZ) of NSW well positioned to connect to the electricity network via the Project EnergyConnect transmission line. A Scoping Study has been submitted to the Department of Planning, Industry and Environment (DPIE).

Vestas of Denmark

Vestas acquired the 700MW Winterbourne Wind Farm proposal in the New England REZ near Walcha, NSW. Vestas has been involved with the project since 2019 and is progressing project planning and approvals, with construction expected to start in 2023. [37]

Virya Energy

Virya was established by German wind pioneer Joachim Ueckler in March 2020 as an Australian counterpart to Energiequelle GmbH, one of the largest privately owned renewable energy developers in Europe with over 300 staff and 750 projects.

Virya has proposed the 1,500MW Yanco Delta Wind farm near Jerilderie, NSW with modelling of up to 210 wind turbines, plus a 500MW/500MWh BESS and 300MW of solar, with construction proposed for 2025 and connection to Project EnergyConnect (Eastern) via the proposed Dinawan Terminal Station in the South West REZ. [38]

[37] CEF, Winterbourne Wind Farm: Submission on State Significant Development SSD-10471 to NSW Department of Planning & Environment, 23 January 2023

[38] Renew Economy, Another giga-scale wind, solar and battery project jostles for a spot in new REZ, 18 November 2022

Appendix B: NSW Transmission - Transgrid

Transgrid is the NSW Transmission Network Service Provider (TNSP), operating 13,000km of high voltage transmission wires and 121 substations in NSW and the ACT, with connections to Victoria and Queensland.

In December 2015, the NSW Electricity Networks Consortium acquired the Transgrid assets from the NSW State Government by way of a 99-year lease and a Sale and Purchase Agreement for $10.3bn. This consortium comprises of Spark Infrastructure (15%, which is owned by KKR, Ontario Teachers' Pension Plan Board and Public Sector Pension Investment Board), Utilities Trust of Australia (22.5%, an infrastructure fund run by Morrison & Co NZ), Canada's Caisse de depot et placement du Quebec (22.5%), Abu Dhabi Investment Authority (22.5%), and the Canadian pension fund, Ontario Municipal Employees Retirement System (OMERS, 19.99%).

June 2023 saw Transgrid announce a $16.5bn investment over the coming decade to ensure the grid can run at up to 100% instantaneous renewable energy.

$14bn of this is to build 2,500km of transmission lines to connect new large-scale renewable energy and storage to the grid, integrate five renewable energy zones, and expand transmission interconnection between states. Transgrid is accelerating delivery of the nation-critical projects including EnergyConnect, HumeLink and VNI West vital to facilitate Australia's clean energy transformation. The plan is predicated on the basis that by 2033, over 80% of NSW's coal-fired capacity will retire, while hundreds of new large-scale wind and solar generators and storage and millions of rooftop solar systems will add 28GW of new capacity to the NSW power system in their stead (17GW large scale renewables and batteries, mostly across the 5 REZ, 11GW behind the meter).

The balance of $2.5bn is to build system-strength absent coal generation. Transgrid states it has undertaken a "global Expression of Interest process to provide system strength resulted in nearly 70 potential technology solutions. These include more than 10GW of existing or conversions of existing synchronous generators, a pipeline of 10GW of innovative grid-forming batteries, and 5GW of other new generation and energy storage projects, such as pumped hydro and gas." [39]

Completed Grid Projects

Queensland-NSW Interconnector (QNI, July 2022)

The QNI upgrade involved uprating the 300km of Liddell to Tamworth lines and installing new dynamic reactive support at Tamworth and Dumaresq involving capex of $236m with the aim of reducing the need for new generation and large-scale storage in NSW to meet demand following Liddell Power Station's forecast retirement over 2022/23. [40]

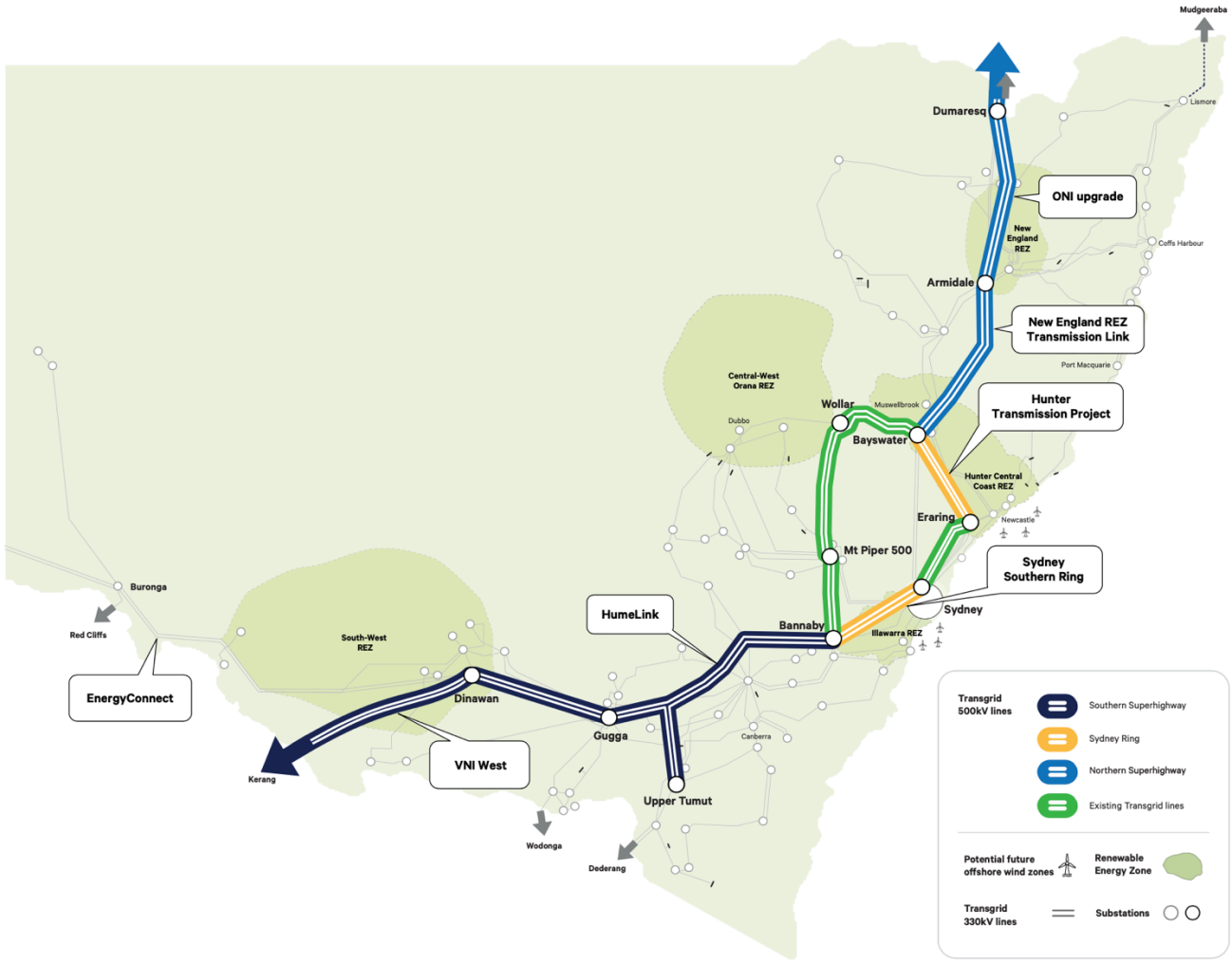
July 2022 saw this project completed, allows 460MW more power to be transferred into Queensland and 190MW more into NSW and the ACT when needed. [41]

Victoria-NSW Interconnector (VNI, November 2022)

[39] Transgrid, Transgrid Roadmap to secure grid in the clean energy transition, 21 June 2023
[40] Transgrid, Expanding NSW-QLD transmission transfer capacity, 20 December 2019
[41] Transgrid, Transgrid delivers $236m QNI upgrade, increasing energy capacity between the states, 28 July 2022

December 2021 saw Transgrid invest $45m in new SmartValve devices to increase energy flows on existing transmission lines by 170MW by diverting electricity from lines which are experiencing constraints to those better able to carry it to customers. [42] VNI was completed on time and on budget in November 2022.

Figure B1: NSW Interstate Interconnections Map



Source: Transgrid Roadmap, June 2023

Southern Superhighway (2024-2028)

Transgrid is proposing to build 1,600km of new transmission over 2024-2028 at a combined capital cost of $7bn, covering the EnergyConnect, Humelink and VNI West projects to collectively unlock 3GW of renewable energy and the Snowy 2.0 PHS.

EnergyConnect (2024-2026)

Transgrid projects that EnergyConnect has a delivery date of 2024 (stage 1) and 2026 (stage 2), enabling the sharing of energy and unlocking renewables between NSW, South Australia and Victoria.

[42] Transgrid, Victoria-NSW Interconnector technology will unlock additional energy for 30,000 homes, 22 December 2021

In June 2023 Transgrid confirmed EnergyConnect had managed to strike 95% of landowner deals by agreement, with only six landowners requiring compulsory acquisition. [43]

Humelink (2026)

HumeLink has a projected delivery date of 2026, enabling the integration of new generation from the South-West NSW REZ and unlocking the full capacity of Snowy 2.0 to be shared with the Sydney, Wollongong and Newcastle load centres.

Transgrid says it "remains committed" to completing HumeLink by 2026, with costs estimated at $3.3bn "in 2020 dollars". A more realistic assessment comes from Bruce Mountain, director of the Victoria Energy Policy Centre and a longtime critic of Snowy 2.0, HumeLink may cost $4.5bn – or more than the $4.15bn NSW received for the Snowy share sale. [44]

Victoria-NSW Interconnector (VNI) West (2028)

Transgrid has proposed a 3 year pull forward of the delivery date of 2028 for VNI West, to access the benefits of bulk-buying and to facilitate greater energy sharing between NSW and Victoria and connecting into EnergyConnect.

December 2021 saw Transgrid invest $45m in new SmartValve devices to increase energy flows on existing transmission lines by 170MW by diverting electricity from lines which are experiencing constraints to those better able to carry it to customers. [45]

Sydney Ring (2028-2031)

Transgrid is proposing to add 240km of grid with a $2.5bn investment to facilitate 10GW of new renewables.

Hunter Transmission Project (2028)

The Hunter Transmission Project (HTP) has a proposed delivery date of 2028 and will facilitate the transfer of electricity generated by the New England, Central-West Orana and Hunter-Central Coast REZs in northern NSW, into the Hunter, Greater Sydney and Illawarra regions, and includes enabling the 850MW Waratah Super Battery. The HTP will also strengthen the electricity grid as electricity demand continues to grow, making it easier to transport electricity around the Hunter-Sydney-Illawarra regions, where 80% of the State's electricity is consumed. At the Commonwealth level, the HTP is classified as a "NSW actionable project" under the Australian Energy Market Operator's 2022 Integrated System Plan for the transformation of the National Electricity Market and must be operating by mid-2027. EnergyCo is in the planning stage of the HTP and expects to start detailed community engagement on the project in 3Q2023.

Sydney Southern Ring (2031)

Transgrid has proposed the Sydney Southern Ring for delivery in 2031, to strengthen the southern connection to Sydney, facilitating additional flow from HumeLink and the Illawarra REZ, including potentially offshore wind.

[43] AFR, Delay Eraring closure as 'insurance', says Transgrid's Redman, 20 June 2023
[44] The Guardian, $5.9bn and rising: Snowy 2.0 wrestles with delays and budget blowouts, 18 June 2023
[45] Transgrid, Victoria-NSW Interconnector technology will unlock additional energy for 30,000 homes, 22 December 2021

Northern Superhighway (2028-2033)

Transgrid is proposing to add 580km of grid with a $5bn investment to facilitate 6GW of added network capacity.

New England REZ Transmission Project (2028)

The New England REZ network infrastructure is due for delivery starting in 2028 and will be built to enable new generation and storage projects to connect and transport energy to consumers. Some of this infrastructure will need to be built outside the REZ geographical area to connect the REZ to the main backbone transmission network. EnergyCo is in the early stages of assessing what new network infrastructure should be built to unlock and service the New England REZ and has identified a preliminary study corridor to host essential electricity transmission infrastructure in the New England and Upper Hunter. Community consultation on the preliminary study corridor will begin shortly.

QNI Connect (2033)

Transgrid proposes a delivery date of 2033 to enable greater sharing of renewable energy between NSW and Queensland.

Other NSW Grid Projects

Central-West Orana Transmission Project

The Central-West Orana REZ will be serviced by new transmission network infrastructure, including high-capacity transmission lines and energy hubs, which will transfer power generated by solar and wind farms to electricity consumers. This infrastructure will be critical for the successful operation of the REZ. EnergyCo is leading the development of the REZ transmission network infrastructure.

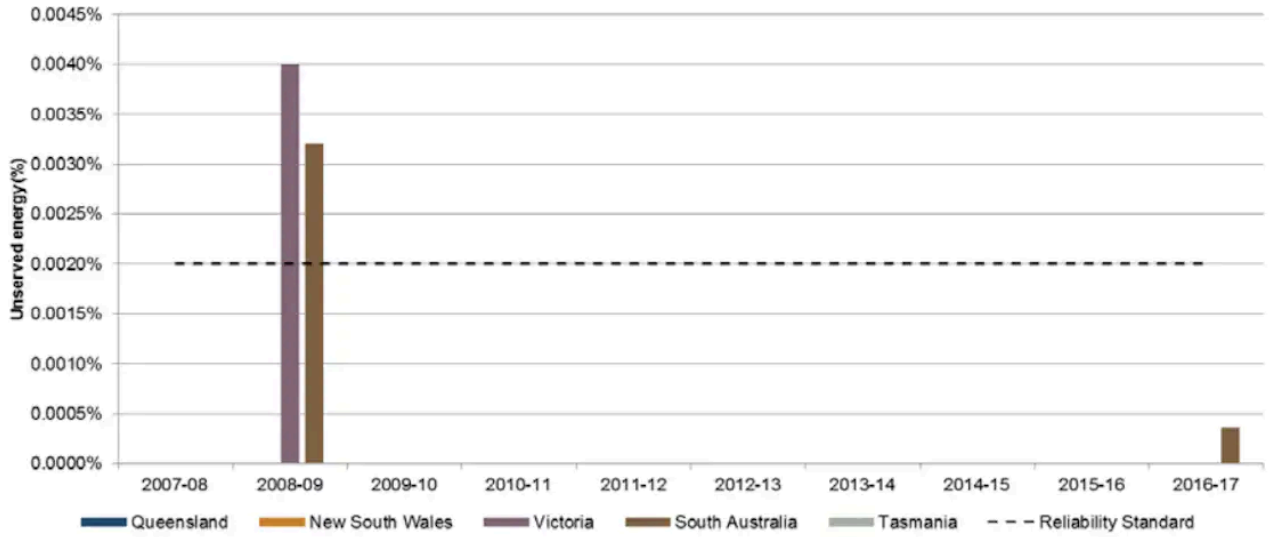
EnergyCo is responsible for developing and overseeing the planning and approval processes for the REZ network infrastructure and also running a competitive tender process to appoint a Network Operator to design, build, finance, operate and maintain the REZ transmission network. EnergyCo has selected ACE Energy as the first ranked proponent as Network Operator for the Central-West Orana REZ. ACE Energy is sponsored by Acciona, Cobra and Endeavour Energy. EnergyCo will now work closely with ACE Energy to finalise and enter into a Commitment Deed in 3Q2023 at which time they will be confirmed as the preferred Central-West Orana REZ Network Operator.

EnergyCo will carry out a variety of field investigations in 2023 to understand local land uses and to confirm environmental conditions, local topography and engineering constraints as part of investigations to inform the design and an Environmental Impact Statement (EIS) for the REZ transmission infrastructure. The EIS will be lodged with the NSW Department of Planning and Environment and placed on public exhibition for community feedback in late 2023.

Gold-Plating Grid Reliability is a tax on Australia's Most Vulnerable

The Australian electricity runs a 0.002% Unserved Energy Reliability standard. This was tightened in FY2005, and sets a massive cost on those most vulnerable in Australia in terms of gold-plating, and is being used to recommend delay to the implementation of the electricity decarbonisation objectives of Australia, in compete denial of the environmental costs of the climate crisis and the skyrocketing cost of the approaching end of life coal and methane gas power generation.

Figure B2: Unserved energy in the NEM: 2007-08 to 2016-17



Source: AEMC 2018, 2017 Annual Market Performance Review, The Conversation [46]

[46] The Conversation, Amid blackout scare stories, remember that a grid without power cuts is impossible… and expensive, 27 August 2018

Offshore Wind

Offshore wind is set to be a key tool for Australia to move beyond its 82% renewables by 2030 target, with Victoria leading in Australia's planning, and West Australia rapidly building momentum. [47]

For Australia to maximise the value and opportunities of offshore wind, we need to thing about policies that leverage the critical mass of $30-40bn of collective investments to ensure the creation an Australian domestic supply chain and build 5-8 offshore wind farms in series consecutively, rather than concurrently like Queensland did at the Gladstone six-train LNG debacle.

June 2023 saw Spanish offshore wind developer BlueFloat Energy announce a "re-launch" of its 105 floating turbines in its proposed 1.6GW South Pacific Offshore Wind Project, which it now plans to develop 14-30km off the coast of NSW, between Shellharbour and Clifton. While the company flags construction of the project is planned to start in early 2028 with the project expected to be fully operational by early 2031, CEF considers this to be optimistic. [48] BlueFloat has previously announced its proposed 1.7 GW Eastern Rise offshore wind project, located off the NSW Hunter coast. BlueFloat has announced plans for a 7.6 GW of floating offshore wind farms in Philippines, part of its global 32GW pipeline.[49]

Energy Estates is involved in the Hunter Central Coast Offshore Energy, a 1.65GW floating wind technology project to be located off the coast of the Hunter - Central Coast region of NSW. In addition, there is the 2GW project being developed by OceanEx and Equinor, and the biggest floating wind project proposed for Australian waters d by France's EDF.

March 2023 saw Spark Renewables, Simply Blue Group and Subsea7 partner to pursue floating offshore wind development in in the Hunter and Illawarra regions of NSW. [50]

Copenhagen Infrastructure Partners (CIP), along with Cbus and the original Australian founders, own Australia's most advanced offshore wind proposal, the 2.2GW Star of the South in the Bass Strait off the Latrobe Valley in South East Victoria, leveraging the existing transmission infrastructure. CEF notes that Star of the South is just one of 40 applications to the National Offshore Petroleum Titles Administrator for Victoria in April 2023 spanning Origin Energy, Macquarie Group, CIP, Shell, JERA, Beach and Orsted, showing the massive global capital available to drive a step change in absolute scale of ambitious thinking in industrial renewable energy projects here. [51]

July 2023 saw the Federal Government officially declare Australia's second offshore wind development zone, a 2,000 kilometres square area in the Pacific Ocean off the coast of the NSW Hunter region capable of hosting up to 5GW of turbines. [52]

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[47] The West Australian, Proposed Leeuwin Offshore Wind farm project gains lead agency status from State Government, 16 June 2023
[48] Renew Economy, BlueFloat moves ahead, and further north, on NSW floating offshore wind project, 9 June 2023
[49] Renew Economy, BlueFloat targets 7.6GW of floating offshore wind in Philippines, 7 June 2023
[50] Spark Renewables, Spark Renewables, Simply Blue Group and Subsea7 partner to pursue floating offshore wind development in NSW, 22 March 2023
[51] AFR, Renewable heavyweights seek offshore wind licences, 11 May 2023
[52] Renew Economy, Offshore wind: Race for space as pared back Hunter zone officially declared, 12 July 2023

Appendix C: Exporting Embodied Decarbonisation

As NSW and Australia's REZ progressively come on line, this should open up massive opportunities to aggressively decarbonise the NEM, the SWIS plus the yet-to-be-established common user grid in the Pilbara. The unprecedented, massive development of industrialised firmed renewable energy infrastructure should progressively open up a sustainable competitive advantage for Australian manufacturing and refining – low cost, deflationary zero emissions electricity such that Australia can export 'embodied decarbonisation' in our world-scale green iron, green aluminium and green lithium hydroxide.

There is a huge opportunity for Australia to become a renewable energy powered critical minerals and green metals export superpower. June 2023 saw Rio Tinto and the world's largest steel company, China Baowu Group announce the intent to explore the opportunities for green iron exports for the Pilbara. [53] West Australia at Kwinana and Kemerton is completing the construction and commissioning of three of the world's largest lithium hydroxide refineries outside of China, to be powered by West Australia's new SWIS Demand Assessment that models the construction of 50 GW of new wind, solar and batteries and 4,000km of intrastate grid transmission capacity by 2042. [54]

But these massive investment, regional employment and value-added export opportunities are not constrained to West Australia.

NSW has Australia's largest aluminium refinery at Tomago. And NSW has ASM's $1.7bn proposed refined critical minerals industrial precinct at Dubbo. And BlueScope could invest $1bn to build Australia's largest electric arc furnace at Port Kembla leveraging recycled scrap and low cost zero emissions renewable energy to replace its near-end-of-life steel blast furnace #5. This would leverage the EFA and CEFC in support of the ASM refinery, and the newly formed $15bn National Reconstruction Fund for Pt Kembla and Tomago.

ASM's proposed Dubbo, NSW refined critical minerals industrial precinct

ASX-listed Australian Strategic Metals (ASM) is an emerging vertically integrated producer of value-added rare earth products across Australia and South Korea, a perfect illustration of the collaboration and partnership opportunities the US IRA could unlock.

ASM has a proposed investment into mining, separation and refining of rare earths and critical minerals (Neodymium, praseodymium, dysprosium, terbium, zirconium, hafnium, niobium) at Dubbo, NSW, with the aim to then ship the metal oxides and mixed chlorides to ASM's **Korean Metals Plant** at Ochang Foreign Investment Zone for further refining into NdPr metals and Copper Titanium (CuTi) alloy for use in Korea and NdFeB alloy for sale into the US.

In December 2021 ASM signed a Joint Statement of Cooperation with the Korean Mine Rehabilitation and Resource Corporation (KOMIR), the renamed Korean Resources Corporation (KORES), to enable the supply of critical minerals and metals into Korea. In May 2022 ASM raised US$15m in new equity

[53] AFR, Rio, world's biggest steelmaker join forces on green iron plant in WA, 12 June 2023
[54] WA Government, SWIS Demand Assessment, 17 May 2023

from KCF Energy Co., a Korean consortium made up of Cerritos Holdings, Polo Equity Partners and ACE Equity Partners, with the intent to secure a significantly larger US$280m equity investment from a new strategic investor.

ASM's **Dubbo Project** should create 1,000 jobs during construction and 270 ongoing local jobs. The proposed A$1.7bn investment is underpinned by a June 2021 A$200m letter of financial support from EFA. September 2022 saw ASM sign a MoU with the Korean Development Bank to establish a rare earths supply chain. November 2022 saw ASM complete a A$41m equity raising in support of the Dubbo Project. December 2022 saw ASM awarded $10.5m in grant funding from the NSW government and in May 2023 received a $6.5m grant from Australian Government under Tranche 2 of the Critical Minerals Development Program (CMDP). January 2023 saw the award of the engineering, procurement and construction definition work (EPCD) to Hyundai Engineering Co., Ltd. ASM expects to finalise bankable offtakes and equity from strategic partners and/or governments in 2HCY2023 before going to a FID in 2HCY2024 and awarding the EPC contract. Given the rapid decarbonisation of the Australian electricity grid, ASM targets powering the mine and refinery with 100% renewable energy.

April 2023 saw ASM sign a binding agreement with Vietnam Rare Earth Company (VTRE) for the purchase of rare earth oxides from Vietnam to be used as feedstock at ASM's Korean Metals Plant.

Tomago aluminium refinery

NSW has Australia's largest aluminium refinery at Tomago. The long term electricity supply contract with AGL Energy expires in 2028, and this is a brilliant opportunity for Tomago to work in conjunction with the NSW and Federal governments to develop a pricing model that drives decarbonisation and the production of green aluminium, as well as incorporates a massive price signal to incentivise demand response management - as the user of 10% of NSW's electricity, Tomago is uniquely positioned to act as a virtual battery to enhance grid reliability and allow a dramatic increase in renewable energy for the entire state. Alignment of Rio Tinto's ambitious decarbonisation objectives can be commercially aligned with the need for low overall cost of energy to ensure sustained competitiveness of this major NSW employer.

Pt Kembla EAF

BlueScope should invest $1bn to build Australia's largest electric arc furnace at Port Kembla leveraging recycled scrap (both imported from both WA and collected here on the Eastern Australia from all our end-of-life ICE clunkers) and low cost zero emissions renewable energy.