Clean Economy Jobs Bill 2024

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From the desk of Saxon Davidson, Research Fellow
[redacted]

Institute of Public Affairs

7 March 2024

Committee Secretary
Clean Economy Jobs, Resources and Transport Committee
Parliament House
George Street
Brisbane Qld 4000

Dear Committee Secretary

Institute of Public Affairs submission to the Inquiry into the Clean Economy Jobs Bill 2024

The purpose of this letter is to share research and analysis conducted by the Institute of Public Affairs ("the IPA") with the Clean Economy Jobs, Resources and Transport Committee ("the committee", as it conducts its inquiry into the Clean Economy Jobs Bill 2024 ("the bill").

The bill aims to enshrine into legislation the emission reduction targets of the state government, those being 30 per cent reduction below 2005 levels by 2030, 75 per cent reduction below 2005 levels by 2035, and net zero by 2050; empower ministers responsible for specific economic sectors to create 'emissions reduction plans' stating how the sector can contribute to achieving the emissions reduction targets; and create a new government agency—the Clean Economy Expert Panel—which will provide advice to the environment minister about achieving these targets and recommendations to reduce greenhouse gas emissions in Queensland.

IPA analysis of the bill finds:

- The bill confers on government ministers inappropriate discretion to set interventionist 'emission reduction plans' on specific industries that will impose significant economic harm on regional Queensland.
- Net zero will increase household power prices through the removal of baseload power sources.
- The bill will undermine Queensland's energy security.

On the basis of these findings the IPA recommends that the bill and the policy of net zero emissions by 2050 be abandoned, and further recommends that the Queensland state government legislate a mechanism in which no baseload power station can be closed down unless and until there is a like for like baseload replacement ready, such as coal or nuclear.

The legislating of net zero emissions will impose significant economic harm on regional Queensland

Meeting the emissions reduction targets outlined in the bill will mean no new coal, gas, or oil project will be allowed to proceed, and existing projects must either change practice or be shut down. As part of this process, the bill confers on government ministers a discretionary power to create 'emission reduction plans' stating how each economic sector will contribute to achieving emission reduction targets. The emission reduction plans, which are created and amended by the relevant minister as laid out in part 3 of the bill, will target emission intensive industries and will put at risk jobs in critical sectors such coal mining, agriculture, and energy supply.

IPA analysis has found that this bill will put up to 157,710 jobs at risk across the state of Queensland, with the vast majority of them located in regional parts of the state, with just under 75 per cent of the jobs at risk located outside of Greater Brisbane and the Gold Coast. These jobs are in industries which are high emitting. These cancelled jobs—concentrated in sectors such as agriculture, coal mining, oil and gas extraction, and electricity supply—are unlikely to return: since 2010, for every one job created in ‘renewable activities’, five manufacturing jobs have been destroyed.

The policy of net zero emissions by 2050 will make household power prices unaffordable in Queensland

Emission reduction targets, such as those contained in the bill, deter investment in the extraction and utilisation of emission intensive industries, such as coal and gas which are used to generate electricity. The consequence of this deterrent effect is to artificially reduce the state’s energy supply and cause surges in the power bills households will be required to pay.

IPA research from 2022 found that Queensland households can expect their electricity bills to more than double by the end of the decade. This is due to the absence of equivalent replacement energy sources in the energy grid. The replacement energy sources, wind and solar, are intermittent and cannot provide energy under all circumstances unlike coal or gas, and hydro projects require the construction of dams, which has not been successfully done in Queensland for over a decade.

The bill fails to consider the state’s energy security

A key objective of governments is to achieve energy security, which is the uninterrupted supply of energy sources at an affordable price. The policy objective of net zero is incompatible with the objective of energy security as it requires the replacement of reliable baseload sources of energy (such as coal and natural gas) with intermittent sources of energy (such as wind and solar).

This comes in the wake of AEMO’s recent *2023 Electricity Statement of Opportunities* report, which found that Queensland will begin experiencing reliability gaps at the end of the decade, the same time as one of the targets included in the bill.

Previous IPA analysis found that no baseload power station should be allowed to close unless and until a like for like baseload replacement, such as coal or nuclear, is ready to come online. For most operators, this will mean pushing out closure dates of gas and coal projects well beyond those promised in the rush to meet governments’ unrealistic plans for net zero and increased renewable energy. Enacting this, whilst also expanding baseload power sources, will help prevent the projected reliability gaps.

The lack of focus on energy security is most evident when analysing the creation of the Clean Economy Expert Panel, outlined in Part 4 of the bill. Clause 15(1) of the bill outlines the matters in which the minister may ask the panel for written advice about a range of listed matters relating to meeting emissions reduction targets. The list does not include matters such as reliability or overall energy security. Likewise, the relevant qualifications of the members of the Clean Economy Expert Panel, listed clause 16(2) of the bill, do not make reference to energy security, reliability, or affordability.

While the state has planned to introduce two pumped hydro projects, Pioneer-Burdekin and Borumba Dam, to replace coal fired power stations, the IPA has reservations about the medium-term viability of the projects. The state government has yet to complete financial, engineering, or environmental investigations on the proposed Pioneer-Burdekin Pumped Hydro project and may not do so until after the 2024 state election. This is concerning as similar projects such as Snowy Hydro in New South Wales have experienced cost blowouts and delays. Additionally, both the proposed projects require the construction of at least seven dam structures each over the next decade. The state's ability to build multiple dam structures in the next ten years should not be assumed, given Queensland has not constructed a dam in the last 13 years. Instead of pursuing the speculative and potentially expensive pumped hydro projects, the state government should invest in upgrading existing coal power station infrastructure, which has proven capable of providing baseload and affordable energy for Queenslanders.

Recommendations

1. The bill should be rejected.

2. The policy of net zero emissions by 2050 should be abandoned.

3. The Queensland state government should legislate that no baseload power station, such as Callide Power Station, can be closed down unless and until there is a like for like baseload replacement ready, such as coal or gas.

Enclosed IPA research

Net Zero Jobs: An Analysis of the Employment Consequences of a Net Zero Target in Australia (February 2021)

Australia's Net Zero Energy Crisis: An analysis of the electricity price implications of net zero by 2050 (June 2022)

Liddell The Line In The Sand (May 2023)

An Analysis of the Employment Consequences of a Net Zero Target in Queensland (March 2024)

I wish to thank the committee for the opportunity to provide this submission. Please do not hesitate to contact me at [redacted] for further consultation or discussion.

Kind regards,

Saxon Davidson
Research Fellow

February 2021

NET ZERO JOBS

AN ANALYSIS OF THE EMPLOYMENT IMPACTS OF A NET ZERO EMISSIONS TARGET IN AUSTRALIA

Cian Hussey, Research Fellow
Daniel Wild, Director of Research

Institute of Public Affairs

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Introduction

Australia is facing increased international pressure to adopt a target of achieving net zero carbon equivalent emissions (CO_2-e) (hereafter referred to as emissions). With the election of President Joe Biden in the United States, who has re-committed to the Paris Agreement, this pressure will only increase in the lead up to the Glasgow Climate Change Conference in late 2021.

Adopting a net zero emissions target will come at great expense to Australians, who have already seen jobs destroyed and their electricity bills increase as a result of ill-conceived policies aimed at reducing emissions.

The 2019 election provided firm evidence that Australians reject the idea of risking jobs and economic prosperity for the sake of reducing emissions. The election was framed as the 'climate election' by the political left,[1] whose policies were rejected by the Australian people after they failed to give regard to the negative impact those policies would have on the economy and society.

Since 2019, the Coalition government has begun to shift its positioning on emissions. In January 2020, Prime Minister Scott Morrison refused to commit to a net zero emissions target, arguing that people who do so "make a glib promise about that and they can't look Australians in the eye and tell them what it will mean for their electricity prices, what it will mean for their jobs."[2] By early 2021, however, the Prime Minister conceded that the government's goal was to achieve net zero emissions, although there is yet to be a commitment to doing so by 2050.[3]

This report presents an analysis of the effects of a net zero emissions target on jobs. It is broken up into three sections.

The first section finds that a target of net zero emissions would impose significant and irreparable economic and social damage due to the infliction of mass job losses. This report estimates that up to 653,600 jobs would be directly put at risk from a net zero emissions target. This estimate does not include potential indirect job losses which could occur in related industries and the communities where at risk jobs are vital.

Potential job losses are concentrated, in order, in the agricultural sector (306,000 jobs), the primary metal and metal product manufacturing sector (74,100 jobs), the electricity supply sector (64,100 jobs), coal mining (62,000 jobs), and air and space transport sector (38,100 jobs).

1 Adam Morton, "The climate change election: where do the parties stand on the environment?," *The Guardian*, 12 May 2019, https://www.theguardian.com/australia-news/2019/may/12/the-climate-change-election-where-do-the-parties-stand-on-the-environment.

2 Andrew Tillett and Mark Ludlow, "No net zero emissions target if it hurts jobs: PM," *Australian Financial Review*, 20 January 2020, https://www.afr.com/politics/federal/no-net-zero-emissions-target-if-it-hurts-jobs-pm-20200120-p53t18.

3 Greg Brown, "Politics of carbon has ended, Scott Morrison declares," *The Australian*, 22 January 2021, https://www.theaustralian.com.au/nation/politics/politics-of-carbon-has-ended-scott-morrison-declares/news-story/fa662d7b2af40426f852b9f1c18946b8; Phillip Coorey, "PM inches closer to net zero by 2050," *Australian Financial Review*, 1 February 2021, https://www.afr.com/politics/federal/pm-inches-closer-to-net-zero-by-2050-20210201-p56ybg.

The second section provides an analysis of Commonwealth electoral divisions and ranks electorates by those which contain the most jobs put at risk from a net zero emissions target. This report finds that 17 of the top 20 electorates with jobs put at risk by a net zero emissions target are currently held by the Coalition government. Two (Hunter and Lyons) are held by the Labor Party and one is held by Katter's Australian Party (Kennedy). The top 10 seats with jobs at risk are all Coalition-held.

The Coalition is also over-represented in the bottom 20 electorates ranked by at risk jobs, holding a total of 12 seats. This reveals an underlying tension within the Coalition as it relates to their stance on a net zero emissions policy: the Coalition holds the majority of seats which are likely to suffer the most job losses as a result of a net zero emissions target, but it also holds the majority of seats which are least likely to suffer job losses as a result of such a target.

The final section outlines recent changes in the labour force, demonstrating that for each new renewable activity job created between 2009-10 and 2018-19, five manufacturing jobs were destroyed. Renewable activity jobs are those principally engaged in the production of renewable energy, or the design, construction or operation and maintenance of renewable energy infrastructure.[4] The majority of jobs created since the election of the Rudd government in 2007 have been in industries with high public sector employment, and the promise of new, green jobs to replace manufacturing ones has not materialised.

A net zero emissions target would destroy communities where there is a high reliance on relatively more energy-intensive jobs. Adopting such a target in the wake of the largest economic contraction and employment crisis in recent memory, caused by lockdowns implemented in response to COVID-19, would be devastating for Australian workers.

4 Australian Bureau of Statistics, "Employment in Renewable Energy Activities, Australia methodology," April 2020, https://www.abs.gov.au/methodologies/employment-renewable-energy-activities-australia-methodology/2018-19.

Jobs put at risk by net zero emissions target

This report uses data from the *National Greenhouse Gas Inventory by Economic Sector* report published by the Department of Industry, Science, Energy and Resources, along with industry employment data from the Australian Bureau of Statistics, to estimate how many jobs would be placed at risk from a net zero emissions target.

A net zero emissions target will have the greatest impact on jobs that are relatively more energy intensive. As such, 'at risk' jobs are calculated as the total number of jobs in industries where emissions per job are above the economy-wide average of 0.22 kt CO_2. There are 10 industries in Australia where emissions per job are higher than this average, and the jobs in these industries are deemed at risk.

The industries where jobs would be placed at risk by a net zero emissions target are: agriculture; forestry and logging; coal mining; oil and gas extraction; petroleum and coal product manufacturing; non-metallic mineral product manufacturing; primary metal and metal product manufacturing; electricity supply; waste collection, treatment and disposal services; and air and space transport.

Agriculture refers to the growing and cultivation of horticultural and other crops, along with the controlled breeding, raising, or farming of animals. A typical worker in this industry could be employed as a beef cattle or dairy farmer.

Forestry and logging includes logging native or plantation forests, including felling, cutting, and roughly chopping logs into products such as railway sleepers or posts. Also includes cutting trees and scrubs for firewood. A typical worker in this industry could be employed cutting or felling trees.

Coal mining refers to the extraction of coal, and includes underground and open cut mining, along with operations related to mining activities (such as crushing, screening, washing). A typical worker in this industry could be employed as an excavator operator on a coal mine.

Oil and gas extraction refers to producing crude oil, natural gas or condensate through the extraction of oil and gas deposits. This includes activities such as natural gas extraction, petroleum gas extraction, and oil shale mining. A typical worker in this industry could be employed as a drill rig operator on an oil rig.

Petroleum and coal product manufacturing refers to transforming crude petroleum and coal into intermediate and end products, for example petroleum refineries, asphalt paving mixture and block manufacturing, and petroleum lubricating oil and grease manufacturing. A typical worker in this industry could be employed as a mechanical technician in a petroleum refinery.

Non-metallic mineral product manufacturing includes the manufacturing of glass, ceramic, cement, lime, plaster, and other non-metallic mineral products. A typical worker in this industry could be employed as a cement crusher operator in a cement manufacturing plant.

Primary metal and metal product manufacturing includes activities such as iron smelting and steel manufacturing, copper, silver, lead, and zinc smelting and refining, and aluminium smelting. A typical worker in this industry could be employed as a steel cutter in a steel manufacturing plant.

Electricity supply includes electricity generation, transmission, distribution, on selling electricity, and electricity market operation. A typical worker in this industry could be employed as a lineworker maintaining power lines.

Waste collection, treatment and disposal services includes the collection, treatment and disposal of solid, liquid, and other waste types, including hazardous waste; this includes landfills, combustors, incinerators, and compost dumps, but does not include sewage treatment facilities. A typical worker in this industry could be employed as a garbage truck driver.

Air and space transport includes air freight and passenger transport services, along with aircraft charter, lease or rentals with crew. A typical worker in this industry could be employed as a flight attendant.

Table 1 below shows the total number of people employed in each of these industries, and therefore how many jobs are placed at risk by a net zero emissions target.[5] Together, these industries are responsible for 78.3% of total emissions,[6] and employ 653,600 Australians. A list of all industries and the emissions per job is shown in Table 2.

Table 1: Industries with above average emissions per job

Industry	Jobs at risk
Agriculture	306,200
Primary Metal and Metal Product Manufacturing	74,100
Electricity Supply	64,100
Coal Mining	62,000
Air and Space Transport	38,100
Waste Collection, Treatment and Disposal	37,800
Oil and Gas Extraction	32,400
Non-Metallic Mineral Product Manufacturing	28,900
Petroleum and Coal Product Manufacturing	6,300
Forestry and Logging	3,800
Total	653,600

Source: IPA, ABS.

Note: Numbers may not add to the total due to rounding.

5 Australian Bureau of Statistics, "Labour Force, Australia, Detailed, December 2020," January 2021, https://www.abs.gov.au/statistics/labour/employment-and-unemployment/labour-force-australia-detailed/dec-2020.

6 Department of Industry, Science, Energy and Resources, "National Greenhouse Gas Inventory by Economic Sector: 2018," Australian Government, May 2020, https://www.industry.gov.au/data-and-publications/national-greenhouse-gas-inventory-by-economic-sector-2018.

Table 2: Average emissions per job by industry

Industry	Emissions per job (kt CO_2)
Electricity Supply	2.7205251
Oil and Gas Extraction	1.4474496
Petroleum and Coal Product Manufacturing	0.772735
Coal Mining	0.5702873
Forestry and Logging	0.3472612
Non-Metallic Mineral Product Manufacturing	0.3464191
Primary Metal and Metal Product Manufacturing	0.3440861
Agriculture	0.338292
Waste Collection, Treatment and Disposal Services	0.2595126
Air and Space Transport	0.2369107
AVERAGE	0.22
Gas Supply	0.1624972
Chemical, Polymer and Rubber Product Manufacturing	0.1321899
Aquaculture	0.1020797
Rail Transport	0.0786029
Metal Ore & Non-Metallic Mineral Mining & Quarrying	0.0751363
Water Supply, Sewerage and Drainage Services	0.0729917
Fishing, Hunting and Trapping	0.0556844
Road Transport	0.0474011
Other Transport, Services, Postal and Storage	0.0301497
Food Product, Beverage and Tobacco Product Manufact.	0.0189193
Agriculture, Forestry and Fishing Support Services	0.0144851
Wood, Pulp, Paper and Printing	0.0134398
Textile, Leather, Clothing and Footwear Manufacturing	0.0129719
Fabricated Metal Product Manufacturing	0.0119534
Heavy and Civil Engineering Construction	0.011543
Construction Services	0.0104959
Information Media and Telecommunications	0.0060873
Administration, Public Administration and Services	0.00592
Building Construction	0.0032787
Wholesale and Retail Trade	0.0024282
Finance, Insurance, Rental, Hiring and Real Estate	0.0024063
Transport and Machinery Equipment Manufacturing	0.0022129
Other Services	0.0018086
Accomm., Food Services, Education and Health Services	0.0010584
Professional, Scientific and Technical Services	0.0008304
Furniture and Other Manufacturing	0.0005159
Arts and Recreation Services	-0.0034578

Source: IPA, ABS, Department of Industry, Science, Energy and Resources.

Note: This is the most granular breakdown of emissions data by industry/sub-industry available from the Department of Industry, Science, Energy and Resources. As such, not all industries are at the same ANZSIC classification level.

Electoral analysis of at risk jobs

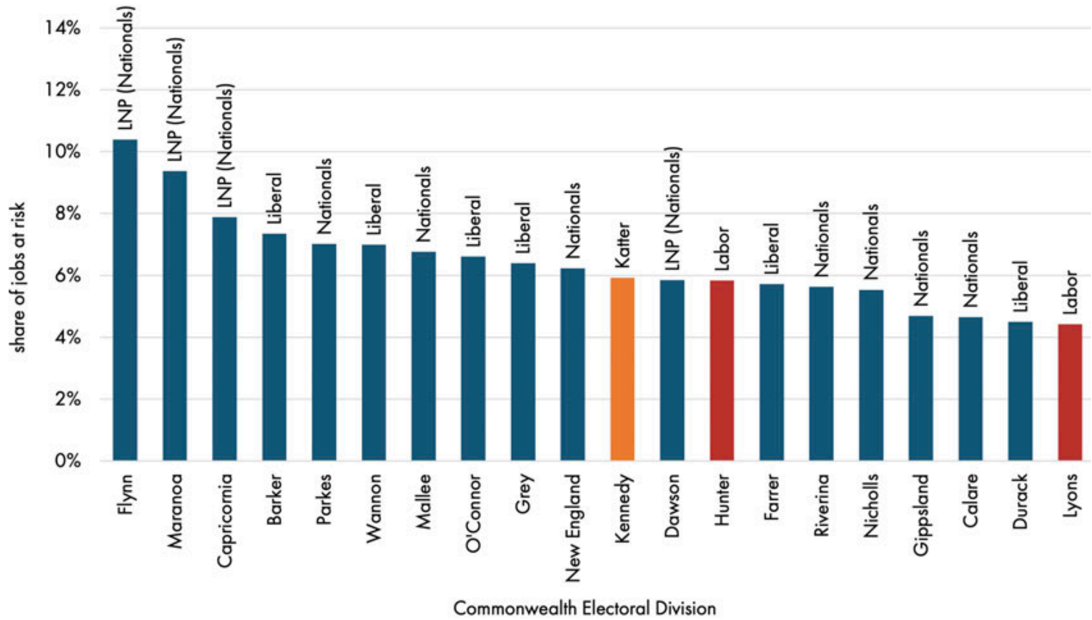
While the 653,600 jobs placed at risk by a net zero emissions target should be concerning for all members of parliament, the burden of these job losses will not fall equally across electorates.

Chart 1 below shows the top 20 electorates ranked by the share of jobs in that electorate which are placed at risk by a net zero emissions target. For example, in Flynn, 10.4% of all employment is in at-risk industries.

Strikingly, 17 of the 20 electorates are Coalition seats, held either by the Liberal Party (Barker, Wannon, O'Connor, Grey, Farrer, Durack), the National Party (Flynn, Parkes, Mallee, New England, Riverina, Nicholls, Gippsland, and Calare), or the Liberal National Party (Maranoa, Capricornia, and Dawson). Only two seats are held by the Labor Party (Hunter and Lyons), and the final seat is held by Katter's Australian Party (Kennedy). All of the top 10 electorates are held by a Coalition party, and while the Coalition have ten electorates where more than 6% of all jobs are at risk, Labor have none. Of these top 10 electorates, six are currently held by the Nationals Party Room. Additionally, 73% of the seats in federal parliament held by the Nationals are 'at risk' seats, compared with just 10% of seats held by the Liberals, and 3% of seats held by the Labor Party.

Of these 20 electorates, six are in New South Wales, five are in Queensland, four are in Victoria, there are two each in South Australia and Western Australia, and one in Tasmania.

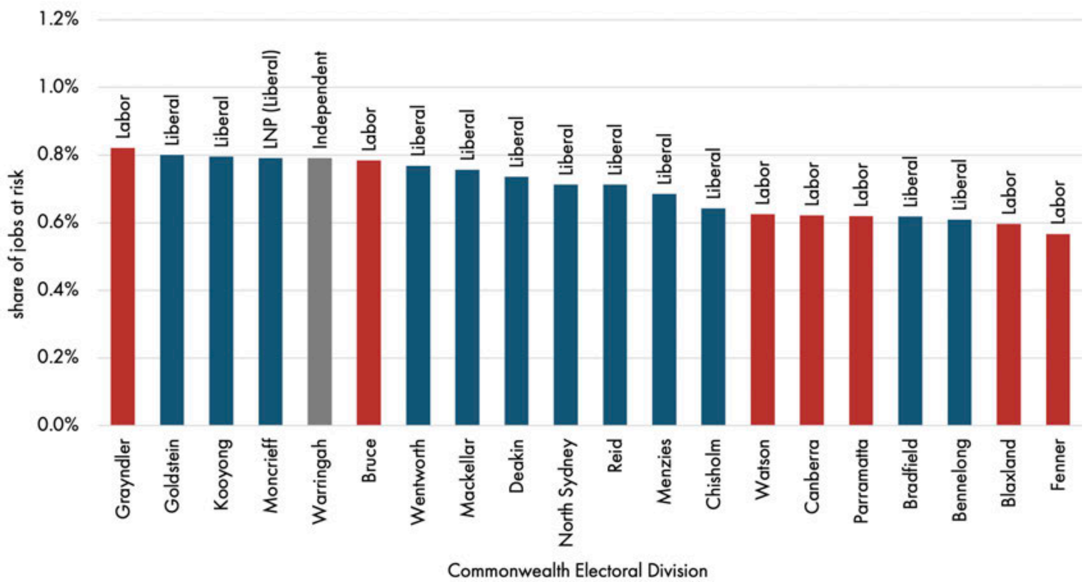
Chart 1: Top 20 electorates with jobs at risk



Source: IPA, ABS.

While the Coalition dominates the top 20 electorates ranked by at risk jobs, it is also over-represented in the bottom 20 electorates ranked by at risk jobs, as shown in Chart 2 below. Of these electorates, 12 are Coalition (Goldstein, Kooyong, Moncrieff, Wentworth, Mackellar, Deakin, North Sydney, Reid, Menzies, Chisholm, Bradfield, and Bennelong), seven are Labor (Grayndler, Bruce, Watson, Canberra, Parramatta, Blaxland, and Fenner), and one is independent (Warringah). This reveals an underlying tension within the Coalition as it relates to emissions reduction policies: the Coalition holds the majority of the seats which are likely to suffer the most job losses as a result of a net zero emissions target, but it also holds the majority of seats which are least likely to suffer job losses as a result of such a target.

Chart 2: Bottom 20 electorates with jobs at risk



Source: IPA, ABS.

‘Green’ jobs have not offset destruction of manufacturing jobs

Workers are often assured that their livelihoods will not be put at risk by a net zero emissions target because, while such a target will destroy jobs, this will be offset by the creation of new jobs in renewable and related industries. The effort to reduce emissions to date, however, has seen relatively few jobs created in ‘renewable activities’, as measured by the Australian Bureau of Statistics and shown in Chart 3 below. Renewable activity jobs are those principally engaged in the production of renewable energy, or the design, construction or operation and maintenance of renewable energy infrastructure.[7]

There are two key concerns with the effect that a net zero emissions target will have on jobs.

Firstly, while some jobs may be created by renewable energy activities and other emission reduction efforts, many of these jobs will not go to those who lose their jobs in the agricultural, manufacturing, and other at-risk industries. According to the *Clean Jobs Plan* set out by the Climate Council, for example, 70% of the 76,000 jobs estimated to be created under the plan are in construction and administrative services. Additionally, one-third of the jobs require minimal training, which means they are low-skill and therefore likely low-paying.[8]

Secondly, these new job creations are unlikely to outweigh the job losses seen in at risk industries. There are a range of estimates for how many jobs could be created by a net zero emissions target, however these fail to consider the negative effect such a target would have on the industries identified in this report. For example, the Australian Greens’ *Jobs Plan* taken to the 2019 federal election states that 179,770 jobs could be created under their “renewable energy future” policy.[9] Another estimate, found in Beyond Zero Emissions’ *The Million Jobs Plan* claims that 207,100 ongoing jobs could be created by investing in a low-carbon economy.[10] Even if all these jobs were created under a net zero emissions target, they would not outweigh the significant job losses likely to occur in at risk industries.

Past experience shows that while the push for emissions reduction may create some jobs, such as in renewable activities, these will not be enough to offset job losses in other, more energy-intensive industries. Between 2009-10 and 2018-19 employment

7 Australian Bureau of Statistics, “Employment in Renewable Energy Activities, Australia methodology,” April 2020, https://www.abs.gov.au/methodologies/employment-renewable-energy-activities-australia-methodology/2018-19.

8 AlphaBeta, “Clean Jobs Plan,” Climate Council, July 2020, https://www.climatecouncil.org.au/wp-content/uploads/2020/07/Climate-Council_AlphaBeta-Clean-Jobs-Plan-200720.pdf.

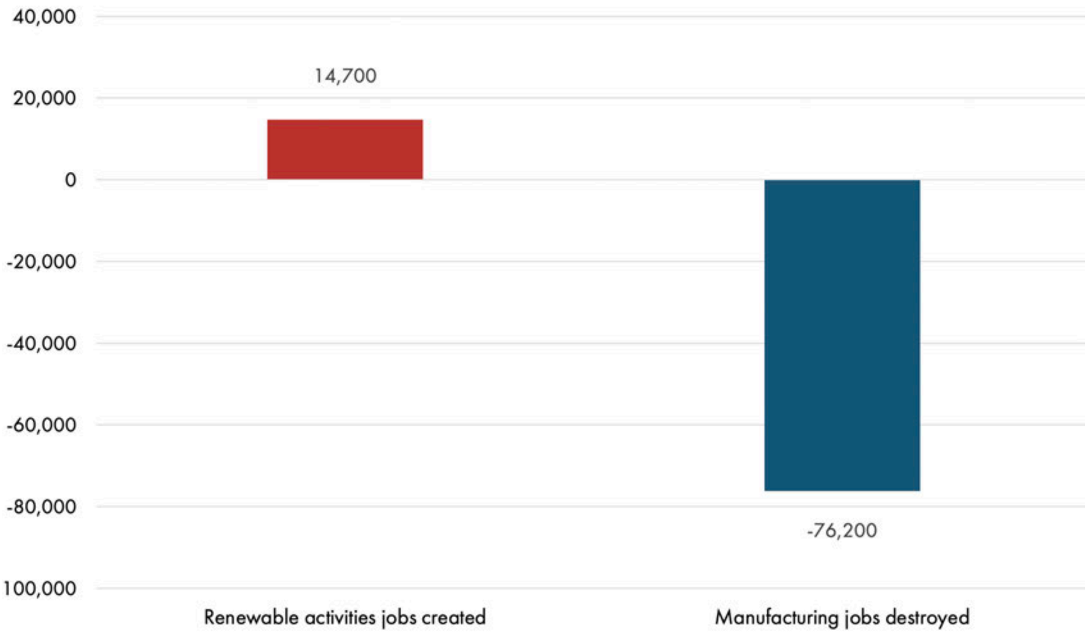
9 The Australian Greens, “Creating the Jobs of the Future: The Greens’ Jobs Plan, Election 2019,” https://greens.org.au/sites/default/files/2019-05/Greens%202019%20Policy%20Platform%20-Creating%20the%20jobs%20of%20the%20future.pdf.

10 Beyond Zero Emissions, “The Million Jobs Plan,” June 2020, https://bze.org.au/wp-content/uploads/2020/11/BZE-The-Million-Jobs-Plan-Full-Report-2020.pdf.

in renewable activities increased by 14,700, but 76,200 manufacturing jobs were destroyed.[11] This means that for every job created in renewable activities over this time, five manufacturing jobs were lost. The period 2009-10 to 2018-19 is used as that is the entire time series available from the Australian Bureau of Statistics.

It is also worth noting that many of the estimates of jobs created under a net zero emissions target would be created directly through government policy and taxpayer support. This indicates that the share of the workforce directly reliant on private sector workers would increase, requiring either higher taxes or fewer government services elsewhere to fund them. By contrast, the industries placed at risk by a net zero emissions target tend to have very high levels of private sector employment, suggesting that these workers are vital contributors to the taxation pool which funds the public sector. For example, 99.6% of jobs in the agriculture, forestry and fishing industry are in the private sector, 100% of mining jobs are in the private sector, and 99.7% of manufacturing jobs are in the private sector.[12]

Chart 3: Job changes between 2009-10 and 2018-19



Source: IPA, ABS.

11 Australian Bureau of Statistics, "Employment in Renewable Energy Activities, Australia, 2018-19 Financial Year," April 2020, https://www.abs.gov.au/statistics/labour/employment-and-unemployment/employment-renewable-energy-activities-australia/2018-19; Australian Bureau of Statistics, "Labour Force, Australia, Detailed, December 2020," January 2021, https://www.abs.gov.au/statistics/labour/employment-and-unemployment/labour-force-australia-detailed/dec-2020.

12 Ibid.

Conclusion

The 2019 federal election delivered a clear message to Australia's political class: mainstream Australians care about their livelihoods and are not willing to risk losing their jobs in pursuit of economically and socially devastating emissions reduction policies.

Despite the clear, democratic mandate to maintain a relatively less-destructive emissions policy, the federal government has changed course since its re-election.

In January 2020 Prime Minister Scott Morrison refused to commit to a net zero emissions target, arguing that people who do so "make a glib promise about that and they can't look Australians in the eye and tell them what it will mean for their electricity prices, what it will mean for their jobs."[13]

One year later, the Prime Minister said that the government's "goal is to reach net zero emissions as soon as possible, and preferably by 2050."[14]

Adopting such a target would be devastating for the Australians whose livelihoods will be placed at risk.

As this report has outlined, a net zero emissions target will directly place up to 653,600 jobs at risk. This does not account for indirect job losses as a result of reduced economic activity.

These job losses would place an enormous strain on mainstream Australians, and as outlined in this report, the electorates which will suffer most are disproportionately held by Coalition parties. At the same time, the majority of the seats which are least likely to suffer job losses as a result of a net zero emissions target are also held by the Coalition, which reveals an internal tension within the government.

It is also unlikely that jobs lost as a result of a net zero emissions target will be replaced by 'green' jobs. As this report highlights, between 2009-10 and 2018-19, five manufacturing jobs were destroyed for each renewable activity job created.

A net zero emissions target would destroy communities where there is a high reliance on relatively more energy-intensive jobs. Adopting such a target in the wake of the largest economic contraction and employment crisis in recent memory, caused by COVID-19 and resulting lockdowns, would be devastating for Australian workers.

13 Andrew Tillett and Mark Ludlow, "No net zero emissions target if it hurts jobs: PM," *Australian Financial Review*, 20 January 2020, https://www.afr.com/politics/federal/no-net-zero-emissions-target-if-it-hurts-jobs-pm-20200120-p53t18.

14 Phillip Coorey, "PM inches closer to net zero by 2050," *Australian Financial Review*, 1 February 2021, https://www.afr.com/politics/federal/pm-inches-closer-to-net-zero-by-2050-20210201-p56ybg.

NET ZERO JOBS AN ANALYSIS OF THE EMPLOYMENT IMPACTS OF A NET ZERO EMISSIONS TARGET IN AUSTRALIA

About the Institute of Public Affairs

The Institute of Public Affairs is an independent, non-profit public policy think tank, dedicated to preserving and strengthening the foundations of economic and political freedom.

Since 1943, the IPA has been at the forefront of the political and policy debate, defining the contemporary political landscape.

The IPA is funded by individual memberships and subscriptions, as well as philanthropic and corporate donors.

The IPA supports the free market of ideas, the free flow of capital, a limited and efficient government, evidence-based public policy, the rule of law, and representative democracy. Throughout human history, these ideas have proven themselves to be the most dynamic, liberating and exciting. Our researchers apply these ideas to the public policy questions which matter today.

About the author

Cian Hussey joined the Institute of Public Affairs as a Research Associate in 2019. He is interested in the impacts of red tape on small businesses and the broader economy. His work at the IPA focuses on using RegData Australia to quantitatively analyse the impacts of regulation. He has published a number of opinion pieces in The Australian, The Daily Telegraph, The West Australian, The Spectator, and regularly appears on Sky News. Cian received a Bachelor of Arts from The University of Notre Dame Australia, majoring in Politics and International Relations.

Daniel Wild is the Director of Research at the Institute of Public Affairs. He specialises in red tape, regulation, economic policy, the philosophy of free enterprise, and criminal justice. Daniel has authored research papers on economic policy, environmental regulation, and criminal justice reform. Daniel frequently appears in the media, and has published a number of opinion pieces in The Australian, The Daily Telegraph, The Sydney Morning Herald, The Courier Mail, and The Spectator. Daniel has also made a number of radio and television appearances, including on 2GB, 3AW, Sky News, and Channel 7 News. Daniel previously worked at the Commonwealth Department of the Prime Minister and Cabinet where he analysed global and domestic macroeconomic policy. Prior to that he worked at the Commonwealth Department of Finance where he worked on regulatory reform. Daniel holds an honours qualification in economics and a degree in international studies from the University of Adelaide.

Institute of Public Affairs

AUSTRALIA'S NET ZERO ENERGY CRISIS

AN ANALYSIS OF THE ELECTRICITY PRICE IMPLICATIONS OF NET ZERO EMISSIONS BY 2050

June 2022

Dr Kevin You, Research Fellow
Daniel Wild, Director of Research

Institute of Public Affairs

Contents

Introduction

The policy of net zero emissions by 2050 presents a significant risk to job growth, economic development, and Australia's energy reliability and affordability.

In April, the Institute of Public Affairs published a landmark study, *The Economic and Employment Consequences of Net Zero Emissions by 2050*, which identifies that to reach net zero emissions by 2050, at a minimum, all 89 coal, gas and oil projects currently in the construction pipeline must be cancelled. It was estimated that this could come at a cost of approximately $274 billion in lost economic output over the next decade and prevent the creation of approximately 478,000 jobs, the majority of which would be in regional Australia.

The significant economic and humanitarian consequences of the policy of net zero emissions by 2050 are already materialising. Net zero is directly responsible for "the rapidly changing conditions in the National Electricity Market" cited by Origin Energy as the reason for the early closure of the Eraring coal-fired power station,[1] Australia's largest electricity provider which is responsible for more than 20% of New South Wales' electricity production.[2]

A more recent report published by the IPA in May 2022, *The Employment Consequences of the Early Closure of the Eraring Power Station,* identifies that job losses from the early closure of Eraring are likely to be at least 40% higher than the originally expected 1,000-job lay-offs in the Hunter Valley region. Moreover, the overwhelming majority of jobs lost will be permanent, full-time, high-paying positions, which are characteristic of jobs in coal mines and coal-fired power generation facilities.

But the consequences of the closure of Eraring as well as the closures of other coal-fired generators will be more widespread.

Under the policy of net zero emission by 2050, six coal-fired power stations are set to close in Australia by 2030. The capacities of these six facilities account for close to half of the total coal-based capacity of the NEM. They also account for over 20 per cent of the total energy capacity of the NEM. The coal-fired power stations due to close are: Yallourn W, Eraring, Bayswater, Liddell, Vales Point B and Callide B.

The purpose of this report is to estimate the impacts that the closures of these six coal-fired power stations could have on wholesale and retail electricity prices by 2030.

To do this, the report undertakes a quantitative event analysis on the wholesale price implications of the closures of the ten coal-fired power generators decommissioned from 2010 to 2020. This is achieved by measuring the average national wholesale electricity price changes in the quarters immediately before and after the closures

1 Origin Energy (2022, February 17) *Origin proposes to accelerate exit from coal-fired generation,* Origin Energy, https://www.originenergy.com.au/about/investors-media/origin-proposes-to-accelerate-exit-from-coal-fired-generation/

2 Eraring is the largest coal-fired power station in Australia if Loy Yang A and Loy Yang B are counted as separate stations.

of the power stations. The results are then extrapolated to provide an estimate of the potential price impact of the closures of the six coal-fired power stations set for decomissioning by 2030. A detailed explanation of the methodology is provided in the body of the report.

Our research estimates that the closures of the six coal-fired generation facilities set to be decommissioned by 2030, in the absence of equivalent replacements in the electricity grid, could result in a 310% increase in wholesale electricity prices by 2030. Since the wholesale component makes up approximately one-third of retail electricity costs, this translates to a 103% increase in retail electricity prices.

This means that a typical Australian family will see its electricity bill more than double as a result of the closures of the six coal-fired power stations under the policy of net zero emissions by 2050.

The average annual electricity bill for a typical Australian family is approximately $1,600 per year, which is $400 per quarter. An increase of 103% translates into an average annual increase of $1,648, which would see the average annual electricity bill increase to approximately $3,248 per year which is $812 per quarter. The figures by states are as follows:

- Queensland families face the prospect of a 110% increase in retail electricity bills, rising from $1,200 to around $2,500 p.a.
- NSW families face the prospect of a 100% increase in retail electricity bills, rising from $1,300 to around $2,600 p.a.
- Victorian families face the prospect of a 95% increase in retail electricity bills, rising from $1,300 to around $2,500 p.a.
- South Australian families face the prospect of a 90% increase in retail electricity bills, rising from $1,700 to around $3,200 p.a.
- Tasmanian families face the prospect of a 125% increase in retail electricity bills, rising from $2,000 to around $4,500 p.a.

In Australia, the average disposable household income in the 2019/20 financial year was $1,124 per week[3] or $58,448 p.a. according to the Australian Bureau of Statistics. An annual bill of $3,248 or a quarterly bill of $812 will make up 5.6% of the average household disposable income, up from around 2.7% today.

3 Gross income minus tax, the Medicare levy and the Medicare levy surcharge, and equivalised for statistical purposes. Based on this, the non-equivalised figure for a family with one child under 15 was $2,023 and $2,360 for a family with two children under 15. The non-equivalised figure for a couple without any children was $1,686.

The price impact of decommissioning coal-fired power stations

Over the next decade, six coal-fired power stations are scheduled to be decommissioned: Yallourn W in Victoria; Liddell, Vales Point B, Bayswater and Eraring in NSW; and Callide B in Queensland. The combined capacity of these facilities is close to 11 GW and makes up 44% of the total installed capacity of coal-powered generation facilities in the NEM. It makes up 21% of the total capacity of the NEM.

Table 1: Coal-fired power stations scheduled for decommissioning by 2030

Generator	State	Exp Closure	Capacity
Liddell	NSW	2023	2000 MW
Eraring	NSW	2025	2880 MW
Yallourn W	Victoria	2028	1450 MW
Callide B	Queensland	2028	700 MW
Vales Point B	NSW	2029	1320 MW
Bayswater	NSW	2030	2640 MW

This study focuses on the impact that the closures will have on the average wholesale price of electricity,[4] changes to which will have a flow-on effect on retail prices affecting households.

To estimate the price impact of the closures of the six coal-fired power stations, we performed a quantitative event analysis on the wholesale price implications of the closures of the ten coal-fired power plants decommissioned between the years 2010 and 2020. The full list of all ten coal-fired power plants decommissioned since 2010 is presented in Table 2.

Specifically, we measured the change in the average national wholesale price of electricity in the quarter immediately prior to and in the quarter immediately following the decommissioning of each station or group of stations decommissioned in the same year.

As can be seen from Table 2, a number of coal-fired power stations closed at around the same time. This makes it difficult to attribute a price change to the closure of a given station. For this reason, we aggregate data arising from the closures of stations decommissioned in the same year. In each case where the data need to be aggregated, the pre-closure average price used as the basis of the price change calculation is the average nationwide price in the quarter immediately preceding the first plant closure of the year; the post-closure average price is the average nationwide price in the quarter immediately following the last plant closure of the year.

4 Average (nationwide) wholesale price is here defined as the average of wholesale spot prices (per MWh) in the states which participate in the NEM: Queensland, NSW, Victoria, South Australia and Tasmania.

The aggregate reduction in capacity for each year a plant was decommissioned is the sum of the capacities of the plants shut down within that calendar year. For example, the generation capacity removed from the NEM in 2012 was 1,280 MW, comprising of Munmorah's 600 MW capacity, Swanbank B's 500 MW capacity and Collinsville's 180 MW capacity.

Table 2: List of coal-fired power stations closed between 2010 and 2020

State	Station	Year of Commissioning	Date of Closure	Capacity
Queensland	Swanbank B	1970-1973	May 2012	500 MW
NSW	Munmorah	1969	Jul 2012	600 MW
Queensland	Collinsville	1968-1998	Dec 2012	180 MW
NSW	Redbank	2001	Aug 2014	143 MW
Victoria	Morwell	1958-1962	Aug 2014	189 MW
NSW	Wallerawang C	1976-1980	Nov 2014	1,000 MW
Victoria	Anglesea	1969	Aug 2015	160 MW
South Australia	Northern	1985	May 2016	546 MW
South Australia	Playford	1960	May 2016	240 MW
Victoria	Hazelwood	1964-1971	Mar 2017	1,760 MW

Source: Senate Environment and Communications References Committee - Retirement of coal fired power stations final report, 2017.

The reason that quarterly rather than annual price changes are analysed in this study is that the shorter-term analysis better enables the identification of the price impact of the closure of a specific coal-fired power station or group of stations. The limitation with an annual price change analysis is that one coal-fired power station is closed each year on average over the decade from 2010 to 2020. Thus, the annual price impact of a given decommissioning will be affected by the decommissioning of the next station.

Price changes following the decommissioning events are added up and subsequently divided by the total amount of coal-powered capacity removed between 2010 and 2020 to arrive at a figure indicating the price increase per MW capacity taken off the NEM. This figure is then multiplied by the amount of capacity to be removed from the NEM by 2030. Doing so provides an expected wholesale price increase associated with the upcoming closures.

Table 3: Price changes from coal-fired power station closures

Year	Station/s Closed	Capacity Removed	Pre-closure Quarter	Pre-closure Price/MWh	Post-closure Qtr	Post-closure Price/MWh	Δ Price
2012	Collinsville, Swanbank, Munmorah	1,280 MW	Q1 2012	$30	Q1 2013	$66	$36
2014	Redbank, Wallerawang, Morwell	1,332 MW	Q2 2014	$48	Q1 2015	$50	$2
2015	Anglesea	160 MW	Q2 2015	$37	Q4 2015	$54	$17
2016	Northern, Playford	786 MW	Q1 2016	$58	Q3 2016	$70	$12
2017	Hazelwood	1,760 MW	Q4 2016	$56	Q2 2017	$104	$48

Table 3 above outlines the price change before and after the decommissioning of a given coal-fired power station or group of coal-fired power stations.[5]

We find that for every MW of coal-generated capacity removed from the NEM over the period between 2010 and 2020, average wholesale prices on the NEM increased by approximately 2.2¢/MWh.

The next step is to apply this result to estimate the potential price changes resulting from the closures of coal-fired power stations scheduled for decommissioning in the next decade, which provides the result outlined in Table 4.

Table 4: Estimating the impact of coal-fired plant closures by 2030

Generator	State	Exp Closure	Capacity	Exp Δ Price/MWh	Exp %Δ Price*
Yallourn W	Victoria	2028	1450 MW	$31.9	41%
Eraring	NSW	2025	2880 MW	$63.4	81%
Bayswater	NSW	2030	2640 MW	$58.1	74%
Liddell	NSW	2023	2000 MW	$44.0	56%
Vales Point B	NSW	2029	1320 MW	$29.0	37%
Callide B	Queensland	2028	700 MW	$15.4	20%
Aggregated Total			10,990 MW	$241.8	310%

* Expected percentage change in price over the average wholesale spot price of electricity since the closure of Hazelwood.

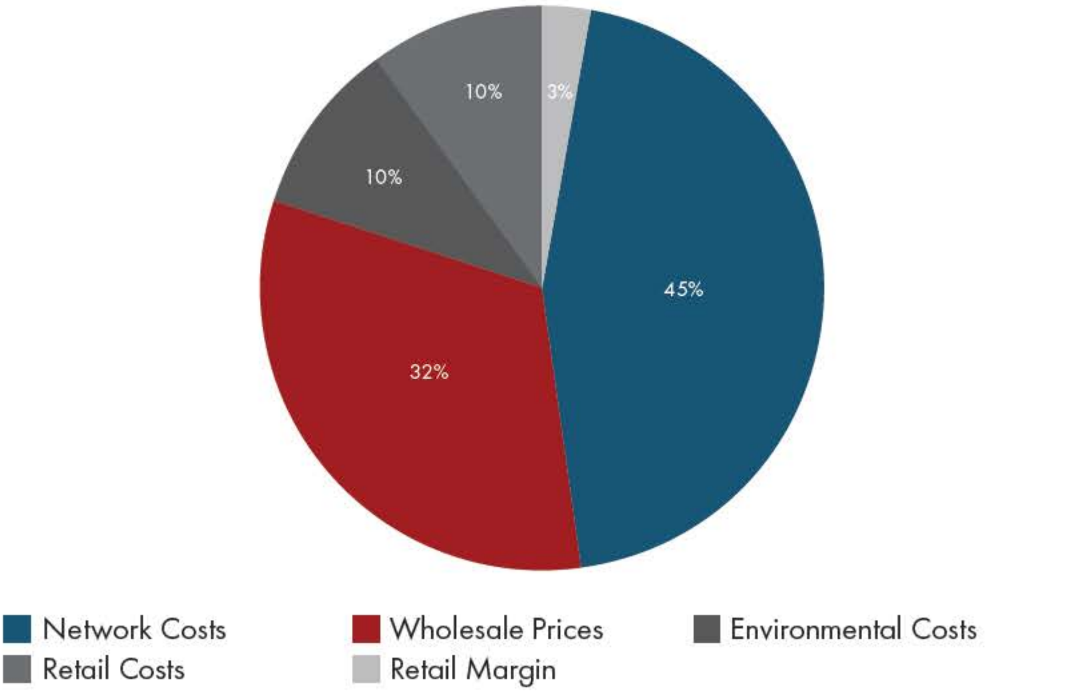
The point of comparison for the expected price increase is the average wholesale price in the five years following the closure of the Hazelwood coal-fired power station in the year 2017.

5 The Tasmanian component of the average national wholesale price of electricity in the first quarter of 2016 was normalised to control for the 2016 Tasmanian energy crisis, which resulted in unusual power disruptions and price increases.

The sum of the expected change in wholesale price, resulting from the decommissioning of the six coal-fired power stations at the centre of this study, is $242 per MWh. The average nationwide wholesale spot price over the post-Hazelwood years, between the third quarter of 2017 and the fourth quarter of 2021 (inclusive), was $78 per MWh. The estimated increase represents an increase of 310%.

The wholesale component of the cost of supplying electricity to households amounts to approximately a third, with the rest being made up of network maintenance costs, environmental and environmental compliance costs, retail operational costs and the retail margin.[6] An increase in the wholesale cost of electricity can therefore be expected to increase household electricity prices by 103%.

Graph 1: Components of retail electricity supply cost to households



Source: Australian Competition and Consumer Commission

The average annual price of electricity per household in the financial year ending June 2021 was approximately $1,600.[7] A 103% increase amounts to an increase of $1,648, which translates to an expected annual electricity bill of $3,248 per household.

State by state breakdown

- The sum of the expected change in wholesale price amounts to around a 330% increase in Queensland's average wholesale price for the relevant period. Queensland households face the prospect of a 110% increase in retail electricity bills, rising from $1,200 to around $2,500 p.a.

6 ACCC (2021, November 22), Inquiry into the National Electricity Market: November 2021 Report, Australian Competition and Consumer Commission.
7 AEMC (2021, November 25), Residential Electricity Price Trends, Australian Energy Market Commission.

- The sum of the expected change in wholesale price amounts to around a 300% increase in NSW's average wholesale price for the relevant period. NSW households face the prospect of a 100% increase in retail electricity bills, rising from $1,300 to around $2,600 p.a.
- The sum of the expected change in wholesale price amounts to around a 285% increase in Victoria's average wholesale price for the relevant period. Victorian households face the prospect of a 95% increase in retail electricity bills, rising from $1,300 to around $2,500 p.a.
- The sum of the expected change in wholesale price amounts to around a 280% increase in South Australia's average wholesale price for the relevant period. South Australian households face the prospect of a 90% increase in retail electricity bills, rising from $1,700 to around $3,200 p.a.
- The sum of the expected change in wholesale price amounts to around a 370% increase in Tasmania's average wholesale price for the relevant period. Tasmanian households face the prospect of a 125% increase in retail electricity bills, rising from $2,000 to around $4,500 p.a.

Conclusion

The closures of coal-fired power stations scheduled for decommissioning by 2030 will take 11 GW of generation capacity off the NEM, resulting in an expected price upsurge of 310% over the post-Hazelwood national wholesale spot price average. This is expected to increase retail electricity prices by approximately 103%.

In the absence of reliable and affordable replacement baseload power supply facilities in the next decade, consumers can expect to see more than a doubling in their electricity bills as a result of the closures.

The average annual price of electricity per household in the financial year ending June 2021 was around $1,600. A 103% increase amounts to an increase of $1,648, which translates to an expected annual electricity bill of $3,248 for the average household. The figures by states are as follows:

- Queensland families face the prospect of a 110% increase in retail electricity bills, rising from $1,200 to around $2,500 p.a.
- NSW families face the prospect of a 100% increase in retail electricity bills, rising from $1,300 to around $2,600 p.a.
- Victorian families face the prospect of a 95% increase in retail electricity bills, rising from $1,300 to around $2,500 p.a.
- South Australian families face the prospect of a 90% increase in retail electricity bills, rising from $1,700 to around $3,200 p.a.
- Tasmanian families face the prospect of a 125% increase in retail electricity bills, rising from $2,000 to around $4,500 p.a.

Australia's average disposable household income in the 2019/20 financial year was $1,124 per week or $58,448 p.a. according to the ABS. An annual bill of $3,248 or a quarterly bill of $812 will make up 5.6% of the average household disposable income, up from around 2.7% today.

The electricity cost relief promised by an increasing uptake in renewable sources of energy has never come to fruition. Prices are continuing to climb and this, combined with the reliability gap arising from the ongoing pressure faced by the decommissioning of reliable and affordable power stations, is putting unwelcomed additional pressure on Australian households.

AUSTRALIA'S NET ZERO ENERGY CRISIS: AN ANALYSIS OF THE ELECTRICITY PRICE IMPLICATIONS OF NET ZERO EMISSIONS BY 2050

About the Institute of Public Affairs

The Institute of Public Affairs is an independent, non-profit public policy think tank, dedicated to preserving and strengthening the foundations of economic and political freedom. Since 1943, the IPA has been at the forefront of the political and policy debate, defining the contemporary political landscape.

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Dr Kevin You is a research fellow at the IPA. His background is in the fields of political economy, industrial relations and organisational studies. Prior to joining the IPA, Kevin worked in academia - both as a teacher and research associate. His articles have been published in such periodicals as the Review of Social Economy, Journal of Industrial Relations, Journal of Global Responsibility, Labour and Industry, and International Journal of Employment Studies.

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Daniel frequently appears in the media and has published a number of opinion pieces in The Australian, The Daily Telegraph, The Sydney Morning Herald, The Courier Mail and The Spectator. Daniel has also made a number of radio and television appearances, including on 2GB, 3AW, Sky News and Channel 7 News.

Daniel previously worked at the Commonwealth Department of the Prime Minister and Cabinet where he analysed global and domestic macroeconomic policy. Prior to that he worked at the Commonwealth Department of Finance where he worked on regulatory reform.

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Institute of Public Affairs

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LIDDELL THE LINE IN THE SAND

WHY IT'S TIME TO HIT PAUSE ON THE CLOSURE OF COAL-FIRED BASELOAD POWER STATIONS IN THE NEM

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Kevin You, Research Fellow

Institute of Public Affairs

Cover Image: Mark Baker, AP

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Executive Summary

With the recent closure of Liddell Power Station, the electricity system is on a knife's edge. It is time for energy policy makers to take stock – and focus on energy security – before it is too late.

Australia can continue down the path of closing what have been reliable low-cost baseload power stations without adequate replacements being available.

Or it can do what should be obvious to all elected officials – keep the lights on while building new power stations that are able to meet the real-world energy needs of Australian households and industry.

This IPA Research Paper demonstrates that energy security has been given insufficient attention by energy policy makers. It should in fact be the priority of all governments. We can no longer afford the luxury of pretending otherwise.

The recent announcement by Origin Energy's new owner, Canadian private equity fund Brookfield, that it is prepared to entertain discussions about keeping open Eraring power station (Australia's largest baseload plant) rather than closing it in 2025, should be welcomed by the New South Wales government.

At the very least, this is a victory for the real world over ideologically driven theoretical energy-market models that promise a high level of certainty while failing to explain why power prices and the risk of blackouts keep increasing.

While previous closures of baseload plants in New South Wales and South Australia were effectively offset by the shutdown of energy intensive aluminium smelters in New South Wales and Victoria, and by the shutdown of the car industry, Hazelwood's closure in May 2017 provided an insight into what awaits Australia.

Wholesale prices jumped more than 70 per cent compared with the previous year. Over the following three years, the average wholesale electricity price was 135 per cent higher than the average over the previous decade. All the while, threats to system reliability became more acute.

Yet, between 2011 and 2021, wind turbine capacity in Australia increased more than 320 per cent to 8,951 MW. Solar capacity increased 672 per cent to more than 19,000 MW.

To put this in context, Hazelwood power station produced 1,600 MW.

But what is occurring in Australia has already been tried, and has failed, elsewhere. Germany and California offer sobering lessons for Australia on the risks of moving towards a high level of dependence on renewable energy.

Germany's electricity costs 50 per cent more than France, yet produces 8 times the CO_2 emissions. Californian households now pay 66 per cent more compared with the rest of the US.

But unlike Germany and California, Australia cannot rely on electricity supplies from neighbours. As an electricity system that is literally an island, the proportion of variable renewable energy in the energy grid, at 21.7 per cent (in 2021), already makes Australia the world leader by that measure.

The Albanese government's push to increase renewable energy to 82 per cent by 2030 will only result in higher prices and lower reliability. No feasible or affordable combination of intermittent renewables, batteries, pumped hydro and grid extensions can substitute for the reliable and affordable power provided by the proven technology of existing baseload power stations.

The strains on the system will be made worse by the push to electrify everything, especially motor vehicles and industrial processes like steel smelting and minerals processing. Electricity demand is set to increase significantly. Critical international lessons have been ignored by Australian policy makers.

While Australia and other developed countries off-shored their energy intensive manufacturing to China, India and South East Asia, this was achieved by large-scale investment in new coal and gas fired power stations.

This explains why worldwide generation of electricity using fossil fuels is actually rising. In 2021, wind and solar only contributed 10 per cent of global electricity supplies. Fossil fuels still generate more than 80 per cent.

Promised and widely promoted, the global energy transition is not happening at anywhere near the pace politicians and renewable advocates are suggesting.

The inconvenient truth is that no major industrialised country has successfully decarbonised its electricity sector through large-scale investment in renewable energy.

Yet against all the international evidence, Australian governments – federal and state – insist they can deliver lower electricity prices, while electrifying everything and keeping the lights on.

The continuing refusal of the Federal Government to consider nuclear energy as an option means that it has in effect placed a desire to promote renewable energy above the stated policy objective of reducing emissions. Given the confusion of such a stance, it is legitimate now to prioritise energy security as the overriding objective – providing a stable national electricity grid and removing the source of upward pressure on wholesale prices.

The IPA concludes that in New South Wales and across Australia more generally, it is time for elected officials to do their job and focus on energy security and affordability – keeping the lights on and ensuring the remaining fleet of baseload power stations continues to operate for as long as is necessary.

No baseload power station should be allowed to close unless and until a like for like baseload replacement – be it coal-fired or nuclear – is ready to come online. For most operators, this will mean pushing out closure dates well beyond those promised in the rush to meet the Federal Government's unrealistic plans for net zero and increased renewable energy.

Introduction

Australia, like all modern economies, relies on electricity to power its economy and provide the living standards its citizens have all come to enjoy.

For decades, our electricity networks and markets worked cohesively to supply the energy needs of Australian households and businesses. Demand increased in line with population and economic activity, but the electricity market attracted new investment when it was needed (though much of it was publicly funded).

The priority for policy makers was to ensure security of supply, including regulating regional monopolies on network infrastructure, and subsequently electricity price increases tended to be in line with inflation.

But Australians now face a different paradigm with regard to energy. The push for a zero carbon future has led to a surge in intermittent energy sources which while capable of providing energy, do not necessarily do so when it is needed or in a form compatible with the electricity system. This paradigm shift has upended the electricity market.

Australia is following the path taken by many other nations which have adopted the policy-led approach to renewable energy investment; but it is doing so blindly, and without properly assessing the likely outcomes of such an approach.

This IPA Research Paper examines international energy trends and the lessons to be learned from fellow OECD nations which have implemented energy policies similar to Australia's.

Unfortunately, the lessons are not positive and to date they have not been learned.

Among OECD nations, electricity and broader energy demand is stagnating. The policy-mandated pursuit of variable renewable energy has led to higher electricity prices, increased supply risks, falling consumption and less-competitive domestic local industry in most jurisdictions.

However, with the push to electrify everything, especially motor vehicles and industrial processes like steel smelting and minerals processing, electricity demand could increase significantly.

The experience of other energy markets, especially those which have pursued aggressive decarbonisation strategies like Germany and California, demonstrates the real-world consequences of higher prices and lower reliability when traditional energy sources such as baseload power stations are closed without adequate replacements being in place.

But unlike Germany and California, Australia cannot rely on electricity supplies from neighbours.

As an electricity system that is literally an island, the proportion of variable renewable energy in the energy grid, at 21.7 per cent (in 2021), already makes Australia the world leader by that measure.

This research paper examines the effect of successive closures of baseload power stations in New South Wales, South Australia and Victoria. Put simply, whatever spare capacity there was in the system has gone.

The closure of large energy users like the Kurri Kurri and Point Henry aluminium smelters over the past decade, along with the shutdown of the Australian automobile industry, mitigated the impact of power station closures.

In contrast, the closure of Hazelwood Power Station in 2017 gave a taste of what can happen when additional large baseload plants close. Wholesale power prices jumped more than 80 per cent, and the threats to system reliability became more acute.

The recent closure of Liddell Power Station has placed the system on a knife-edge.

It is not too late for Australia to learn from experience. We must not forgo energy security and expose our economy to the cascading effect of higher energy prices by forcing the early retirement of our dispatchable electricity generators.

The announcement that the new owners of Eraring Power Station – Australia's largest – are prepared to delay its previously announced closure in 2025 should be welcomed. Likewise, other power stations slated to close over the next decade should not be allowed to close until adequate replacement capacity is available.

But instead of acknowledging the central role fossil fuel baseload power stations play in providing low cost and reliable power, the Albanese government continues to maintain against all evidence that pursuing a renewable energy future (82 per cent by 2030) is not only achievable but will reduce energy costs.

All this at a time when government policy is simultaneously aiming to increase the use of electric vehicles, support greater electrification in households, and re-invest in energy intensive manufacturing.

The outcome of this wishful thinking is unlikely to be efficacious. And, as always, it will be Australian households and businesses that pay the cost – not the policy makers.

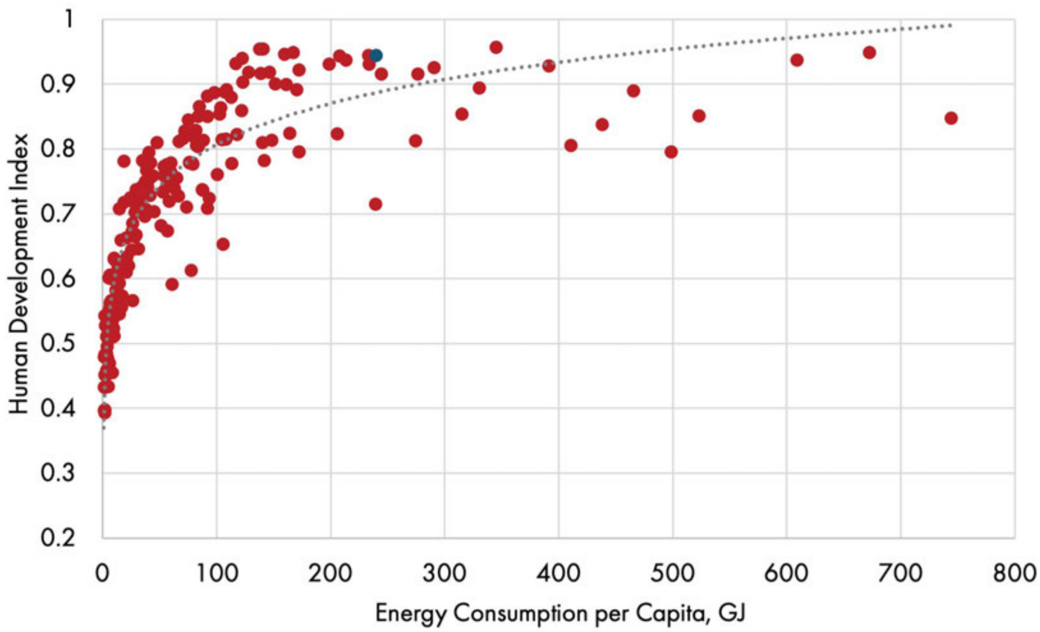
World electricity trends

The importance of energy

Energy is essential in a modern society and advanced economy such as Australia.

As shown below, countries with high levels of per capita energy consumption tend to rate higher on the United Nation's human development index. Rising energy consumption per capita produces significant gains in prosperity but, as with many economic variables, eventually diminishing returns set in. This point of diminishing returns may move further out in the future if increased autonomous manufacturing and advanced IT systems play an increasingly important role in a nation's economic development and prosperity.

Figure 1: The relationship between human development and energy consumption.



Source: United Nations Development Program, website; Our World In Data, website.

Electricity is just one form of energy, but an important one. Worldwide, it accounts for around a quarter of total energy consumed. Though usually unseen, and for the main part unappreciated until we don't have it, electricity is literally everywhere in our lives. It powers nearly all the things we use daily – the lights in our homes, our mobile devices, our televisions, refrigerators, air conditioning and cooking appliances.

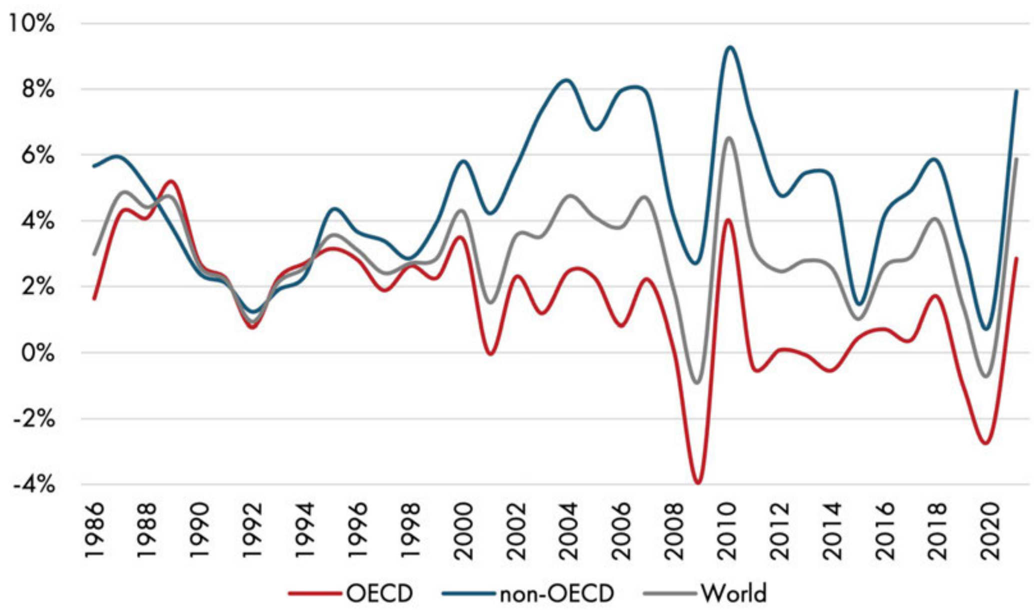
Without electricity, our economy as we know it would simply not function. Industries such as manufacturing, mining and healthcare all rely heavily on it. In particular, the IT industry depends heavily on electricity. The network of servers, data storage sites and computers that make up the internet, support the cloud and let us work from home are heavily energy-intensive and require an uninterrupted supply of electricity to function.

World electricity trends

While world electricity generation has been rising steadily in the 21st century, the distribution of this growth has been uneven. Total world electricity generation increased 83 per cent in the period 2000 to 2021, but the vast majority of this growth has been in non-OECD nations.

As can be seen in figure 2 below, at the macro-level OECD and non-OECD electricity generation growth tend to move together over time. However, since the start of the 21st century there has been a noticeable divergence between the two. Electricity generation growth in the non-OECD has been considerably higher than the OECD as a greater share of energy-intensive manufacturing has shifted to nations such as China, India and those in South-East Asia.

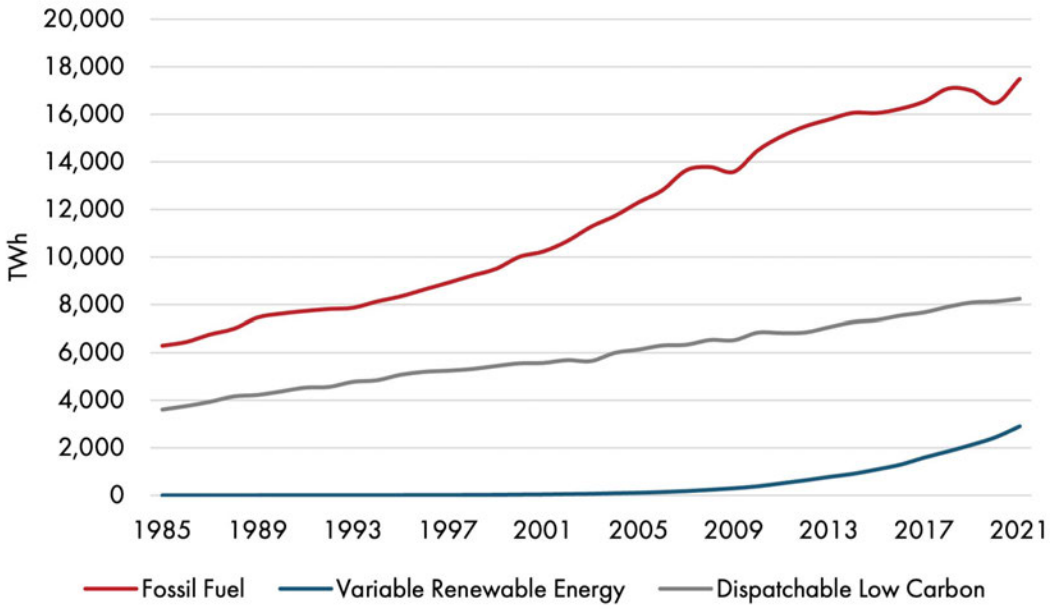
Figure 2: OECD and non-OECD electricity generation growth.



Source: BP, Statistical Review of World Energy.

There is another noticeable difference between OECD and non-OECD nations. Whereas OECD nations are making commitments to reducing their reliance on fossil fuels, non-OECD countries are consuming electricity sourced from coal, gas and oil at record and still rising levels. So much so that growth in coal and gas fired electricity in the non-OECD has more than offset any declines in the OECD in recent years.

Figure 3: Rising world use of fossil fuel-powered electricity.



Source: BP, Statistical Review of World Energy.

It may be an inconvenient truth, but world generation of electricity using fossil fuels is actually *rising* – even since the Paris Treaty was signed in 2015. With China, India and South-East Asian nations continuing to invest in new coal-fired power stations, this trend seems unlikely to change any time soon.[1]

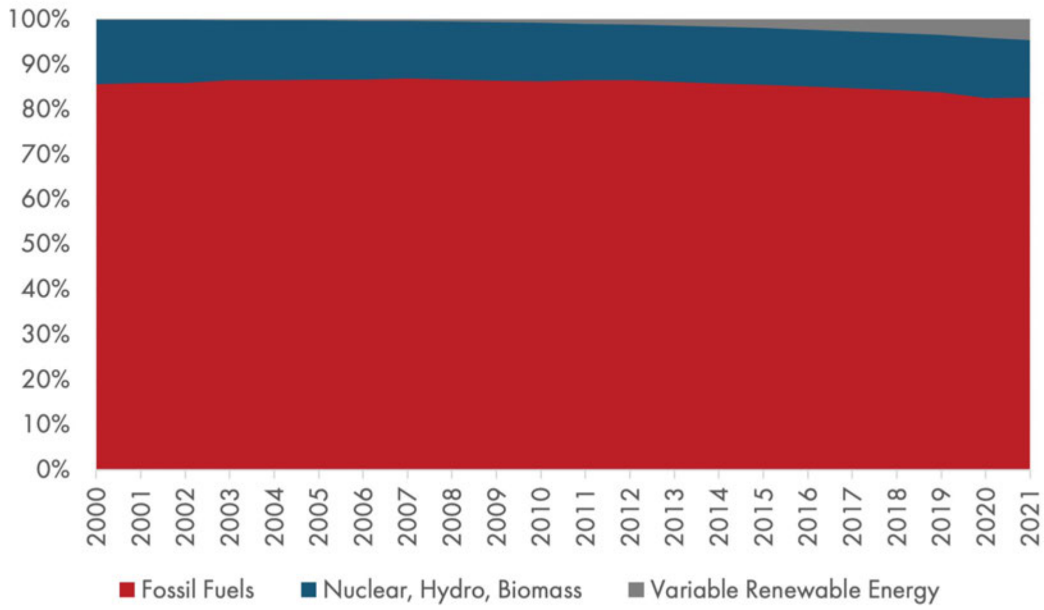
Despite billions of dollars of annual investment subsidies, Variable Renewable Energy (VRE), which includes solar, and wind generated electricity that is reliant on the weather and therefore not dispatchable, is not even growing at a rate that covers incremental annual increases in electricity demand – let alone offsets the effects of closing existing coal and gas fired power plants.

In 2021, electricity sourced from wind and solar accounted for 10 per cent of global electricity generation. When considered in the broader context of total energy use (that includes transportation fuels and industrial heat sources), VRE was just 4.6 per cent of total energy consumption in 2021 – up from 1 per cent in 2011.

The promised and widely promoted global energy transition is just not happening at anywhere near the pace politicians and renewable advocates are suggesting.

1 Bloomberg News, *China to Speed Up Construction of Coal Power Plants This Year*, Bloomberg, 20 January 2023.

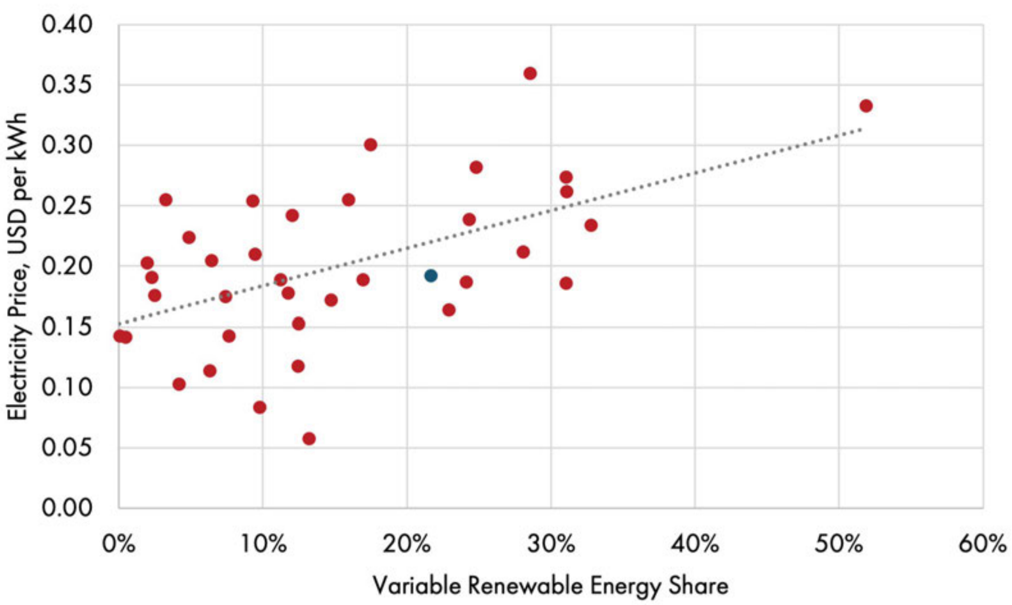
Figure 4: The global energy mix is far from shifting to 100 per cent variable renewable energy.



Source: BP, Statistical Review of World Energy 2022.

Policy makers in governments around the world, including Australia, need to become more realistic about what can and cannot be achieved with wind and solar energy. Moreover, there must be a greater focus on the economic impacts of the rapid deployment of VRE. The experience of OECD nations demonstrates definitively that replacing dispatchable electricity generators with VRE correlates closely with rising retail electricity prices, debunking the policy makers' promises that renewable energy is cheap.

Figure 5: Variable renewable energy correlates with higher electricity prices in OECD nations.



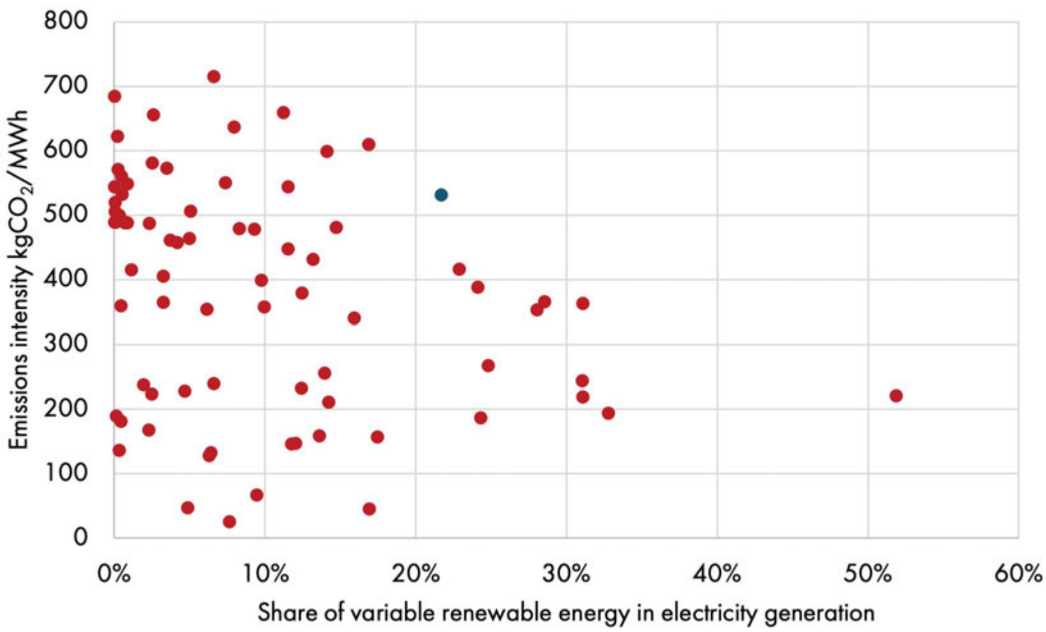
Sources: Australian Energy Council; BP.

The problem is not that the generation of electricity via a solar PV cell or wind turbine is expensive – indeed the shift to mass manufacturing of these items in China has delivered substantial cost reductions over the last decade. But prices are set by markets and not just the cost of equipment.

Markets dominated by VRE are regularly exposed to prolonged periods in which solar and wind generators produce well-below their theoretical maximum potential. Gaps in supply and the resulting tight market set electricity prices (usually delivered by the highest cost, but flexible sources of generation) at higher levels in order to reduce demand.

No major industrialised nation has yet successfully decarbonised its electricity sector through large-scale investment in renewable energy. In fact, nations with the lowest emissions intensity for electricity generation are those with high shares of nuclear, hydroelectricity and geothermal energy – all of which are dispatchable sources of electricity.

Figure 6: There is no correlation between variable renewable energy and electricity emissions.



Source: Our World In Data; BP, Statistical Review of World Energy 2022.

The experience of electricity markets that are closing down reliable, low-cost baseload generators has not been positive. The intended policy outcome of low carbon emissions is only being achieved in part, and many markets are experiencing a series of unintended consequences – higher electricity prices and reduced grid reliability (often culminating in energy shortages).

Germany and California provide telling examples of these unintended consequences.

Case Study 1: Germany's Energiewende – billions spent to be worse off

Germany's Energiewende policy has been held up as the wunderkind of the bold transition to renewable energy. But instead of being the inspiration for a global renewable energy movement, Germany serves as the perfect example of problematic policy-led energy systems.

The cracks in Germany's energy transition had started to appear long before Russia invaded Ukraine, causing a spike in gas prices. Experts at McKinsey reported on the progress of Energiewende in 2019:

> *Germany has been a leader in the transition toward a low-carbon-energy system, but it will still miss most of its energy-transition targets for 2020.*
>
> *...Today's necessary message is clear: the country misses key targets... problems are emerging in all three dimensions of the "energy triangle." These recent struggles in Germany illustrate the potential pitfalls of a fast energy transition, but they can provide important lessons for other countries endeavoring on their energy transition.*
>
> *On the core issue of environmental sustainability, the energy transition is lagging far behind its 2020 targets. In 2018, 866 million tons of CO_2 equivalents (CO_2e) in emissions were released. While this amount represents a 4.5 percent drop from the previous year, it was still 116 million tons above the target of 750 million tons for 2020.*
>
> ***Security of supply under pressure***
>
> *... Germany has enjoyed a highly secure electricity supply for decades, but the tide is beginning to turn. The German power grid repeatedly faced critical situations in June of this year: significant shortfalls in available power were detected on three separate days. At its peak, the gap between supply and demand reached six gigawatts—equivalent to the output of six major power plants. Imports arranged on short notice from surrounding countries were required to stabilize the grid. Also, the price for balancing energy jumped to €37,856 per megawatt-hour in one instance. In 2017, the price for balancing energy averaged €63.90 per megawatt-hour.*
>
> *....The supply situation will become even more challenging in the future. The phaseout of nuclear power until the end of 2022, and the planned reduction of coal-fired generation, will gradually shut down further secured capacity. If new generation facilities are not added, the reserve margin will tumble, with consequences that vary considerably from one region to the next. Industrial areas in western and southern Germany will be hit especially hard, as large drains on capacity exist in these regions and high rates of renewable expansion are unlikely there. Furthermore, the shift from dispatchable capacity to fluctuating renewable sources could also lead to problems in situations when demand is high but supply from renewable energy is low...*

Electricity costs remain high

> Economic development and growth have long constituted a problematic area for energy transition—especially when it comes to electricity-price development. For years, German consumers have paid more for their electricity than their European neighbors do. Today the electricity price for households is still about 45 percent above the European average.[2]

The risks forecast by McKinsey have not only been realised but accelerated by the Russian invasion of Ukraine. But, as distinguished American environmentalist and energy author Michael Shellenberger highlighted in 2022, this was still a situation created entirely by bad German energy policy:

> *Green campaigns have succeeded in destroying German energy independence—they call it Energiewende, or "energy turnaround"—by successfully selling policymakers on a peculiar version of environmentalism. It calls climate change a near-term apocalyptic threat to human survival while turning up its nose at the technologies that can help address climate change most and soonest: nuclear and natural gas.*
>
> *At the turn of the millennium, Germany's electricity was around 30 percent nuclear-powered. But Germany has been sacking its reliable, inexpensive nuclear plants.*
>
> *...Germany has also spent lavishly on weather-dependent renewables—to the tune of $36 billion a year—mainly solar panels and industrial wind turbines. But those have their problems. Solar panels have to go somewhere, and a solar plant in Europe needs 400 to 800 times more land than natural gas or nuclear plants to make the same amount of power. Farmland has to be cut apart to host solar. And solar energy is getting cheaper these days mainly because Europe's supply of solar panels is produced by slave labor in concentration camps as part of China's genocide against Uighur Muslims.*
>
> *The upshot here is that you can't spend enough on climate initiatives to fix things if you ignore nuclear and gas. Between 2015 and 2025, Germany's efforts to green its energy production will have cost $580 billion. Yet despite this enormous investment, German electricity still costs 50 percent more than nuclear-friendly France's, and generating it produces eight times more carbon emissions per unit. Plus, Germany is getting over a third of its energy from Russia.*
>
> *Germany has trapped itself. It could burn more coal and undermine its commitment to reducing carbon emissions. Or it could use more natural gas, which generates half the carbon emissions of coal, but at the cost of dependence on imported Russian gas. Berlin was faced with a choice between unleashing the wrath of Putin on neighboring countries or inviting the wrath of Greta Thunberg. They chose Putin.*[3]

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2 Fridolin Pflugmann, Ingmar Ritzenhofen, Fabian Stockhausen, and Thomas Vahlenkamp, *Germany's energy transition at a crossroads*, McKinsey website, 21 November 2019.

3 Michael Shellenberger, *The West's Green Energy Delusions Empowered Putin*, 4 March 2022.

Germany's energy policy has been an expensive exercise in replacing what worked with what people hoped would work. The outcome has been higher prices, reduced economic growth and increased risk to the nation's energy security.

As noted in a 2019 article in Der Spiegel, one outcome Energiewende has delivered is an increase in government waste:

> *In the Economics Ministry alone, 287 officials are working on the issue, divided into four divisions and 34 departments. There are at least 45 additional bodies at the federal and state levels, full of people who also want to move the project forward. They collect vast quantities of data and come up with complicated incentives -- a huge effort that has produced only modest results.*[4]

Case Study 2: California dreaming

American author and journalist Robert Bryce has written extensively on the energy policy failings of the state of California. The state has followed Germany down a path of setting renewable energy mandates that force the closure of large baseload generators – nuclear power plants in their case.

The results have been similar to those in Germany – less reliable supply, higher prices and minimal environmental benefit:

> *Perhaps the most obvious casualty of California's climate policies is the state's tattered electric grid. Blackouts in the state have become so common, particularly in the Bay Area, that media outlets have largely quit reporting on them. Nearly every day, maps of Pacific Gas & Electric's service territory show outages across wide swaths of central California. The state's increased blackouts are coinciding with skyrocketing electricity prices. And those skyrocketing electricity prices are coinciding with the implementation of some of America's most-aggressive renewable-energy mandates.*
>
> *In 2008, Governor Arnold Schwarzenegger signed an executive order that required the state's utilities to obtain a third of the electricity they sell from renewables by 2020. In 2015, Governor Jerry Brown signed a law that boosted the mandate to 50 percent by 2030. In 2018, California lawmakers imposed yet another mandate that requires the state's electric utilities to procure at least 60 percent of their electricity from renewables by 2030 and to be producing 100 percent "zero-carbon" electricity by 2045.*
>
> *What has happened since The Terminator signed that executive order? Between 2008 and 2021, the all-sector price of electricity in California increased five times faster than rates in the rest of the continental United States. Last year alone, the all-sector price of electricity in California jumped by 9.8 percent to 19.8 cents per kilowatt-hour. Residential prices increased even more, jumping by*

4 Frank Dohmen, Alexander Jung, Stefan Schultz und Gerald Traufetter, *German Failure on the Road to a Renewable Future*, Spiegel International website, 13 May 2019.

11.7 percent to an average of 22.8 cents per kilowatt-hour. California residential users are now paying about 66 percent more for electricity than homeowners in the rest of the US.[5]

Renewable energy has promised much, with multiple studies claiming solar and wind have the lowest cost of electricity generation of all possible sources. Nevertheless, the experience of energy markets around the world has shown otherwise. The promised price reductions do not occur, and there is a strong positive correlation between the share of intermittent electricity generation in a market and electricity prices..

Empirical studies of the impact of renewable energy on electricity prices are beginning to tell a different story from the forward-looking thought pieces that have to date dominated the political and economic landscape.

A 2020 paper by Michael Greenstone and Ishan Nath at the University of Chicago demonstrated that renewable energy mandates in the United States have caused retail electricity prices to be 11-17 per cent higher than they would otherwise have been. While these policies delivered carbon abatement, it came at a cost ranging from $60 to $300 per tonne of CO_2.[6]

The authors attributed this higher cost, which contradicts many of the theoretical findings on renewable energy deployment, to "indirect grid integration costs such as transmission and intermittency".

These are the very costs that have been broadly overlooked in the race to replace dispatchable generation with intermittent renewables. Yet, there have been studies warning of this emerging issue for some time.

The Nuclear Energy Agency first released its studies on the total system cost impacts of variable renewable energy in 2012 and provided an update in 2019. This study not only showed that there are additional costs associated with managing high shares of variable renewable energy but also that dispatchable energy sources become more costly due to the additional requirement to flex around the often policy-prioritised renewable energy sources:

Profile costs (or utilisation costs) refer to the increase in the generation cost of the overall electricity system in response to the variability of VRE output. They are thus at the heart of the notion of system effects. They capture, in particular, the fact that in most of the cases it is more expensive to provide the residual load in a system with VRE than in an equivalent system where VRE are replaced by dispatchable plants... the presence of VRE generation generally increases the variability of the residual load, which exhibits steeper and more frequent ramps. This causes an additional burden, also called the flexibility effect, to other dispatchable plants in terms of more start-ups and shutdowns, more frequent cycling and steeper ramping requirements, leading to lower levels of efficiency, an increase in the wear and tear of equipment and higher generation costs.[7]

5 Robert Bryce, *California's Energy War on the Poor*, Quillette, 11 July 2022.

6 M. Greenstone and I. Nath, *Do Renewable Portfolio Standards Deliver Cost-Effective Carbon Abatement?*, 2020, University of Chicago.

7 OECD Nuclear Energy Agency, The Costs of Decarbonisation: System Costs with High Shares of Nuclear and

While this report focused on striking a balance between nuclear energy and variable renewable energy, the lessons are relevant to any electricity grid undertaking a shift from large "baseload" generators to variable renewable energy-based systems. In their modelling of the system costs under scenarios based on increasing shares of variable renewable energy, the study found:

> *System costs vary between less than USD 10 per MWh of VRE for a share of 10% of wind and solar PV to more than USD 50 per MWh of VRE for a share of 75% of wind and solar PV. Almost as important is the increase of USD 28 per MWh of VRE to almost USD 50 per MWh of VRE, both at a share of 50% of wind and solar PV, as a function of the availability of flexibility in the system in the form of interconnections with neighbouring countries and flexible hydroelectric resources. While such estimates come with some degree of uncertainty, the order of magnitude provides clear indications for policy choices.*[8]

These system costs are only an additional cost to an existing system using dispatchable sources of electricity in a base case scenario. In the scenario with a high share of variable renewable energy the impact on total electricity provision costs is severe – yet consistent with the international experience:

> *Reaching a 75% VRE target finally implies almost doubling the costs for electricity provision to almost USD 70 billion per year, representing more than USD 33 billion above the base case.*[9]

Australia is on the path to this scenario – we are following Germany and California.

The federal Labor government's energy policy is directing an 82 per cent share for variable renewable energy in Australia by 2030. But the international experience and studies are now clear: closing down our existing dispatchable generators will lead to even higher electricity prices.

Renewables, 2019, p.16.

8 Ibid., p.20.

9 Ibid., p.21.

The Australian experience mirrors the rest of the OECD

More renewable energy = higher prices

Australia has long been considered the lucky country. When it comes to energy, we certainly are. We have abundant sources of energy and have been notably successful in using low cost electricity to grow the economy and improve the lives of our people over the last century.

Our electricity grids are marvels of modern engineering that often go unnoticed. The east coast National Electricity Market has over 40,000 kilometres of transmission lines connecting 65 gigawatts of generators to more than 10 million daily consumers.

It is remarkable that this complex network of individual customers and multiple suppliers can operate every second of every day within some remarkably narrow engineering parameters. At every moment, demand in the grid must be met almost exactly by generation. The tolerance of differences between the two is minimal.

Too much demand, and the drain on the grid would at best cause our lights to flicker and at worst go off altogether.

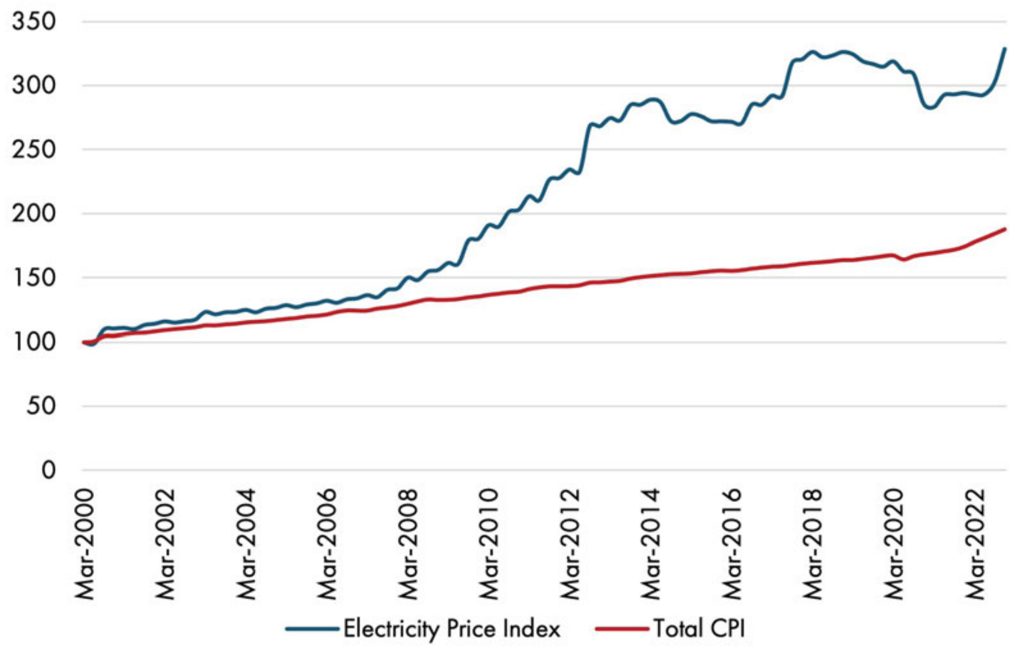
Too much supply can overload the grid, with the surge in electrical energy potentially damaging key infrastructure and maybe even the electrical appliances in our homes if appropriate safeguards are not in place.

This is the great strength of dispatchable and controllable energy in our electricity network. The system we built over a century was based on coal, gas and hydroelectricity generators that system operators and engineers had control over. Coupled with a well-designed market, the grid worked.

But in the last decade, something has gone awry in our electricity markets. The proven engineering and economic imperatives that once guided them have been supplanted by the wishful thinking of central policy makers.

As a result, our electricity prices have skyrocketed, with the electricity prices for households rising at more than double the rate of inflation.

Figure 7: Electricity has outstripped inflation in the calculation of CPI.



Source: Australian Bureau of Statistics.

Despite higher prices, there has been minimal investment in new reliable dispatchable sources of electricity. Instead, the lion's share of electricity investment has been directed towards variable renewable energy projects.

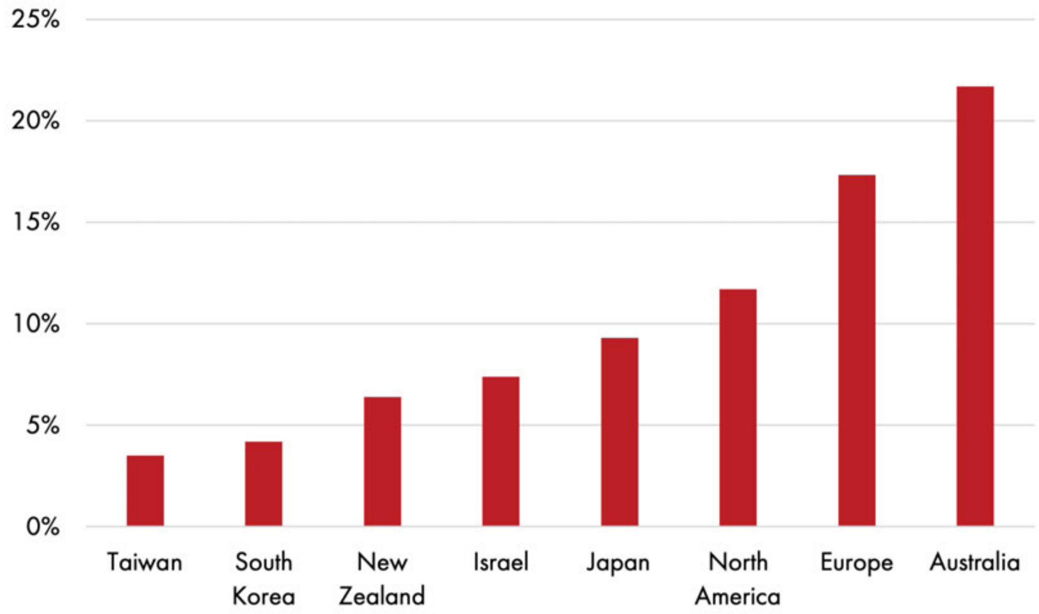
The extensive commentary about a decade of inaction in addressing climate change, and government holding back investment in renewables, could not be further from the truth. Renewable energy capacity and generation have surged in Australia.

From 2011 to 2021 wind turbine generating capacity increased 321 per cent to 8,951 megawatts. In the same period solar capacity, including both rooftop installation on houses and purpose-built solar farms, increased a staggering 672 per cent to 19,074 megawatts.

Australia is not a laggard in variable renewable energy – in fact for a nation with no imports or exports of electricity (often known as an 'islanded grid') we have the highest share of variable renewable energy generation in the world. When compared to the continental-scale electricity systems in Europe and North America, Australia's share of variable renewable energy is actually higher (see Figure 8).

Countries including Denmark, Germany and the UK all have higher individual shares, but their electricity grid connections to France, Norway and other European nations provide them with opportunities to import and export their intermittent energy sources and balance them with dispatchable nuclear and hydro energy when required.

Figure 8: Australia leads the world in variable renewable energy.



Source: BP, Statistical Review of World Energy 2022.

The issues for Australia relating to high variable renewable energy reliance are already starting to emerge. We simultaneously have low hydroelectric, nuclear and geothermal power while government policy is requiring our economy to lessen the carbon footprint of its electricity supplies.

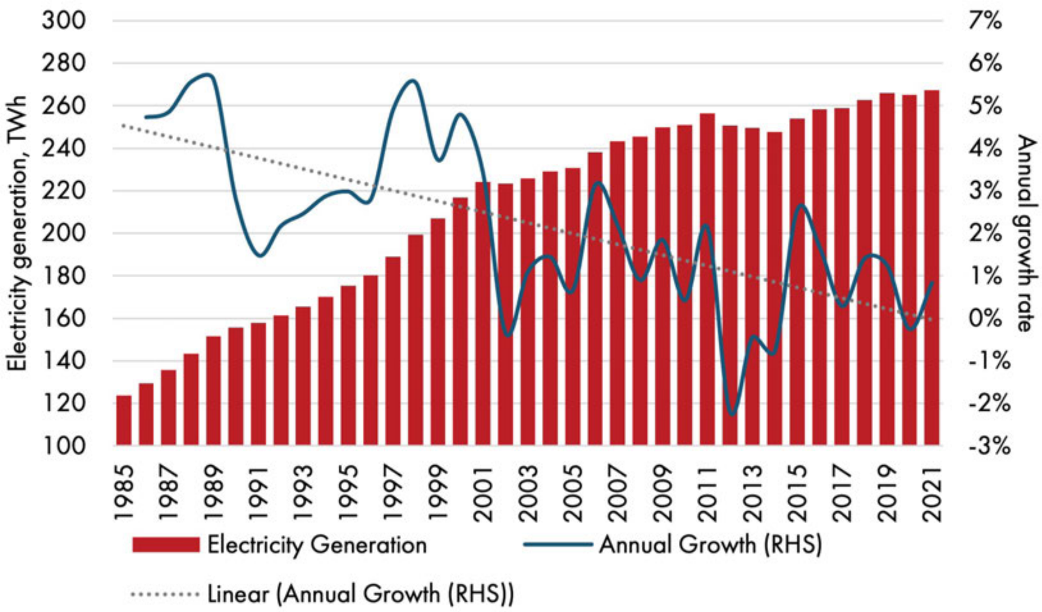
The result is consistent with the international experience – higher electricity prices. And unfortunately, we can expect more price rises to come if our existing dispatchable generators are rapidly closed to meet the government's mandated energy targets.

The impact of rising electricity prices

Higher electricity prices are weighing down the Australian economy and hurting households. Electricity consumption in Australia has barely changed since 2015-16 and has only grown at an annual average rate of 0.4 per cent in the last decade.[10]

Against a backdrop of rising population and a growing economy, this is not an indicator of a functioning energy market or prospering economy. The stagnant growth in electricity consumption is not the outcome of significant investment in energy efficiency, but rather a reflection of the decline in manufacturing activity in Australia which, since the GFC, has seen a 10 per cent decrease in Industry Gross Value Added.[11] In particular, Australia has experienced the closure of some of its most energy intensive businesses, such as aluminium smelting and car manufacturing.

Figure 9: Growth in Australia's electricity generation growth has plummeted.



Source: BP, Statistical Review of World Energy.

Worse still, on a per capita basis, both electricity consumption and total energy consumption in Australia peaked over 15 years ago and have been declining ever since.[12] If electricity consumption is an indicator of progress and economic development, this country is not on the path to prosperity.

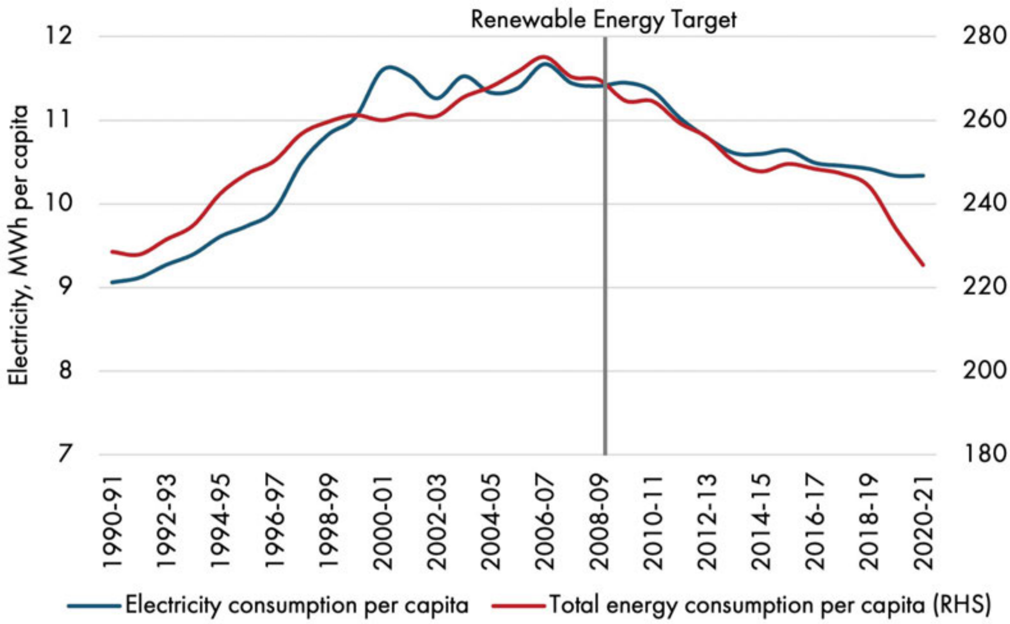
As can be seen in figure 10, it is also noticeable that the peak in Australia's per capita electricity and energy consumption coincided with the boosted Renewable Energy Target policy put in place by the Rudd government in 2007.

10 Department of Climate Change, Energy, the Environment and water, *Australian Energy Statistics*; BP, Statistical Review of World Energy 2022.

11 Australian Bureau of Statistics, *Australian System of National Accounts*, 2021-22 financial year, table 5.

12 Department of Climate Change, Energy, the Environment and Water, *Australian Energy Statistics*, Table B1.

Figure 10: The rise and decline in per capita electricity and energy consumption in Australia.



Source: Department of Climate Change, Energy, the Environment and Water, Australian Energy Statistics 2022.

What happened?

To paraphrase the distinguished American economist Thomas Sowell, when it comes to our electricity supplies, in Australia we have spent the last 20 years replacing what worked with what sounded good.

Whereas Australia previously had an electricity system based on dispatchable power sources including coal, gas and hydroelectricity, we have rapidly pivoted towards intermittent wind and solar energy sources.

In an attempt to decarbonise Australia's electricity system, policy makers across the country and at all levels of government took the nation down the same path several OECD nations have taken and mandated large increases in renewable energy sources (particularly wind and solar) at the expense of dispatchable sources – including the zero carbon nuclear energy.

Unfortunately, as previously highlighted, there have been few, if any, success stories in this space.

In Australia, the multitude of studies predicting lower costs of electricity arising from the mass deployment of variable renewable energy have often been compromised by assumptions that overlooked the strict operating parameters of the electricity grid. They ignored the total system cost approach in favour of a narrow focus on the cost of creating energy at a single site.

The much vaunted and publicised levelised cost of electricity (LCOE) that assesses the financial cost of an independent generating asset became the preferred metric of policy makers and politicians alike.

William Pentland of Genbright best described the misunderstanding and misuse of LCOE in a 2014 Forbes article:

> *The LCOE is like a bad line of code in a software program used to develop other software programs. It has dangerously skewed investors' understanding of the economics of generating electricity from renewable energy resources. It has also had perverse and difficult to undo impacts on local, state and federal energy policies.*[13]

This affect is more technically outlined in the 2021 book *Decarbonised Electricity – The Lowest Cost Path to Net Zero Emissions* by Australian energy experts Geoff Bongers, Andy Boston, Stephanie Bryom and Nathan Bongers, who summarised it superbly:

> *A major, albeit not publicly well-appreciated, risk of this transformation is that far-reaching and expensive decisions may be made – and may already have been made – on incorrect or misleading information flowing from conventional modelling approaches. Metrics widely in use at present, it is argued here, are simplistic and no longer appropriate for supporting key decision-making.*
>
> *...Changes in the market's mix of generation, plus the public and political focus on the need to maintain a fit-for purpose system, mean that cost comparison metrics used in the past have become less useful today.*[14]

Bongers et al consider an approach similar to the OECD Nuclear Energy Agency report on evaluating total system costs of the electricity grid to be a superior approach to simply identifying the stand-alone measurement of costs of an individual asset (such as a wind or solar farm):

> *A fundamental flaw in much of the existing modelling is the mindset that assesses the cost (to consumers) of deploying a particular generation technology independently of the grid in which it must be integrated, and that assesses the only useful output from the technology as electricity. This is of importance as the currently dominant approach to grid transition involves adding technologies that cannot be measured via levelised cost of energy (LCOE), such as synchronous condensers and battery storage.*
>
> *... LCOE, as a guide for policy, planning and development in the NEM, has significant shortcomings and in a diversifying system, its applicability has become increasingly limited. Critically, the use of LCOE in a market pursuing large-scale decarbonization can deliver very inaccurate and misleading signals for investors.*[15]

13 William Pentland, Levelized Cost Of Electricity: Renewable Energy's Ticking Time Bomb?, Forbes, 29 November 2014.

14 Geoff Bongers, Andy Boston, Stephanie Byrom & Nathan Bongers. Decarbonised Electricity. The Lowest Cost Path to Net Zero Emissions. Gamma Energy Technology P/L, Brisbane, Australia, February 2021.

15 Ibid., p.9.

It was only in 2022 that the CSIRO began to consider the total system cost in its flagship Gencost study. Even then the results seem to significantly underestimate the total system costs for integrating high levels of variable renewable energy in Australian electricity markets. Unfortunately, as William Pentland highlighted, there is often a contagion effect of using LCOE estimates. In Australia's case it is that the Australian Energy Market Operators grand visions for our future grid, the Integrated System Plan, draws heavily on the LCOE figures produced in the Gencost study.

Pro-renewable energy policy is delivering an electricity market that is coming under increasing stress – higher prices and supply that is unable to respond to market signals.

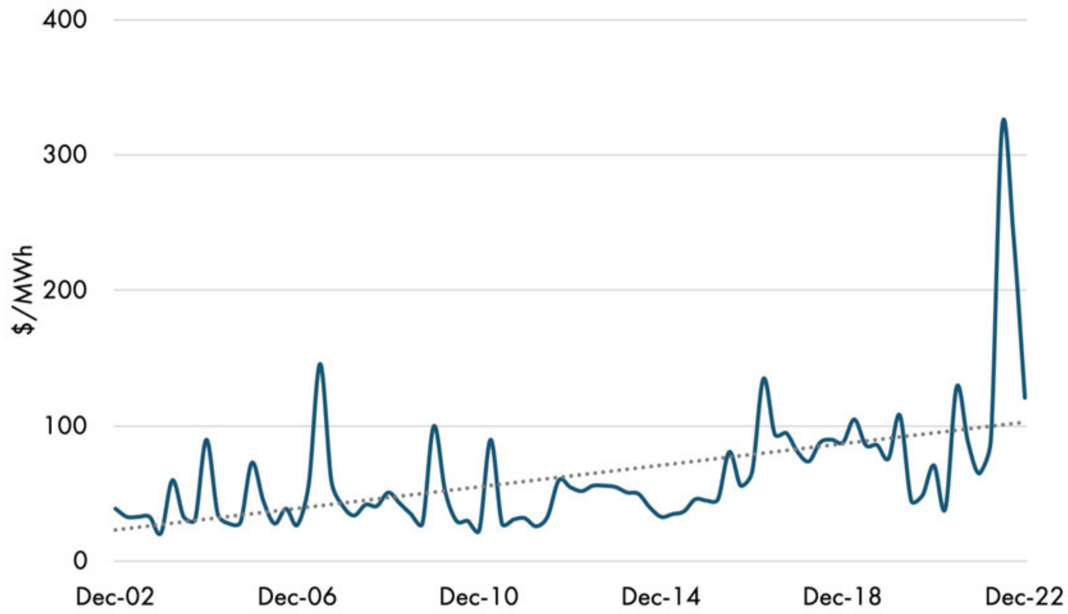
Despite the claims that renewable energy would reduce energy prices in Australia, we have seen the opposite. COVID-19 managed to moderate price hikes for a while due to the reduced demand for electricity in 2020 and 2021, but since the economy re-opened, demand has grown again and electricity prices are now rapidly rising. The trend of rising wholesale electricity prices across the NEM is captured in Figure 11.

In 2022 we glimpsed the future as disruptions at several power stations across eastern Australia removed nearly 8 gigawatts of dispatchable generators from the market during winter. As figure 11 also shows, the resulting price spike was extraordinary. Even though there is an abundance of renewable energy capacity, it was incapable of supplying the market at this time – winter is typically a low period for solar generation and wind droughts are common.

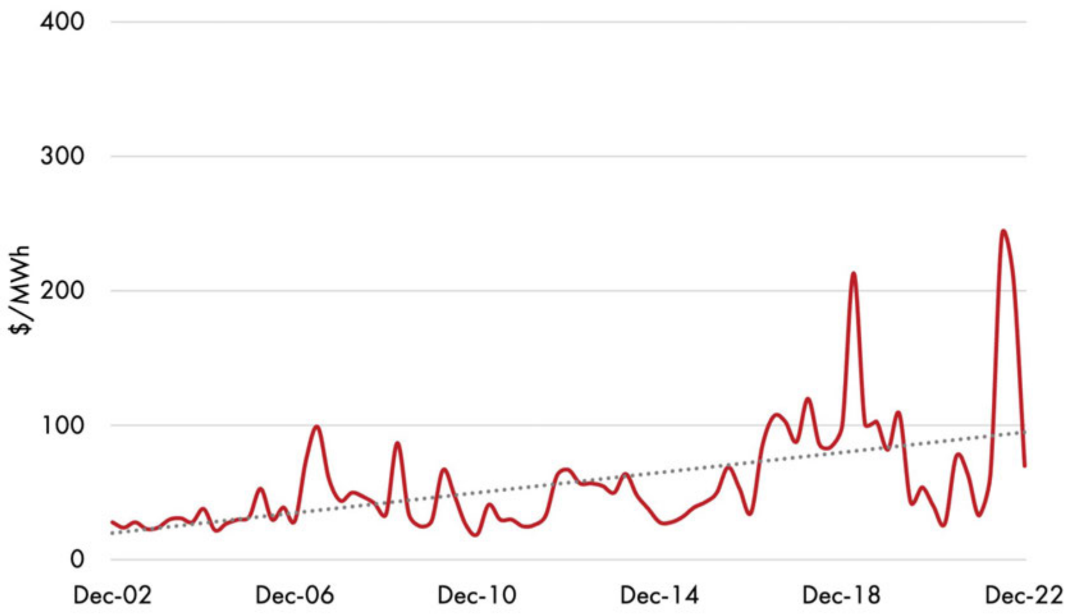
The resulting undersupply and lack of competition pushed wholesale electricity prices to historical highs in every state connected to the NEM, and eventually led the AER to take the extraordinary measure of suspending the market – albeit at a market price of $300 per MWh.

Figure 11: Rising wholesale electricity prices across the NEM.

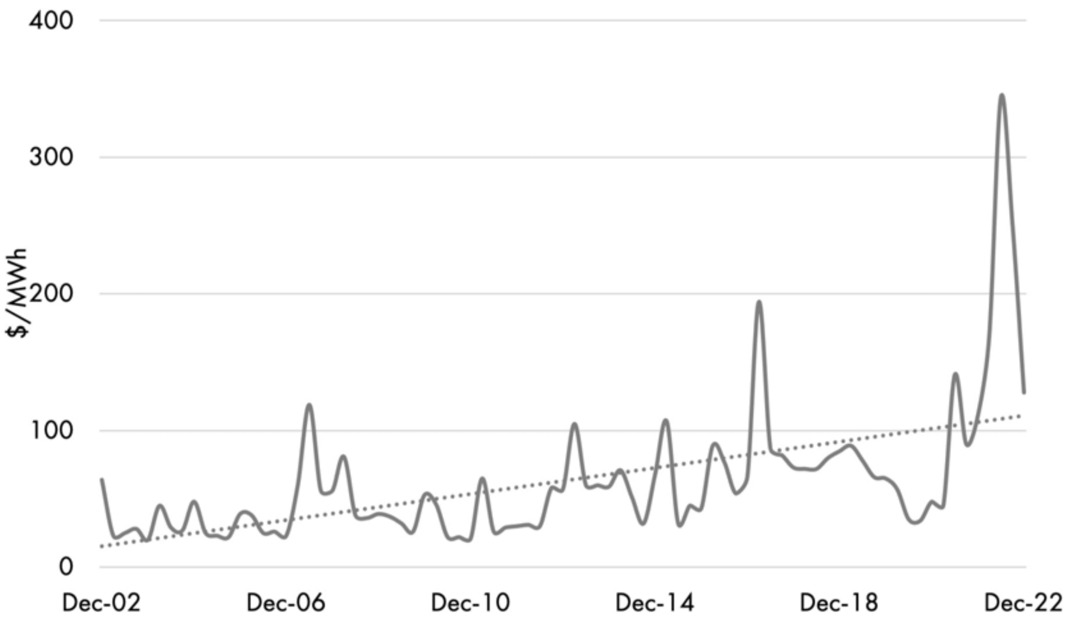
New South Wales



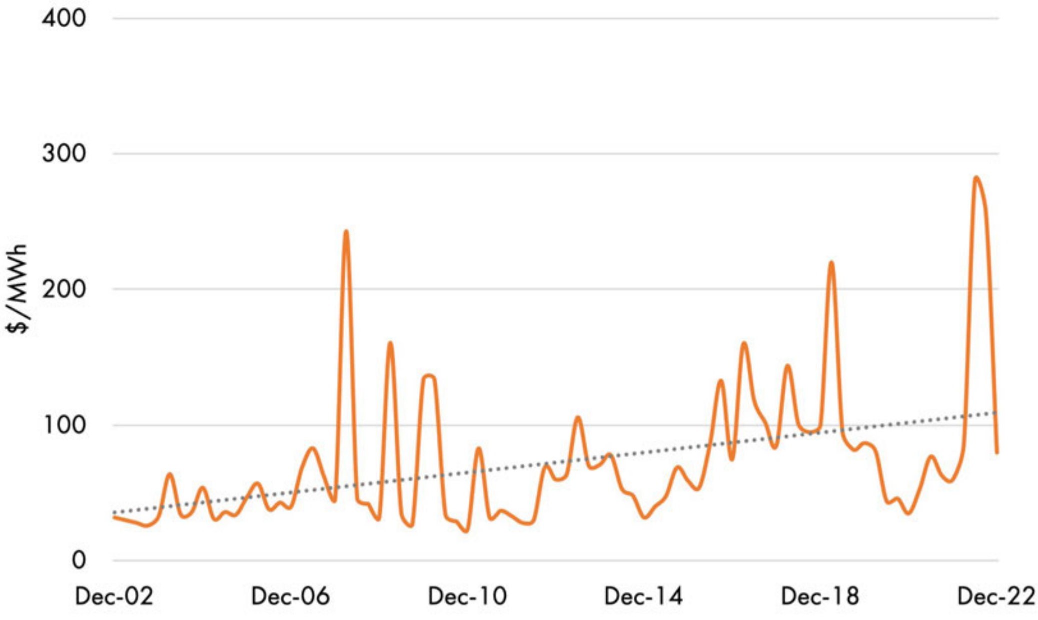
Victoria



Queensland



South Australia



Source: Australian Energy Regulator.

The outlook for Australia's electricity market

There is ample evidence of policy failure in overseas energy markets from which Australia can and should learn. But we can also see the impact of events playing out in our own energy markets. In the last decade around 4 gigawatts of dispatchable generator capacity have closed in Australia.

A review of these closures provides ample insight into the challenges the nation faces as it rushes to close more than 20 gigawatts of capacity by 2035.

Australia has been sleepwalking into the energy crisis for over a decade.

Part 1: Wallerawang and Munmorah power station closures

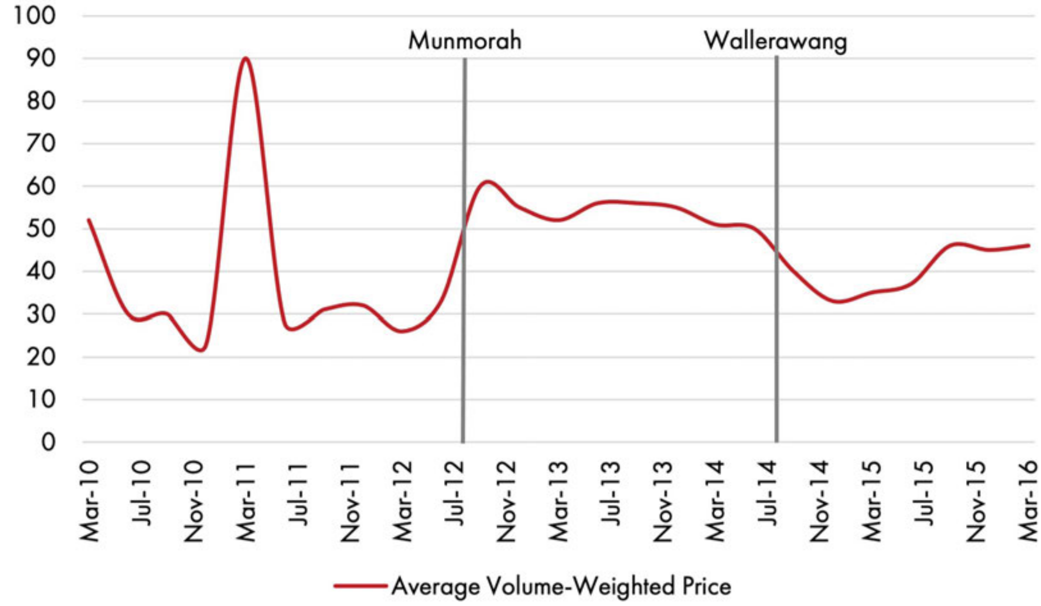
In a short space of time, the New South Wales electricity market experienced the closure of two power plants. Delta Electricity's Munmorah power station near Lake Macquarie shut down in 2012, just prior to the privatisation of Delta Electricity. This removed 1,400 megawatts of capacity from the market – although half of this capacity had already been mothballed since 2010.

Shortly after, Delta Electricity sold the Wallerawang power station to Energy Australia along with the nearby Mt Piper plant. In November 2014, the new owners permanently closed the Wallerawang asset down, removing another 1,000 megawatts of capacity from New South Wales' electricity market.

Faced with dwindling demand and increased competition from lower-cost electricity imports from Queensland, it was simply market forces at work that closed Munmorah and Wallerawang. New South Wales at the time had an oversupplied electricity market and no growth in demand.

The impact of the two power stations closures can be seen in Figure 12. Whereas Munmorah's closure tightened the electricity market and caused an immediate doubling of wholesale prices in New South Wales, Wallerawang's closure was accompanied by the closure of the Kurri Kurri aluminium smelter – one of the largest electricity consumers in the state. The subsequent drop in demand led electricity prices lower even with Wallerawang's closure.

Figure 12: New South Wales wholesale electricity prices after the closure of the Munmorah and Wallerawang power stations.



Source: Australian Energy Regulator

There have been no additional power station closures in New South Wales since Wallerawang shut down. Nevertheless, electricity supplied from its dispatchable coal and gas generators has decreased nearly 14 per cent, or 9,000 gigawatt hours, since then. This has been more than offset by variable renewable energy generation increasing by more than 11,000 gigawatt hours by 2021-22.

Despite the appearance of abundant electricity supply, this period again shows that the market conditions created by rising wind and solar energy generation do not deliver the promised lower prices. New South Wales' average wholesale electricity price increased by 170 per cent.

Part 2: Closing the last coal-fired power station in South Australia

Of all the states in Australia, South Australia is leading the charge to replicate Germany's energy policy. And it is experiencing similar challenges.

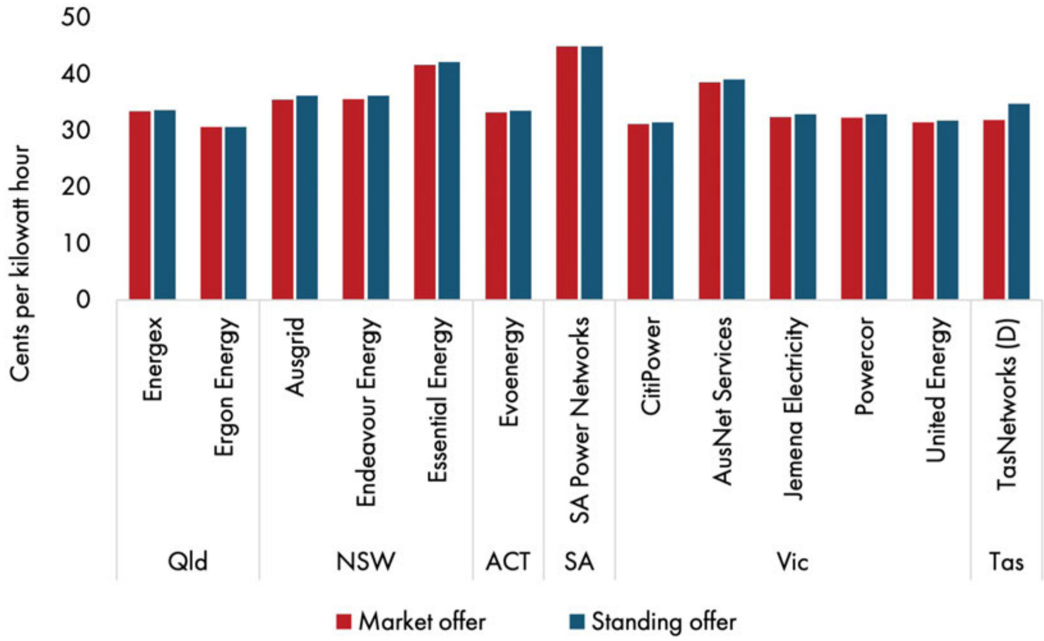
The Australian Capital Territory may claim to be powered by 100 per cent renewable energy, but this is mainly supported by a series of contractual arrangements it has with several wind farms in Victoria that offset its total electricity consumption.

The national capital is instead a small part of the New South Wales electricity market, which gets around 80 per cent of its electricity from fossil fuels.

South Australia is therefore the undisputed king of renewable energy in Australia. Wind and solar energy account already account for over 60 per cent of the state's electricity generation (higher than Germany and Denmark), up from 20 per cent 10 years ago – a fact the state government is volubly proud of.

It may not be as proud of the fact it also has the highest retail electricity prices in Australia, as well as the highest proportion of electricity customers on hardship programs.[16] It would seem the rising number of negative wholesale price periods often attributed to renewable energy has had little beneficial impact on the electricity consumer's experience in South Australia.

Figure 13: Residential electricity median market and standing offer prices.

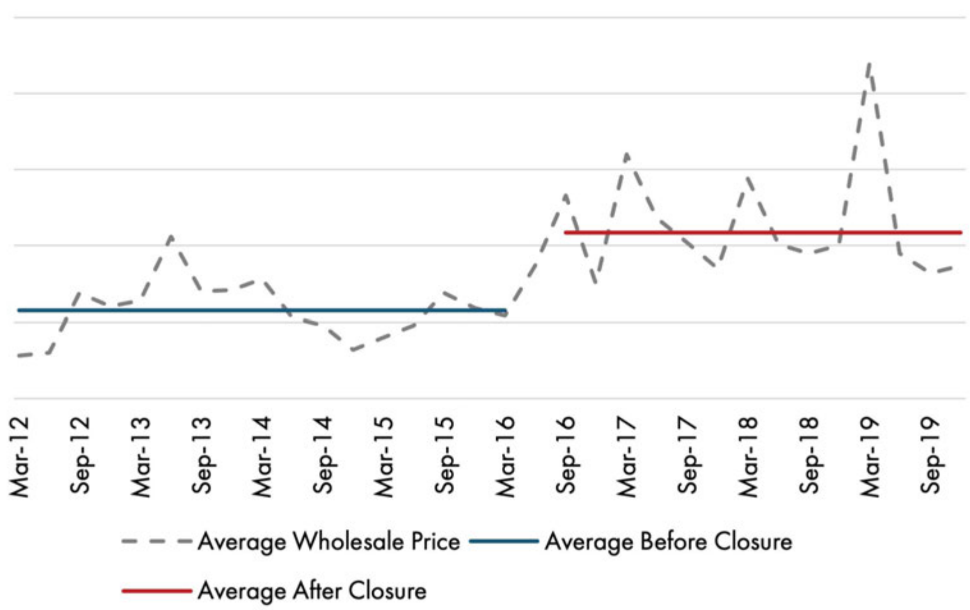


Source: Australian Energy Regulator, Annual retail markets report 2021–22, figure 2.3.

South Australia's misadventures in energy policy can be traced back to the closure of the Northern power station in Port Augusta. In response to the government mandated rise in variable renewable energy generation, Alinta permanently shut down the Northern power station in May 2016. The average wholesale electricity price more than doubled within 3 months and higher prices were locked in for the state until the COVID-19 pandemic created softer demand conditions in the market.

16 Australian Energy Regulator, Annual retail markets report 2021–22.

Figure 14: Rising wholesale electricity prices in South Australia after the closure of the Northern power station.



Source: Australian Energy Regulator

In addition to higher prices, South Australia is facing rising challenges in managing its grid. As noted in the 2020 AEMO Electricity Statement of Opportunities report, this isn't being solved exclusively by adding new battery storage and building more interconnection to New South Wales.

The 2020 ESOO modelling includes 86 MW of committed VRE generation as well as 50 MW of additional battery storage capacity, 15 MW of gas generator upgrades, and 123 MW of additional liquid-fuelled generation in South Australia.[17]

Significantly, "liquid-fuelled generation" refers to a set of leased diesel generators that were required to meet demand at peak times.[18] South Australia also increased its use of these generators during the winter of 2022 when gas supply was tight and prices high.

These diesel generators are set to continue operating because, as noted by the Australian Energy Regulator in the 2022 edition of its *State of the Energy Market* report:

> *both South Australia and Victoria could breach the Interim Reliability Standard in 2023–24.*[19]

The report also succinctly highlights the rising risks associated with the increased deployment of variable renewable energy across the NEM – particularly in South Australia:

> *The wind and solar generators entering the market are less able to support system security. For this reason, the rising proportion of renewable plant in the*

17 Australian Energy Market Operator, *Electricity Statement of Opportunities*, 2020, p124.

18 https://www.abc.net.au/news/2019-08-28/back-up-power-generators-leased-to-private-companies/11457824

19 Australian Energy Regulator, State of the Energy Market, 2022, p.53.

NEM's generation portfolio will mean more periods of low inertia, weak system strength, more volatile frequency and voltage instability. It also raises challenges to the generation fleet's ability to ramp (adjust) quickly to sudden changes in renewable output.

AEMO is more frequently relying on directions to keep the system secure. Directions for system security are intended a last resort intervention, when the market has not delivered the necessary requirements. In South Australia, directions to market participants to take action to maintain or restore power system security have been in place for a substantial amount of time in the past 2 years at a substantial cost. In 2021 total costs for directing South Australian generators for system strength reached $94 million – almost double those costs in 2020.[20]

To South Australia's credit, the AEMO report acknowledges that actions are underway to address its grid reliability issues:

In South Australia, 4 synchronous condensers, installed by ElectraNet, started operating in October 2021 to provide system strength and inertia. Each has a flywheel with a large amount of momentum. In the event of a disturbance on the network, these provide the electrical inertia to power through the fault. They have reduced the number and cost of market interventions, relaxed constraints on wind and solar output and reduced the amount of gas generation required down to 2 units. Directions in South Australia fell from being in place over 80% of the time in the last quarter of 2021 to below 20% of the time in the first quarter of 2022.[21]

Further investment is likely to be required to boost South Australia's grid reliability. In late 2022 the system was again exposed when storm damage to a transmission tower cut an interconnector to Victoria.[22] Despite the investment in reliability management, the state faced a dual challenge of too much electricity from strong solar PV output at times (which would normally be exported to Victoria) and insufficient generation in other periods to operate the grid within the strict engineering parameters.

This was not the first time South Australia had faced transmission issues – in November 2016 the entire state endured a blackout. According to the Australian Energy Regulator:

The state-wide blackout on 28 September 2016 resulted from unprecedented circumstances. It was triggered by severe weather that damaged transmission and distribution assets, which was followed by reduced wind farm output and a loss of synchronism that caused the loss of the Heywood Interconnector. The subsequent imbalance in supply and demand resulted in the remaining electricity generation in SA shutting down. Most supplies were restored in 8 hours, however the wholesale market in SA was suspended for 13 days.[23]

20 Ibid., p.53.

21 Ibid., p.53.

22 AEMO, South Australia disconnected from the National Electricity Market, Media release issued 13 November 2022.

23 Australian Energy Regulator, The Black System Event Compliance Report, 2018, p.5.

There is no disputing the trigger of the event was weather-related; however, South Australia's reliance on variable renewable energy contributed to the problem. Media reports and political statements have often overlooked the inquiry report's detail on wind generation and its role in the tripping of the interconnector. But the inquiry report clearly shows that in the space of just 9 minutes, from 15.42 to 15.51, generation from wind farms fell 21 per cent. The resulting increased reliance on the Heywood interconnector from Victoria exceeded its operating thresholds causing it to disconnect South Australia.[24]

South Australia's electricity policies and experiences provide valuable insights into the challenges associated with high shares of variable renewable energy in a grid at the expense of dispatchable generation. Households and businesses in the state are experiencing rising electricity bills in direct contradiction of the claim that renewable energy is cheap and even forces wholesale prices down.

Renewable energy from wind and solar may be low cost, but the market conditions they produce create significant risks that must be mitigated by expensive investments in additional grid connections, energy storage and back up. Often this increases reliance on fast-response dispatchable generators, such as diesel and gas peakers, which are among the most expensive sources of electricity available.

Yet, even at higher prices and with more investment to come, reliability continues to be a problem. The latest Electricity Statement of Opportunities from AEMO still forecasts significant risks for South Australia, and it seems each successive report revises this risk up and brings it forward.

Rather than learning from the South Australian experience, other states in Australia are going down the same path. They too are closing their dispatchable generators and replacing them with variable renewable energy sources.

Part 3: The closure of Hazelwood

With a capacity of 1,600 megawatts, the Hazelwood power station was a critical piece of Victoria's energy infrastructure. For more than 50 years the plant delivered reliable, dispatchable electricity into the NEM using brown coal sourced from the adjacent mine.

Victoria's energy market was up-ended on 3 November 2016 by the announcement the Hazelwood power station would close. Hazelwood was an aging asset, but still produced 10,000 gigawatt hours of electricity in 2015-16 – around 20 per cent of Victoria's electricity supply.

As can be seen in figure 15 below, the impact on wholesale electricity prices in Victoria was severe. The average price in the March quarter of 2017 was \$85 per MWh – up 70 per cent from the same period twelve months earlier, and the power station did not go fully offline until 29 March 2017.

24 Australian Energy Regulator, The Black System Event Compliance Report, 2018, p.41.

Figure 15: Impact of Hazelwood closure on Victorian wholesale electricity prices.

Source: Australian Energy Regulator

The following quarter delivered extreme price increases for Victorians, due to a shortage in dispatchable supply. The wholesale electricity price increased further and averaged $107 per MWh in the June quarter 2017.

Higher electricity prices became a feature of the Victorian economy for the next three years – averaging $106 per MWh. In the ten years prior to Hazelwood's closure, electricity price averaged just $45 per MWh. This was despite renewable energy generation in Victoria rising 27 per cent, or 2,200 gigawatt hours, from 2015-16 to 2018-19.

The broader problem was that the NEM is an interconnected electricity grid. The shortfalls and higher prices in Victoria were exported to other states, which also experienced higher electricity prices. This increase became locked in until weaker demand during COVID-19 pandemic eased prices.

Table 1: Average annual wholesale prices before and after the Hazelwood closure.

State	2014-15	2015-16	2016-17	2017-18	2018-19
NSW	$36	$54	$88	$85	$92
QLD	$61	$64	$103	$75	$83
SA	$42	$67	$123	$109	$128
TAS[25]	$37	$97	$76	$88	$88

Source: Australian Energy Regulator

25 Tasmania's 2015-16 price spike pre-dated the Hazelwood closure and was the result of low water flow into its hydroelectric power stations. Technical problems also prevented electricity imports via the Basslink interconnector from Victoria. Diesel generators were used more often but caused higher prices throughout 2015-16.

The closure of Hazelwood not only caught the Australian Energy Market Operator off guard, but also immediately created a significant shift in their future risk assessments for the stability of the NEM.

Here is their assessment of risks in the NEM just three months prior to the announced closure of Hazelwood:

> *Under a neutral economic and consumer outlook – and in the absence of new generation, network or non-network development – coal-fired generation withdrawals at the levels assumed may lead to reliability standard breaches.*[26]

The next report, released in September 2017, provided a significant shift in the assessed risks:

> *AEMO's 2017 Electricity Statement of Opportunities (ESOO) modelling shows reserves have reduced to the extent that there is a heightened risk of significant unserved energy (USE) over the next 10 years, compared with recent levels.*
>
> *AEMO's analysis shows a heightened risk that the current NEM reliability standard will not be met, and confirms that for peak summer periods, targeted actions to provide additional firming capability are necessary to reduce risks of supply interruptions.*
>
> *... The highest forecast USE risk in the 10-year outlook is in 2017–18 in South Australia and Victoria. This risk is being addressed by the South Australian Government's Energy Plan developing additional diesel generation and battery storage, and AEMO pursuing supply and demand response through the Reliability and Emergency Reserve Trader (RERT) provisions.*[27]

As previously highlighted, this assessment came at a time when electricity demand growth was stagnant and renewable energy investment was surging. Yet, the closure of just one major coal-fired power station with a capacity of 1,600 megawatts created significant reliability risks and higher prices in the NEM.

The question now is, how will the government's plan to close the next 20,000 megawatts in the next seven years affect the NEM, electricity consumers and the Australian economy?

26 Australian Energy Market Operator, Electricity Statement of Opportunities, 2016.

27 Australian Energy Market Operator, Electricity Statement of Opportunities, 2017.

Where to from here - the closures still to come

Australia's energy market and policy making is now at a crucial point. Government policy is mandating a fundamental shift in the nation's electricity supply while simultaneously aiming to stimulate greater demand through industrial policy, increased immigration and electrification.

The cracks are already appearing.

On 31 August 2022 AEMO released its 2022 edition of the Electricity Statement of Opportunities. A key finding of the report was that reliability gaps are forecast in all mainland NEM regions in the next decade, based on existing and committed developments only. Furthermore, the report noted; *"Since the 2021 ESOO, potential retirements and commissioning delays to committed projects have also influenced the reliability forecast"*.[28]

This includes reliability gaps forecast in South Australia (from 2023-24), Victoria (2024-25) and New South Wales (2025-26).

While the report noted the large and still growing capacity of variable renewable energy, it also signalled this warning:

> *there is enough resource potential to approach and on occasion reach 100% instantaneous supply from renewable resources.... A high proportion of this renewable generation is from inverter-based resources (IBR, meaning wind and solar generation, including distributed PV). With AEMO's current operating toolkit, it would not be possible to maintain the power system securely under these conditions.*[29]

AEMO subsequently released a report titled Engineering Roadmap to 100% Renewables in December 2022. While it is admirable that AEMO is finally adopting the total system approach advocated by numerous energy experts around the world, it also confirms that Australia is on the path to incurring the additional costs associated with high variable renewable energy shares in a grid's electricity mix. Costs inevitably borne by households and businesses.

Notably, the roadmap is a document rich in engineering and policy action items – but it provides no cost information or economic assessment of its planned 100 per cent renewable future.

On 21 February 2022 AEMO released an update to its 2022 Electricity Statement of Opportunities report "due to material changes affecting available generation capacity in the National Electricity Market from that set out in the 2022 Electricity Statement of Opportunities".[30]

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28 Ibid., p11.

29 Ibid., p14.

30 Australian Energy Market Operator, Update to 2022 Electricity Statement of Opportunities, 2023.

The key findings of this update were that recent government actions to invest in energy storage had delayed, but not solved the looming reliability problems facing the NEM. But delays to Snowy 2.0 and the Kurri Kurri gas project (both government-led initiatives) were still putting New South Wales' energy security at risk.

More bad news for New South Wales

New South Wales now finds itself at the forefront of energy market risks. The permanent closure of the Liddell power station at the end of April 2023 is likely to create similar market issues to those caused by the closure of Hazelwood.

Recent experience in Australia and around the world highlights why the occasion of Liddell's closure should mark a line in the sand for the close of baseload power plants.

Liddell was a coal-fired power plant with a capacity of 2,000 megawatts. It had been operating well below its potential due mainly to its age – its generators were first commissioned in 1971. Nevertheless, it had still been producing around 10 per cent of New South Wales' electricity supply.

The surge in variable renewable energy output in New South Wales in recent years (tripling in the last five) is not enough to offset this closure. Clearly, if it were, New South Wales would have been spared the electricity market crunch that came in the winter of 2022.

It wasn't.

New South Wales can instead expect to experience greater price variability in the future. During periods of high renewable energy output, warm sunny days with lots of wind, wholesale prices will be low reflecting strong supply availability and the near zero marginal cost of renewable energy projects.

(It is worth noting that this abundance of renewables is also contributing to their own commercial challenges. The low prices when renewables are abundant reduce the financial returns on wind and solar projects, making them almost un-investable. It is no surprise, though concerning, that the Clean Energy Finance Corporation has returned to offering financing deals for wind and solar farms in Australia.[31])

But when less than ideal conditions prevail, such as wind droughts at night, tight supply conditions will leave a market more reliant on flexible generators such as gas turbines to set wholesale electricity prices.

In the past this may have been manageable, but with Liddell's closure New South Wales can expect to experience even tighter market conditions, with higher price volatility, increased risks of load shedding (the favoured euphemism for brownouts) and demand response (also known as paying large energy consumers to not use energy).

31 Australian Financial Review, Energy prices are soaring, so why are taxpayers helping out new solar?, 15 November 2022.

New South Wales' electricity supply is clearly at risk. Despite its age, Liddell still produced 8,000 gigawatt hours of dispatchable electricity in 2021-22. In comparison, the state's entire network of large-scale wind and solar projects provided about the same amount of electricity that year.

The Kurri Kurri gas power station offered some hope for managing New South Wales' electricity market risks, but it is now delayed at least a year as the result of an ill-conceived policy to have it run partly on hydrogen from day one.

New South Wales' only option is to rely on its network connections to Queensland and Victoria to import even more electricity. But as Hazelwood's closure showed, the integrated NEM also allows the export of reliability risks and higher prices to other states.

Liddell's closure will not only create sustained higher prices for New South Wales households and businesses, but the contagion effect will increase demand and prices in Queensland in particular. Unfortunately, this winter Queensland also finds itself with the prospect of a tighter electricity market, with the Callide coal-fired power station still partly offline for maintenance and repairs.

New South Wales cannot continue down the path of closing reliable, low-cost baseload generators without adequate replacements being available.

Unfortunately, it is.

It gets worse

In February 2022 Origin Energy announced it was bringing forward the closure of the Eraring power station from 2032 to 2025.

Eraring is the largest power station in Australia, with a capacity of 2,800 megawatts. Like Liddell, it has been operating well below its potential, but its output of around 12,000 gigawatt hours represents around 15 per cent of New South Wales' electricity.

The Perrottet government response to the announcement was typical of the head-in-the-sand political approach to energy policy:

> *NSW energy supply will remain secure after the closure of the Eraring Power Station following the NSW Government's announcement that it will move to accelerate transmission upgrades and the construction of new electricity generation.*
>
> *To ensure energy reliability, the NSW Government will work with industry partners to install the Waratah Super Battery, a 700MW/1400MWh grid battery, by 2025 to release grid capacity so Sydney, Newcastle and Wollongong consumers can access more energy from existing electricity generation.*

> *"New South Wales has the strongest reliability standard in the country – the Energy Security Target – which aims to have sufficient firm capacity to keep the lights on even if the State's 2 largest generating units are offline during a one-in-10 year peak demand event," Mr Kean said.*[32]

The Waratah Super Battery, though large, provides no new energy into the New South Wales electricity grid. At best, at any given time it can deliver 25 per cent of Eraring's maximum output – for just two hours before recharging. The government's own project website describes the battery more as a "shock absorber" than a source of new energy.[33]

For the new state government, there is still the potential to avoid the worst of the electricity market problems it has inherited.

On 27 March 2023 private equity fund Brookfield Asset Management signed a deal to finalise the purchase of Origin Energy. A government-led deal with the new owners to delay the closure of Eraring is possible, with Brookfield previously indicating it was open to extending Eraring's operating life to maintain market stability.[34] This would not only be a major political achievement, it would save the state millions in unnecessary electricity bill increases.

Over 20 gigawatts of dispatchable capacity are still scheduled to close by 2035

The federal government's energy policy is clear, albeit problematic. Renewable energy is to account for 82 per cent of Australia's electricity by 2030. This comes despite the mounting empirical evidence that such mandates elevate electricity prices.

But the energy sector is following this lead, with several companies announcing earlier retirement for their assets over the last year.

This disruption will not go unnoticed in electricity markets. Australians should be bracing for higher prices in the future, as more than 20 gigawatts of dispatchable, reliable coal and gas fired power stations are set to close by 2035. The power stations scheduled to close produced around 40 per cent of Australia's electricity in 2021-22.

32 New South Wales Government, NSW response to the closure of the Eraring Power Station.

33 EnergyCo website, Waratah Super Battery, viewed 5 April 2023.

34 Angela MacDonald-Smith and Samantha Hutchison, Brookfield open to talks with NSW on Eraring sale, Australian Financial Review, 28 March 2023.

Table 2: Australia power station closures to 2035.

Power Station	State	Fuel	Expected Closure	Capacity MW	Generation GWh
Liddell	NSW	Coal	2023	2,000	8,106
Eraring	NSW	Coal	2025	2,880	12,012
Torrens Island B	SA	Gas	2026	800	1,074
Collie	WA	Coal	2027	340	1,248
Callide B	QLD	Coal	2028	700	4,293
Yallourn	VIC	Coal	2028	1,450	8,363
Bluewaters	WA	Coal	2029*	400	1,636
Muja	WA	Coal	2029	1,094	4,113
Vales Point B	NSW	Coal	2029	1,300	6,278
Bayswater	NSW	Coal	2033	2,600	14,861
Callide C	QLD	Coal	2035	825	2,570
Gladstone	QLD	Coal	2035	1,680	5,911
Kogan Creek	QLD	Coal	2035	750	5,541
Loy Yang A	VIC	Coal	2035	2,200	15,143
Stanwell	QLD	Coal	2035	1,400	8,616
Tarong & North	QLD	Coal	2035	1,840	11,095
Total				22,259	110,860

Notes: Expected closure date for Bluewaters based on AEMO forecast.

Queensland government owned generators expected to close by 2035 to achieve the state's 80 per cent renewable energy target.

Source: AEMO, Clean Energy Regulator, company reports.

To accommodate the federal government's renewable energy target, several of the power stations shown in table 2, plus those not listed (Mt Piper, Millmerran and Loy Yang B) may need to close sooner or at least significantly curtail their output.

The federal government has already opted against the advice of the Energy Security Board in its announced version of a capacity mechanism scheme. Instead of delivering a program of incentives to keep some of these dispatchable generators online and capable of delivering energy or grid management services in times of generation shortfalls, the government has created another channel for funding variable renewable energy projects with its Capacity Investment Scheme.[35]

The Capacity Investment Scheme is the antithesis of the dispatchable generation the NEM needs to replace the lost output from the power stations listed above.

35 Australian Financial Review, *Coal and gas cut out of capacity mechanism*, 8 December 2022.

Replacing this output with variable renewable energy projects and the associated network, storage and frequency management projects in the timeframe required is not only challenging, recent experience in Australia with delays and cost blow outs on projects including Snowy 2.0 and the Western Renewables Link/VNI West project, suggest it is completely unrealistic.

Not only will projects not be built in time, they will be increasingly expensive which will simply add to energy consumer pain.

And, with their high usage of variable renewable energy, these are the very projects that advocates of the total systems cost approach to modelling energy markets suggest are driving energy prices higher.

Conclusion

The Australian energy market is an experiment being keenly watched by international observers. For some, Australia's continuing push to increase the proportion of variable renewables in its energy markets provides a counter-narrative to the obvious energy market failures in Europe and North America.

In reality, pursuing the renewables dream has little to do with economics; it is more about ideological purity. But it's Australian households and industry that will pay the price for this ideological experiment, not those in Europe and North America looking for vindication despite their own failures.

Australia faces an inflection point.

It can continue down the path of closing what have been reliable low-cost baseload power stations without adequate replacement being available.

Or it can do what should be obvious to all elected officials – keep the lights on while planning to build new plant that is actually capable of meeting the real world energy needs of Australian households and industry.

Liddell's closure means the system is now on a knife's edge. Until new replacement capacity is built that can meet what dispatchable power stations actually provide, Australia is at serious risks of energy shortages.

Variable renewable energy has proven to be an unsuitable substitute when dispatchable generators close down, and a growing body of evidence shows it is also an expensive one.

At the very least, policy makers should halt the premature closure of baseload power stations.

LIDDELL THE LINE IN THE SAND: WHY IT'S TIME TO HIT PAUSE ON THE CLOSURE OF COAL-FIRED BASE LOAD POWER STATIONS IN THE NEM

About the Institute of Public Affairs

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Institute of
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An Analysis of the Employment Consequences of a Net Zero Target in Queensland

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Executive Summary

In February 2024, the Queensland state government introduced the *Clean Economy Jobs Bill 2024* (Qld) into the Legislative Assembly. This bill will enshrine in legislation emissions targets of 30 per cent reduction below 2005 levels by 2030, 75 per cent below 2005 levels by 2035, and net zero emissions by 2050.

This report finds that the policy of net zero emissions by 2050 and the accompanying legislation will put up to 157,710 jobs at risk across Queensland, with almost 75 per cent of all jobs at risk being located outside Greater Brisbane and the Gold Coast.

Potential job losses are concentrated in the agricultural, coal mining, electricity supply, and manufacturing sectors.

The five electorates with the highest proportion of jobs at risk are:

- Gregory: with 7,813 jobs at risk, which are the equivalent to 33.3 per cent of all jobs in the electorate;
- Burdekin: with 9,712 jobs at risk, which are the equivalent to 31.6 per cent of all jobs in the electorate;
- Callide: with 8,091 jobs at risk, which are the equivalent to 30.5 per cent of all jobs in the electorate;
- Warrego: with 5,346 jobs at risk, which are the equivalent to 22.4 per cent of all jobs in the electorate; and
- Mirani: with 5,681 jobs at risk, which are the equivalent to 20.8 per cent of all jobs in the electorate.

These electorates are located in regional Queensland, and the twenty most affected electorates are located outside of Greater Brisbane and the Gold Coast.

The analysis further establishes that:

- Seven of the ten most affected electorates are represented by members of the Liberal National Party (LNP), with Mirani represented by One Nation (ONP), Gladstone represented by the Labor Party (ALP), and Hill represented by Katter's Australian Party (KAP).
- Four of the six most affected electorates in Central Queensland, where fifteen per cent of jobs are at risk region-wide, and where over 29 per cent of Queensland's at-risk jobs are located.
- The ten least affected electorates are all located in Greater Brisbane or the Gold Coast, and nineteen of the twenty least affected electorates are located in southeast Queensland.

This analysis builds on a recent IPA research report, *An Analysis of the Employment Consequences of a Net Zero Emissions target in New South Wales*, which estimated that 138,095 jobs are put at risk in New South Wales due its government's decision to adopt a net zero by 2050 target.

Emissions per job by industry

Estimating the number of jobs at risk from an emissions reduction target requires analysing annual industry emissions against industry jobs numbers.

Industry emissions data were collected from the latest *National Greenhouse Gas Inventory by Economic Sector* report, published by the Department of Climate Change, Energy, the Environment and Water (DCCEW).[1] The latest industry employment data were collected from the Australian Bureau of Statistics.[2]

An analysis of emissions and industry employment data produced an estimate of the nationwide average CO_2-e annual emissions per job by industry.

A government target to reduce emissions will have the greatest impact on jobs that are relatively more emission intensive. As such, 'at-risk' jobs are calculated as the total number of jobs in industries where emissions per job are above the economy-wide average of 0.21 kt CO_2-e per annum. As seen on Table 1, there are nine industries where emissions per job are higher than the economy-wide average, and the jobs in these industries are deemed at risk. The number of people that are employed in these industries in Queensland are listed in Table 2.

Table 1: Average annual emissions per job by industry

Industry	Emissions (kt CO2-e) Per Job
Oil and Gas Extraction	2.29
Electricity Supply	2.01
Coal Mining	0.71
Petroleum and Coal Product Manufacturing	0.45
Forestry and Logging	0.36
Primary Metal and Metal Product Manufacturing	0.32
Non-Metallic Mineral Product Manufacturing	0.28
Agriculture	0.28
Waste Collection, Treatment and Disposal Services	0.27
Average	**0.21**
Gas Supply	0.16
Basic Chemical, Polymer and Rubber Product Manufacturing	0.15
Rail Transport	0.08
Air and Space Transport	0.08
Metal Ore and Non-Metallic Mineral Mining and Quarrying	0.07
Water Supply, Sewerage and Drainage Services	0.06
Aquaculture	0.05
Fishing, Hunting and Trapping	0.05
Road Transport	0.04

[1] DCCEEW (2023, May) National inventory by economic sector: data tables and methodology, Department of Climate Change, Energy, the Environment and Water, Available from: https://www.dcceew.gov.au/climate-change/publications/national-greenhouse-accounts-2021/national-inventory-by-economic-sector-2021

[2] ABS (2024, February) Labour Force, Australia, Detailed: Industry, Occupation and Sector, Australian Bureau of Statistics. Available from: https://www.abs.gov.au/statistics/labour/employment-and-unemployment/labourforce-australia-detailed/latest-release#industry-occupation-and-sector

Wood, Pulp, Paper and Printing	0.02
Other Transport, Services, Postal and Storage	0.02
Heavy and Civil Engineering Construction	0.02
Food Product, Beverage and Tobacco Product Manufacturing	0.02
Agriculture, Forestry and Fishing Support Services	0.01
Fabricated Metal Product Manufacturing	0.01
Construction Services	0.01
Textile, Leather, Clothing and Footwear Manufacturing	0.01
Information Media and Telecommunications	0.01
Building Construction	0.01
Wholesale and Retail Trade	0.00
Finance, Insurance, Rental, Hiring and Real Estate	0.00
Other Services	0.00
Transport and Machinery Equipment Manufacturing	0.00
Professional, Scientific and Technical Services	0.00
Accommodation, Food Services, Education and Health Services	0.00
Furniture and Other Manufacturing	0.00
Administration, Public Administration and Services	0.00
Arts and Recreation Services	-0.03

Table 2: Industries with above average emissions per job in Queensland

Industry	Number of jobs at risk
Agriculture	62,715
Coal Mining	36,127
Electricity Supply	16,055
Primary Metal and Metal Product Manufacturing	15,442
Non-Metallic Mineral Product Manufacturing	8,738
Waste Collection, Treatment and Disposal Services	8,681
Oil and Gas Extraction	8,344
Forestry and Logging	1,026
Petroleum and Coal Product Manufacturing	582
Total	**157,710**

While the state has promised new jobs through the planned introduction of pumped hydro projects, Pioneer-Burdekin and Borumba Dam, which are set to replace some of the at-risk jobs, there are serious concerns over the viability of these projects in the medium to long term.

The state government has yet to complete financial, engineering, or environmental investigations on the proposed Pioneer-Burdekin Pumped Hydro project and may not do so until after the 2024 state election. This is concerning as similar projects such as Snowy Hydro in New South Wales have experienced cost blowouts and delays. Additionally, both the proposed projects require the construction of at least seven dam structures each over the next decade. The state's ability to build multiple dam structures in the next ten years should not be assumed, given Queensland has not constructed a dam since 2011.

Most at risk electorates

Table three shows the top twenty electorates by the share of jobs in each electorate which are placed most at risk by emissions reduction policies.

The classification assigned to each electorate is based on its location within one of Queensland's geographical regions. The geographical regions have been allocated to each electorate in a qualitative manner, guided by the mapping provided by Electoral Commission Queensland, where the mapping of regions overlap.[3]

Table 3: Twenty Queensland state electorates with the highest share of jobs placed at risk from emissions reduction policies

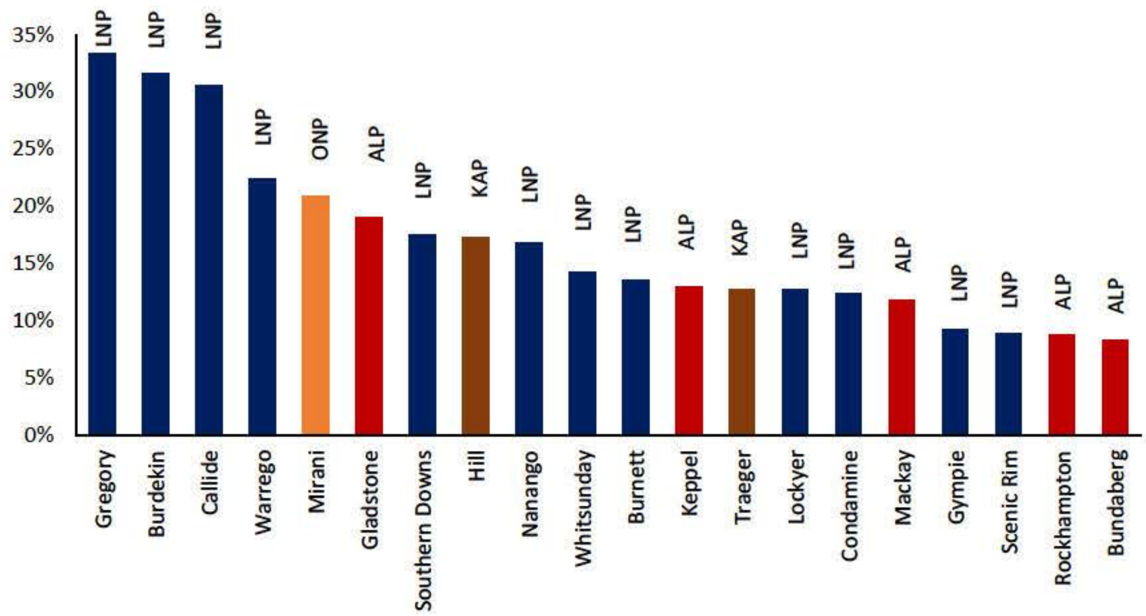
Seat	Jobs at risk	Jobs at risk as a share of the workforce	Held by	Margin	Classification
Gregory	7,813	33.3%	LNP	17.2%	Central Queensland
Burdekin	9,712	31.6%	LNP	7.0%	North Queensland
Callide	8,091	30.5%	LNP	21.7%	Central Queensland
Warrego	5,346	22.4%	LNP	23.1%	Darling Downs & Maranoa
Mirani	5,681	20.8%	ONP	9.0%	Central Queensland
Gladstone	5,240	19.0%	ALP	23.5%	Central Queensland
Southern Downs	4,384	17.5%	LNP	14.1%	Darling Downs & Maranoa
Hill	4,764	17.3%	KAP	22.5%	Far North Queensland
Nanango	3,886	16.8%	LNP	12.2%	Darling Downs & Maranoa
Whitsunday	4,640	14.2%	LNP	3.3%	North Queensland
Burnett	3,151	13.5%	LNP	10.8%	Central Queensland
Keppel	3,807	12.9%	ALP	5.6%	Central Queensland
Traeger	2,943	12.7%	KAP	24.7%	North Queensland
Lockyer	3,430	12.7%	LNP	11.5%	Southeast Provincial
Condamine	3,922	12.4%	LNP	19.2%	Darling Downs & Maranoa
Mackay	3,709	11.8%	ALP	6.7%	Central Queensland
Gympie	2,214	9.2%	LNP	8.5%	Central Queensland
Scenic Rim	2,565	8.9%	LNP	11.4%	Southeast Provincial
Rockhampton	2,462	8.7%	ALP	8.6%	Central Queensland
Bundaberg	1,954	8.3%	ALP	0.01%	Central Queensland

Eighteen of the twenty electorates most affected by emissions reduction targets are located outside southeast Queensland.

Chart one provides a graphical representation of the share of jobs at risk in each of the top twenty at risk electorates, and each bar is colour-coded based on the party representing that electorate.

[3] ECQ (2017, October), State electorate redistributions: Final Maps of Queensland's Regions. Available from https://www.ecq.qld.gov.au/electoral-boundaries/state-electorate-redistributions.

Chart 1: Twenty Queensland state electorates with the highest share of jobs at risk from emissions reduction policies



Source: ABS, DCCEEW

The LNP holds the largest share of the twenty most severely affected seats. Twelve of the twenty most affected electorates are LNP seats, five are held by the ALP, two by the KAP and one is held by ONP.

Figure one provides a heatmap of the employment consequences of net zero in Queensland by electoral district, and figure two provides a delineation of the location of each region.

Figure one shows that there is a stark divide between regional Queensland and the southeast corner of the state, with the electorates least affected by the employment impact of emissions reduction policies and targets being concentrated in Greater Brisbane and the Gold Coast, whereas those most affected are spread across regional and rural areas of the state, with the exception of regional cities such as Cairns and Townsville.

Table 4: Colour Scheme of net zero heatmap

Colour	Percentage of Jobs at Risk
	>20%
	14% - 20%
	12% - 14%
	8% - 12%
	3% - 8%
	<3%

Figure 1: Net zero heatmap of Queensland

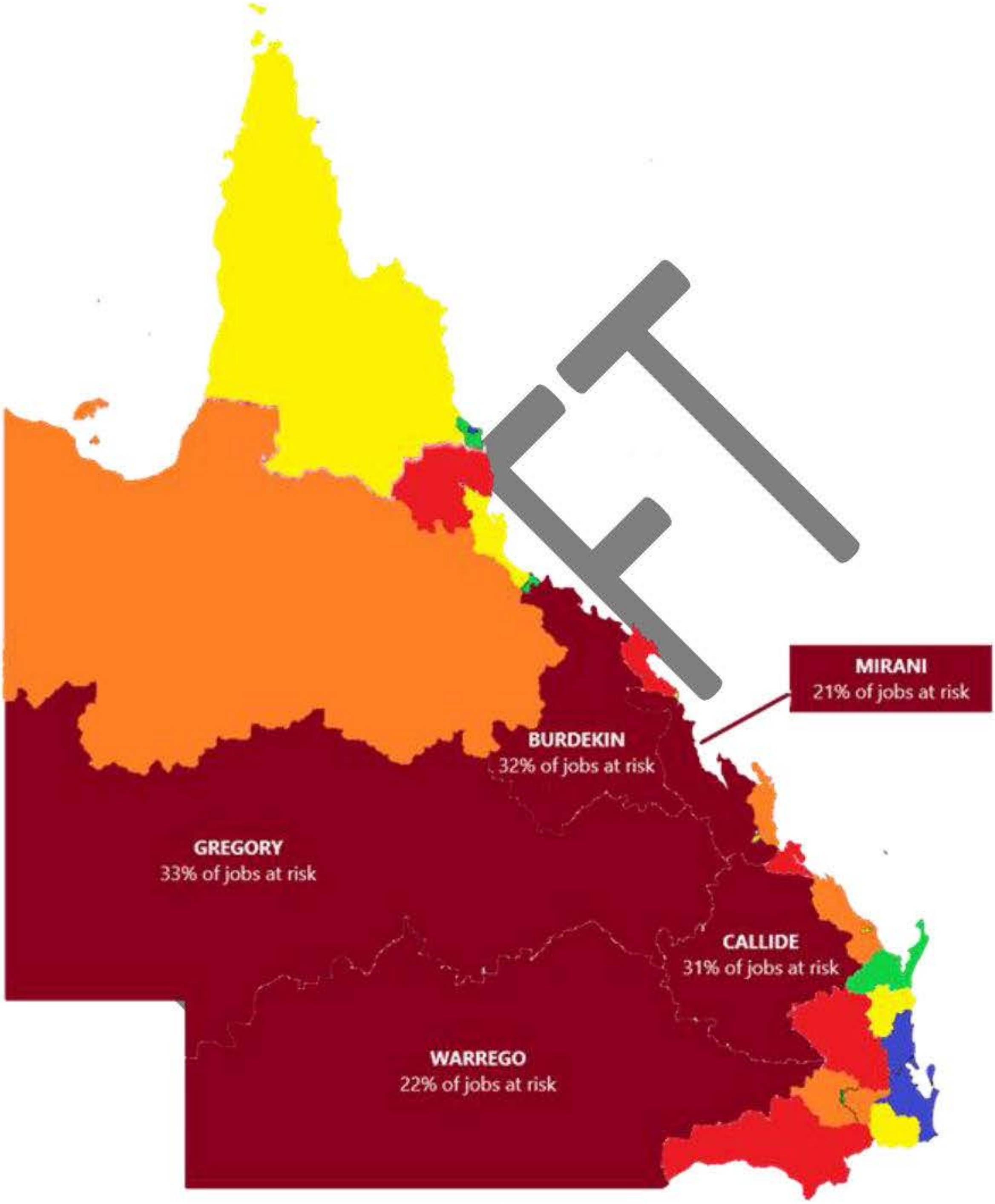


Table five below provides further detail about the electorates that are most severely affected by emission reduction targets such as net zero, all of the seats outlined below have more than twenty per cent of their total jobs at risk.

Table 5: Five most severely affected Queensland state electorates

	Gregory	Burdekin	Callide	Warrego	Mirani
Active Workforce	23,449	30,702	26,495	23,872	27,261
Jobs at risk	7,813	9,712	8,091	5,346	5,681
Share of jobs at risk	33.30%	31.60%	30.50%	22.40%	20.80%
Most at risk sector	Coal Mining	Coal Mining	Agriculture	Agriculture	Coal Mining
Second most at risk sector	Agriculture	Agriculture	Coal Mining	Oil and Gas Extraction	Agriculture
Third most at risk sector	Waste Collection, Treatment and Disposal Services	Oil and Gas Extraction	Electricity supply	Electricity Supply	Electricity Supply

Central Queensland will be the hardest hit

Four of the six most severely affected electorates are located in Central Queensland, and nine of the eleven total electorates in Central Queensland have at least eight per cent of their jobs put at risk. Out of all the jobs located in the region, fifteen per cent are at put at risk by net zero and emissions reduction policies.

Table 6: Central Queensland state electorates' jobs placed at risk from emissions reduction policies

Seat	Jobs at risk	Jobs at risk as a share of the workforce	Held by	Margin
Gregory	7,813	33.3%	LNP	17.2%
Callide	8,091	30.5%	LNP	21.7%
Mirani	5,681	20.8%	ONP	9.0%
Gladstone	5,240	19.0%	ALP	23.5%
Burnett	3,151	13.5%	LNP	10.8%
Keppel	3,807	12.9%	ALP	5.6%
Mackay	3,709	11.8%	ALP	6.7%
Gympie	2,214	9.2%	LNP	8.5%
Rockhampton	2,462	8.7%	ALP	8.6%
Bundaberg	1,954	8.3%	ALP	0.01%
Maryborough	1,381	6.4%	ALP	11.9%
Hervey Bay	638	2.9%	ALP	2.0%
Central Qld Total	46,141	15.0%	N/A	N/A

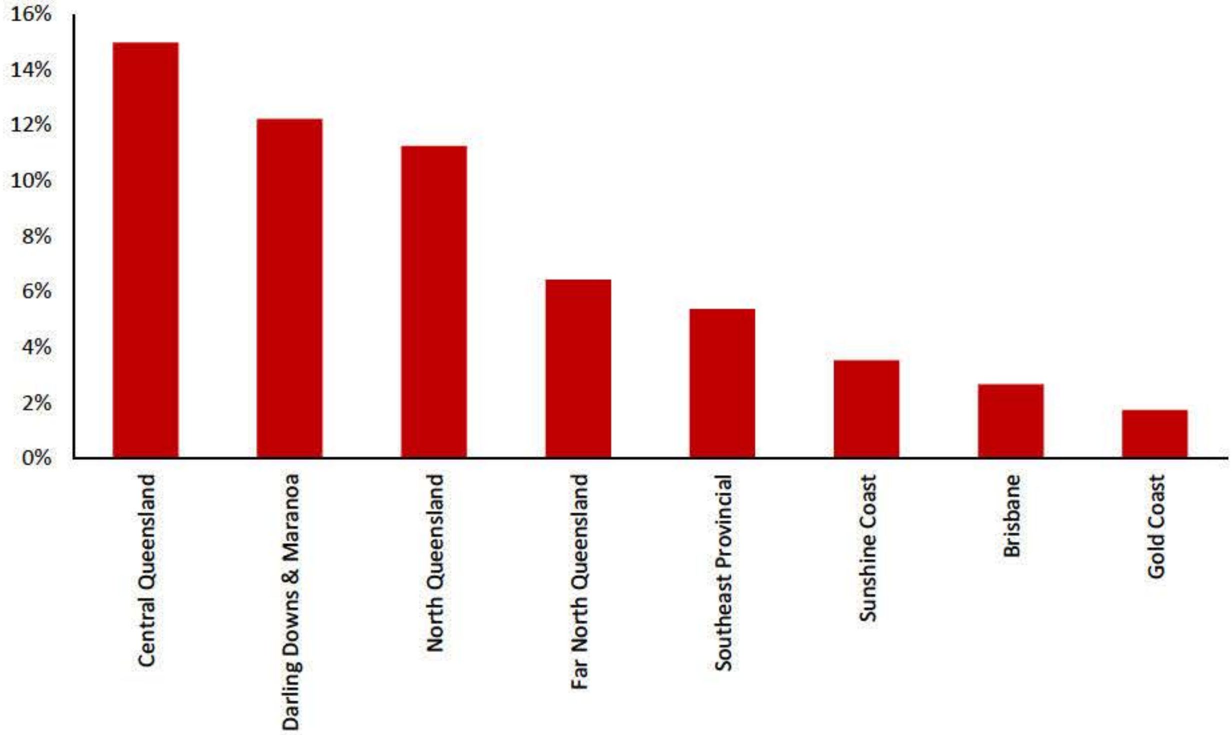
Additionally, Central Queensland has the highest proportion of Queensland's at risk jobs from net zero, with over 29 per cent of all at risk jobs across the state located there.

Table 7: Jobs put at risk by emissions reduction policies by region

Seat	Jobs at risk	Jobs at risk as a share of the workforce	Share of total Queensland jobs at risk
Central Queensland	46,141	15.0%	29.3%
Darling Downs & Maranoa	19,958	12.2%	12.7%
North Queensland	22,793	11.3%	14.5%
Far North Queensland	9,510	6.4%	6.0%
Southeast Provincial	10,184	5.4%	6.5%
Sunshine Coast	8,112	3.5%	5.2%
Brisbane	34,317	2.7%	21.8%
Gold Coast	6,286	1.7%	4.0%

Chart two provides a graphical representation of the share of jobs at risk in each of the regions within Queensland, and chart three provides a graphical representation of the share of jobs at risk that are located in each of the regions. A map detailing the location of each of Queensland's regions can be found in Appendix C.

Chart 2: Proportion of jobs put at risk by emissions reduction policies in each region



Source: ABS, DCCEEW

Least at risk electorates

Table eight shows the bottom twenty electorates by the share of jobs in each electorate placed most at risk by net zero.

Table 8: Twenty Queensland state electorates with the lowest share of jobs placed at risk from emissions reduction policies

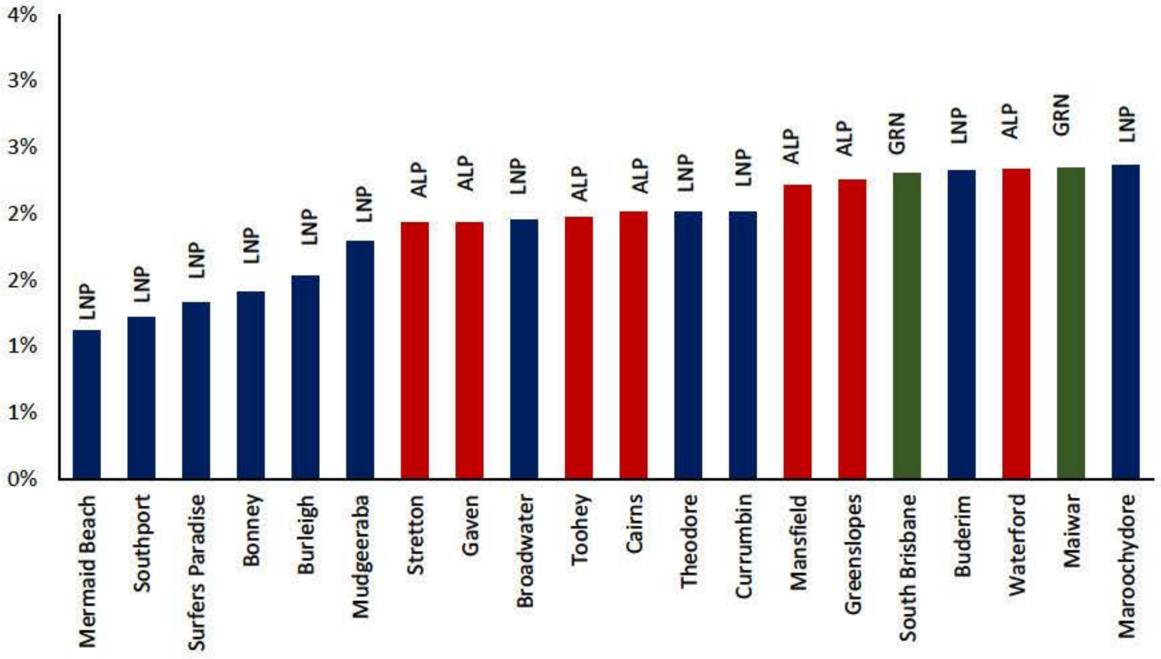
Seat	Jobs at risk	Jobs at risk as a share of the workforce	Held by	Margin	Classification
Mermaid Beach	370	1.1%	LNP	4.4%	Gold Coast
Southport	380	1.2%	LNP	5.4%	Gold Coast
Surfers Paradise	419	1.3%	LNP	16.2%	Gold Coast
Bonney	443	1.4%	LNP	10.1%	Gold Coast
Burleigh	461	1.5%	LNP	1.2%	Gold Coast
Mudgeeraba	620	1.8%	LNP	10.1%	Gold Coast
Stretton	631	1.9%	ALP	13.9%	Brisbane
Gaven	563	1.9%	ALP	7.8%	Gold Coast
Broadwater	506	2.0%	LNP	16.6%	Gold Coast
Toohey	662	2.0%	ALP	14.4%	Brisbane
Cairns	641	2.0%	ALP	5.6%	Far North Queensland
Theodore	713	2.0%	LNP	3.3%	Gold Coast
Currumbin	557	2.0%	LNP	0.5%	Gold Coast
Mansfield	759	2.2%	ALP	6.8%	Brisbane
Greenslopes	835	2.3%	ALP	13.2%	Brisbane
South Brisbane	1,044	2.3%	GRN	5.3%	Brisbane
Buderim	754	2.3%	LNP	5.3%	Sunshine Coast
Waterford	687	2.3%	ALP	16.0%	Brisbane
Maiwar	946	2.3%	GRN	6.3%	Brisbane
Maroochydore	678	2.4%	LNP	9.1%	Sunshine Coast

All of the twenty least affected electorates bar Cairns, an electorate which takes in the city itself, are located in southeast Queensland.

Analysis of the data pertaining to the most and least at-risk electorates presents a problem for the LNP, who represent twelve of the twenty most at risk electorates and eleven of the twenty least at risk electorates.

Chart three provides a graphical representation of the share of jobs at risk in each of the lowest twenty at risk electorates, and each bar is colour-coded based on the party representing that electorate.

Chart 3: Twenty Queensland state electorates with the lowest share of jobs at risk from emissions reduction policies



Source: ABS, DCCEEW

Appendix A: The types of jobs that are at risk

The report identifies nine industries that would be at risk from the Queensland government's net zero emissions target. These industries are as follows:

Agriculture refers to the growing and cultivation of horticultural and other crops, along with the controlled breeding, raising or farming of animals. A typical worker in this industry could be employed as a beef cattle or dairy farmer.

Coal mining refers to the extraction of coal, and includes underground and open cut mining, along with operations related to mining activities (such as crushing, screening and washing). A typical worker in this industry could be employed as an excavator operator.

Electricity supply includes electricity generation, transmission, distribution, on-selling and market operation. A typical worker in this industry could be employed as a line worker maintaining power lines.

Primary metal and metal product manufacturing includes activities such as iron smelting; steel manufacturing; and the smelting and refining of copper, silver, lead, zinc and aluminium. A typical worker in this industry could be employed as a steel cutter in a steel manufacturing plant.

Non-metallic mineral product manufacturing includes the manufacturing of glass, ceramic, cement, lime, plaster and other non-metallic mineral products. A typical worker in this industry could be employed as a cement crusher operator in a cement manufacturing plant.

Waste collection, treatment and disposal services includes the collection, treatment and disposal of solid, liquid and other types of waste. This includes landfills, combustors, incinerators and compost dumps, but does not include sewage treatment facilities. A typical worker in this industry could be employed as a garbage truck driver.

Oil and gas extraction refers to producing crude oil, natural gas or condensate through the extraction of oil and gas deposits. This includes activities such as natural gas extraction, petroleum gas extraction and oil shale mining. A typical worker in this industry could be employed as a drill rig operator on an oil rig.

Forestry and logging includes logging native and plantation forests, including felling, cutting and chopping logs into products such as railway sleepers. It also includes cutting trees and scrubs for firewood. A typical worker in this industry could be employed cutting or felling trees.

Petroleum and coal product manufacturing refers to transforming crude petroleum and coal into intermediate and end products, for example petroleum refineries, asphalt paving mixture and block manufacturing, and petroleum lubricating oil and grease manufacturing. A typical worker in this industry could be employed as a mechanical technician in a petroleum refinery.

Appendix B: Queensland electorate statistics and classifications

Seat	Jobs at risk	Workforce	Jobs at risk as a share of the workforce	Held by	Margin	Classification
Gregory	7,813	23,449	33.3%	LNP	17.2%	Central Queensland
Burdekin	9,712	30,702	31.6%	LNP	7.0%	North Queensland
Callide	8,091	26,495	30.5%	LNP	21.7%	Central Queensland
Warrego	5,346	23,872	22.4%	LNP	23.1%	Darling Downs & Maranoa
Mirani	5,681	27,261	20.8%	ONP	9.0%	Central Queensland
Gladstone	5,240	27,573	19.0%	ALP	23.5%	Central Queensland
Southern Downs	4,384	25,037	17.5%	LNP	14.1%	Darling Downs & Maranoa
Hill	4,764	27,497	17.3%	KAP	22.5%	Far North Queensland
Nanango	3,886	23,087	16.8%	LNP	12.2%	Darling Downs & Maranoa
Whitsunday	4,640	32,638	14.2%	LNP	3.3%	North Queensland
Burnett	3,151	23,278	13.5%	LNP	10.8%	Central Queensland
Keppel	3,807	29,397	12.9%	ALP	5.6%	Central Queensland
Traeger	2,943	23,099	12.7%	KAP	24.7%	North Queensland
Lockyer	3,430	26,938	12.7%	LNP	11.5%	Southeast Provincial
Condamine	3,922	31,702	12.4%	LNP	19.2%	Darling Downs & Maranoa
Mackay	3,709	31,561	11.8%	ALP	6.7%	Central Queensland
Gympie	2,214	24,027	9.2%	LNP	8.5%	Central Queensland
Scenic Rim	2,565	28,922	8.9%	LNP	11.4%	Southeast Provincial
Rockhampton	2,462	28,255	8.7%	ALP	8.6%	Central Queensland
Bundaberg	1,954	23,416	8.3%	ALP	0.01%	Central Queensland
Hinchinbrook	2,424	29,178	8.3%	KAP	14.8%	North Queensland
Cook	2,046	24,667	8.3%	ALP	6.3%	Far North Queensland
Glass House	2,071	25,967	8.0%	LNP	1.6%	Sunshine Coast
Maryborough	1,381	21,635	6.4%	ALP	11.9%	Central Queensland
Morayfield	1,603	28,510	5.6%	ALP	16.7%	Brisbane
Pumicestone	1,061	22,319	4.8%	ALP	5.3%	Brisbane
Nicklin	1,178	26,616	4.4%	ALP	0.1%	Sunshine Coast
Toowoomba North	1,243	28,619	4.3%	LNP	7.3%	Darling Downs & Maranoa

Thuringowa	1,119	28,343	3.9%	ALP	3.2%	North Queensland
Toowoomba South	1,175	30,975	3.8%	LNP	10.2%	Darling Downs & Maranoa
Mulgrave	1,132	29,993	3.8%	ALP	12.2%	Far North Queensland
Ipswich West	1,058	28,359	3.7%	ALP	14.3%	Southeast Provincial
Logan	1,317	35,516	3.7%	ALP	13.4%	Brisbane
Mundingburra	987	28,928	3.4%	ALP	3.9%	North Queensland
Ninderry	1,054	31,425	3.4%	LNP	4.1%	Sunshine Coast
Townsville	968	29,531	3.3%	ALP	3.1%	North Queensland
Jordan	1,304	42,117	3.1%	ALP	17.1%	Southeast Provincial
Caloundra	927	30,033	3.1%	ALP	2.5%	Sunshine Coast
Redlands	884	28,941	3.1%	ALP	3.9%	Brisbane
Kurwongbah	1,020	33,563	3.0%	ALP	13.1%	Brisbane
Woodridge	930	30,728	3.0%	ALP	26.2%	Brisbane
Ipswich	794	26,823	3.0%	ALP	16.5%	Southeast Provincial
Hervey Bay	638	21,676	2.9%	ALP	2.0%	Central Queensland
Pine Rivers	970	33,201	2.9%	ALP	6.7%	Brisbane
Moggill	875	30,088	2.9%	LNP	3.6%	Brisbane
Bundamba	1,033	35,729	2.9%	ALP	20.7%	Southeast Provincial
Nudgee	1,016	36,518	2.8%	ALP	15.1%	Brisbane
Barron River	926	33,612	2.8%	ALP	3.1%	Far North Queensland
Bancroft	888	32,249	2.8%	ALP	12.8%	Brisbane
Noosa	688	25,145	2.7%	IND	15.8%	Sunshine Coast
Bulimba	1,069	39,776	2.7%	ALP	11.4%	Brisbane
Mount Ommaney	827	31,260	2.6%	ALP	12.6%	Brisbane
Oodgeroo	670	25,368	2.6%	LNP	4.5%	Brisbane
Kawana	761	28,901	2.6%	LNP	9.3%	Sunshine Coast
Chatsworth	867	32,940	2.6%	LNP	1.3%	Brisbane
Sandgate	834	31,775	2.6%	ALP	17.3%	Brisbane
Redcliffe	706	26,942	2.6%	ALP	6.1%	Brisbane
Lytton	849	32,479	2.6%	ALP	13.4%	Brisbane
Algester	932	35,852	2.6%	ALP	17.8%	Brisbane
Clayfield	1,060	40,783	2.6%	LNP	1.6%	Brisbane

Macalister	819	31,955	2.6%	ALP	9.5%	Brisbane
Cooper	904	35,376	2.6%	ALP	10.5%	Brisbane
Capalaba	780	30,635	2.5%	ALP	9.9%	Brisbane
Murrumba	998	39,329	2.5%	ALP	11.3%	Brisbane
Coomera	1,254	49,962	2.5%	LNP	1.1%	Gold Coast
Inala	772	31,306	2.5%	ALP	28.2%	Brisbane
Aspley	807	32,842	2.5%	ALP	5.2%	Brisbane
Springwood	792	32,473	2.4%	ALP	8.3%	Brisbane
Stafford	892	36,903	2.4%	ALP	11.9%	Brisbane
Miller	788	32,925	2.4%	ALP	13.8%	Brisbane
McConnel	1,215	51,114	2.4%	ALP	11.1%	Brisbane
Ferny Grove	778	32,745	2.4%	ALP	11.0%	Brisbane
Everton	828	34,883	2.4%	LNP	2.2%	Brisbane
Maroochydore	678	28,735	2.4%	LNP	9.1%	Sunshine Coast
Maiwar	946	40,379	2.3%	GRN	6.3%	Brisbane
Waterford	687	29,459	2.3%	ALP	16.0%	Brisbane
Buderim	754	32,469	2.3%	LNP	5.3%	Sunshine Coast
South Brisbane	1,044	45,402	2.3%	GRN	5.3%	Brisbane
Greenslopes	835	37,013	2.3%	ALP	13.2%	Brisbane
Mansfield	759	34,274	2.2%	ALP	6.8%	Brisbane
Currumbin	557	27,670	2.0%	LNP	0.5%	Gold Coast
Theodore	713	35,495	2.0%	LNP	3.3%	Gold Coast
Cairns	641	31,939	2.0%	ALP	5.6%	Far North Queensland
Toohey	662	33,517	2.0%	ALP	14.4%	Brisbane
Broadwater	506	25,906	2.0%	LNP	16.6%	Gold Coast
Gaven	563	29,172	1.9%	ALP	7.8%	Gold Coast
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Mudgeeraba	620	34,558	1.8%	LNP	10.1%	Gold Coast
Burleigh	461	30,200	1.5%	LNP	1.2%	Gold Coast
Bonney	443	31,399	1.4%	LNP	10.1%	Gold Coast
Surfers Paradise	419	31,568	1.3%	LNP	16.2%	Gold Coast
Southport	380	31,316	1.2%	LNP	5.4%	Gold Coast
Mermaid Beach	370	33,283	1.1%	LNP	4.4%	Gold Coast