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The Australian Energy Policy Debacle

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Abstract

For the past 20 years, Australia has introduced policies encouraging and subsidizing renewable electricity generation. Since the election of the Australian Labor Party government in 2022, these policies have been accelerated. We show that international evidence of the heavy cost of renewable energy projects has been ignored. Cost-benefit studies show that these projects cannot be justified with any reasonable price for carbon dioxide emissions. Consequently, the Australian economy has suffered greatly increased prices for electricity provided by the grid. In turn, this has increased the rate of deindustrialization in key industries, contributed to a cost-of-living crisis for consumers and made the country more strategically vulnerable.

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"*There is only one difference between a bad economist and a good one: the bad economist confines himself to the visible effect; the good economist takes into account both the effect that can be seen and those effects that must be foreseen…*"
Frédéric Bastiat, *Selected Essays on Political Economy* (1848)

"*Fools learn from experience; wise men learn from the experience of others*."
Bismark

Over the past two decades, Australian Federal and State governments have implemented increasingly onerous net zero (NZ)/renewable energy (RE) policies, including heavy subsidies for RE and explicit or implicit taxes and constraints on coal and gas generation. Currently these policies are coming under increasing political pressure from a public that is worried about rising domestic electricity and gas prices and the risks of electricity blackouts. To explain the current situation, it is important to understand the background information on the relevant sectors of the Australian economy and policy evolution.

This paper explores cost-benefit analyses of the Australian NZ policies. Given the large costs associated with this "energy transition", one would expect a series of official cost-benefit studies justifying the policy. But there are no *credible* official studies that calculate the costs *and* benefits of the energy transition.

The current government dismisses calculations from several independent sources, claiming that the benefits are obvious in avoiding catastrophic climate change (CC) extreme weather events. Curiously, the government does not cite research on this topic. There have been numerous studies using computer models and various scenarios to calculate international gross domestic product (GDP) losses associated with increased world temperatures. Given the length of time that CO_2 builds in the atmosphere, most of these studies compute the decrease in GDP by the end of this century. Assuming anthropogenic CC, one can compute the increase of CO_2 in the atmosphere leading to losses in GDP, or – conversely – the benefit of CO_2 reduction in providing a potential gain in world GDP.[1]

[1] For a summary and references see Lomborg (2020), Chapter 5, and Koonin (2024), Chapter 4. These authors discuss the limitations of these models, biased predictions and their empirical reliability. This is a non-trivial research program. For example, given the multidecade horizon, it is difficult to predict technological innovations that could have major impacts on CO_2 emissions.

While the government has commissioned some reports on the cost of the energy transition, these are deeply flawed, claiming that increasing RE would reduce electricity prices. Over the past three years, electricity prices have risen substantially, making a mockery of the government's claims.

In this paper, we will explore the costs of an energy transition using RE. This is a very complex topic that draws upon the scientific, engineering and economic knowledge required to design and operate an electrical system. Much public discussion of energy policy in the mainstream media (MSM) and by politicians is oblivious to the complexity and consequences of energy policies.

Given the huge investments in RE and associated technology, it is extraordinary that these policies were introduced with such flimsy analysis.

Because Australian policy is aligned with various international agreements on NZ and RE, the paper reviews some international experience with the costs of RE policies, providing important background before analyzing the Australian situation. What is deeply disturbing is that international research on costs and benefits of RE has been ignored by the Australian Federal and State governments. This highly critical evidence was readily available for several years before the recent aggressive introduction of RE policies.

Section 1 provides a brief introduction to the economic and political structure of Australia. Canadians will observe strong similarities, but also some important differences. Section 2 is a brief introduction to the relatively recent history of the energy market in Australia. Section 3 discusses coal and gas resources in Australia for domestic and export markets. Section 4 describes recent State and Federal NZ policies impacting the coal and gas industries. Section 5 describes NZ policies encouraging wind and solar generation. Section 6 summarizes recent research on cost-benefit analyses of Ontario wind and solar generation. Section 7 summarizes cost-benefit research on UK wind and solar farms and NZ policies. Section 8 reviews Australian research on the costs of NZ and RE policies. This includes implications for the manufacturing sector and strategic resilience. Section 9 provides a brief introduction to an alternative policy approach to innovations in electricity generation. The Conclusion briefly summarizes the current situation, reasons for the policy debacle and why the government's current policy is heading for disaster.

1. The Political and Economic Structure of Australia

1.1 Political Structure

Australia is a Federation, with the Commonwealth government in Canberra and the State governments in the six capital cities and two Territories. The political system is almost identical to that of Canada, with the exception that the Senate Upper House is elected with a fixed number of representatives from each of the States and Territories. There are two main parties and several smaller parties. The major parties are the Australian Labor Party (ALP) and the Liberal Party (Liberals).

The ALP was formed around the time of Federation (1901) and was largely controlled by trade union organizations. Since the mid-1960s it has become dominated by two groups: a large construction trade union and tertiary-educated public sector employees. The party's policies are a blend of trade union labour market regulations and "progressive" social and economic policies similar to the policies of the Canadian Liberal Party and the New Democratic Party.

The Liberal Party has traditionally supported the private sector, similar in many respects to the Canadian Conservative Party. Federally it has been in coalition with a smaller party, the National Party, which had a tradition of representing regional and agricultural interests. The Coalition is often referred to as the Liberal–National Coalition (LNP). Over the past decade, the LNP has struggled to accommodate conservative and more progressive factions, leading to inconsistent policy formation and implementation, especially in energy policy.

1.2 The Australian Domestic Economy

The Australian economy has some strong similarities with the Canadian economy, but with notable differences. First, we consider the similarities. Australia has a current population of approximately 27 million. With a very low birth rate it has, since 2006, run an aggressive immigration program. In the past few years, immigration has boosted population growth to record highs. This has increased stress on infrastructure and services. With onerous Real Estate zoning restrictions, restrictive labour laws and government infrastructure labour demands, the housing market has experienced major shortages, dramatic increases in house prices, mortgage stress and increasing intergenerational income and wealth inequality.

Labour productivity growth has been very low for well over a decade, and negative in recent quarters. Consequently, Australia has seen falling GDP per capita, with increasing stress on households.[2] Federal and most State governments have responded by running budget deficits with rapidly increasing debt.

Second, we discuss the differences. Compared with Canada, Australia has a small and declining manufacturing sector. Its major industries are mining (largely iron ore), liquefied natural gas (LNG), coal and, to a much lesser extent, agriculture. Like Canada, Australia "exports" tertiary education with a very large full-fee-paying student program – far larger in per capita terms than that of Canada. The Federal government began this program in the late 1980s; Australian universities are heavily reliant on the foreign student fee income.[3]

The following graphs summarize the key indicators of economic performance.

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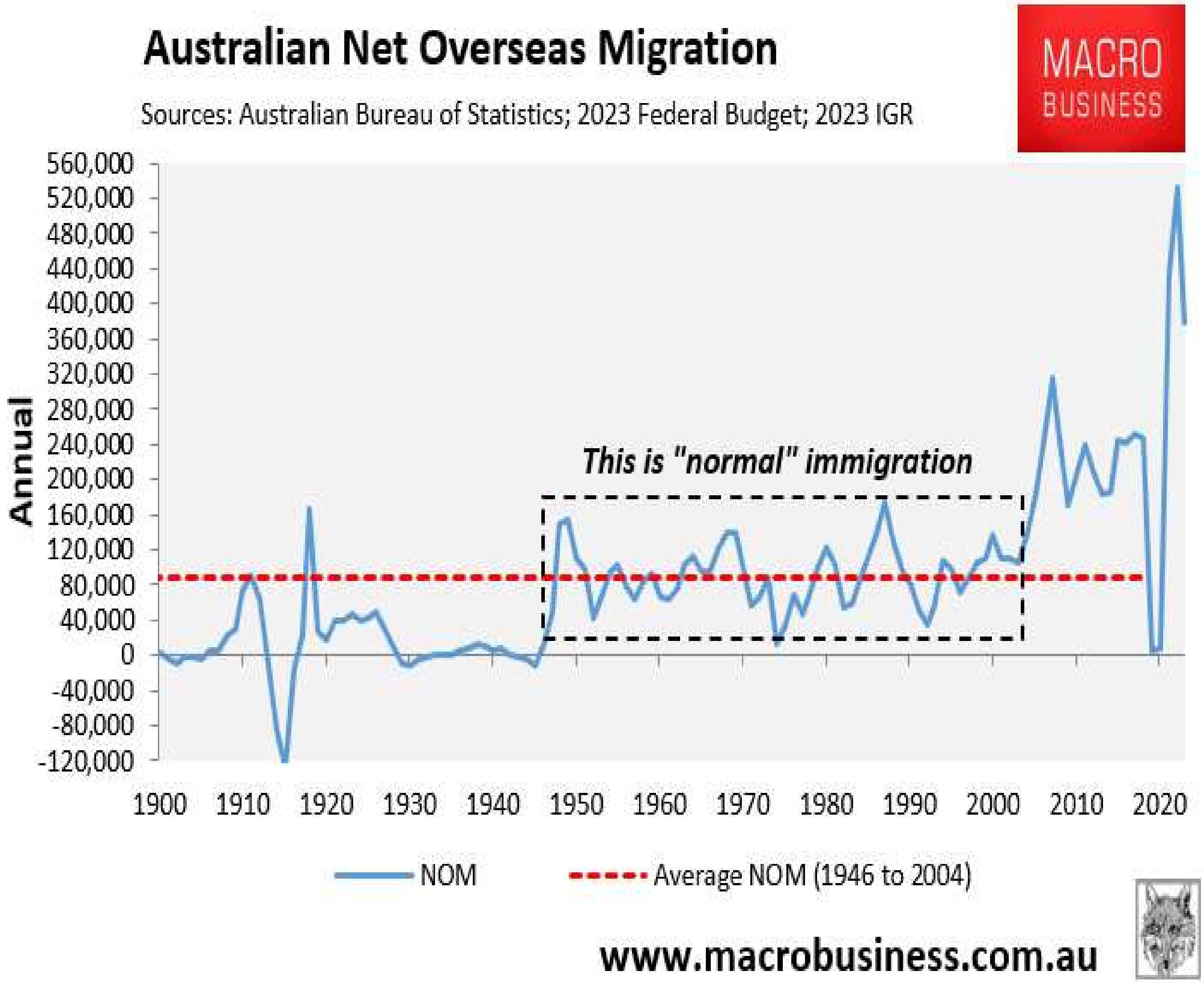
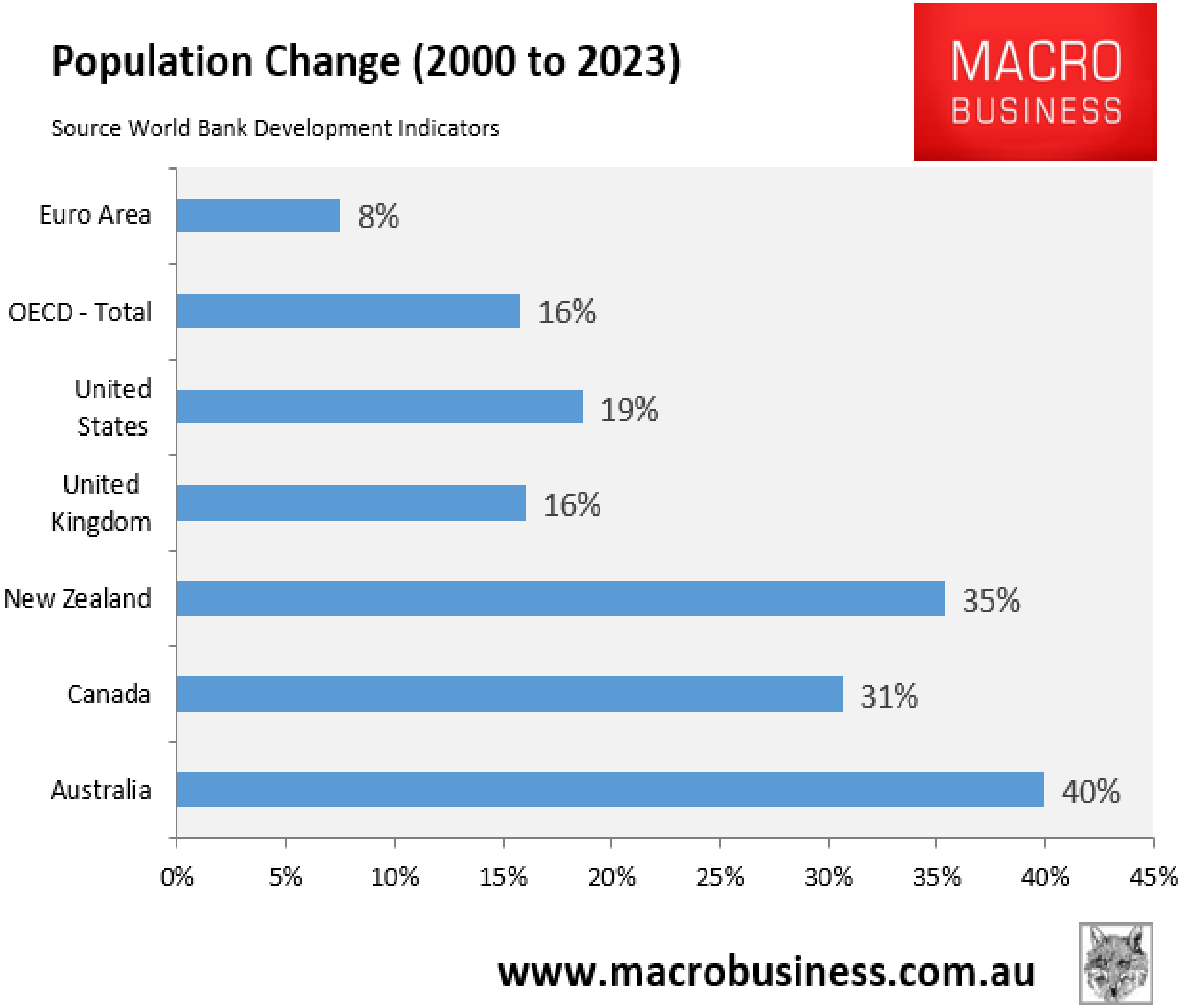
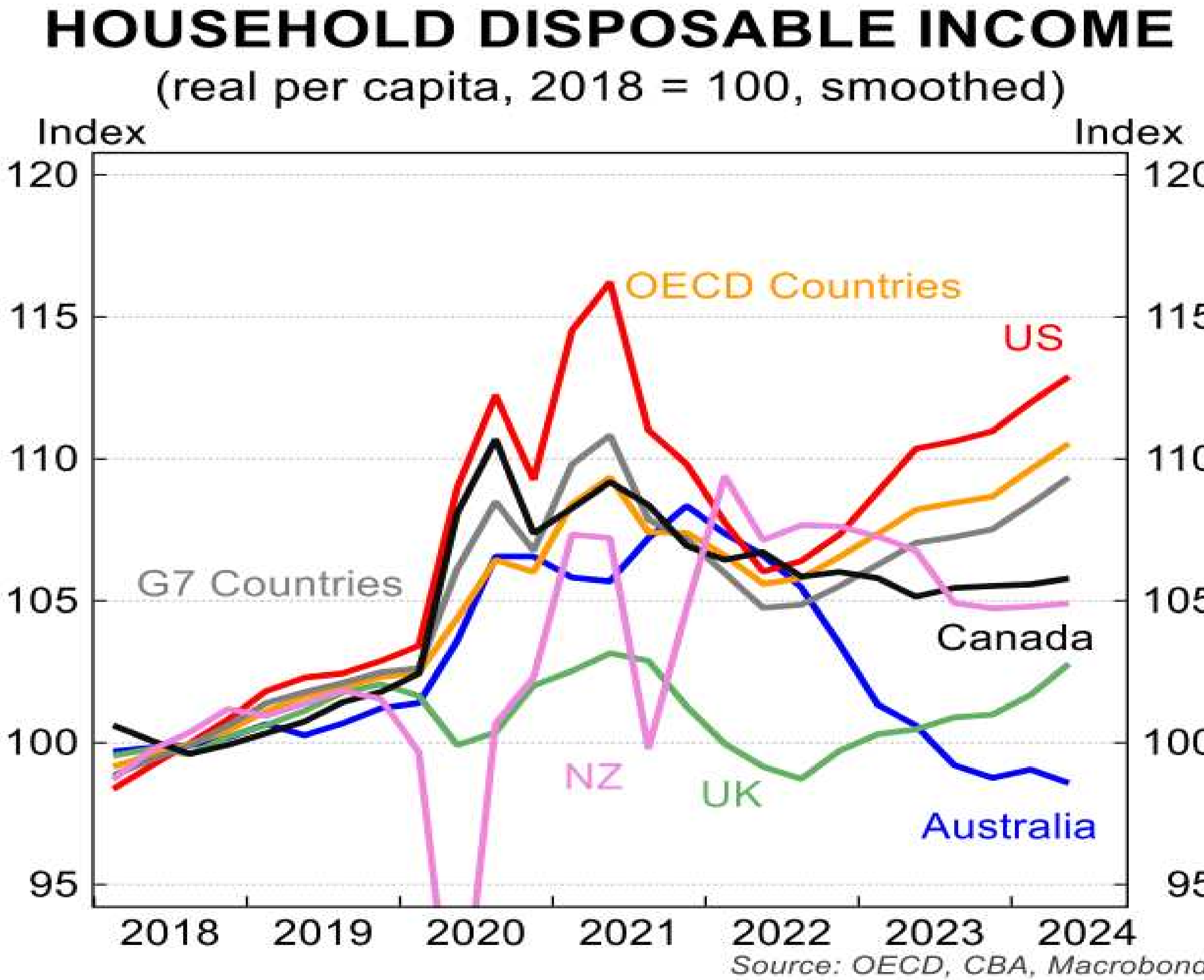
[2] For many years, Australian governments had boasted that it was a "miracle economy" that had suffered no recession for three decades. This claim relied on the arbitrary measure of no two quarters of negative GDP growth but ignored population growth. In per capita terms, Australia's record is mediocre at best. See https://www.stlouisfed.org/on-the-economy/2019/september/australia-28-year-expansion. Over the past two years, measures of average standards of living have fallen. See https://www.imf.org/en/News/Articles/2024/10/02/mcs-australia-staff-concluding-statement-of-the-2024-article-iv-mission and the following tables.

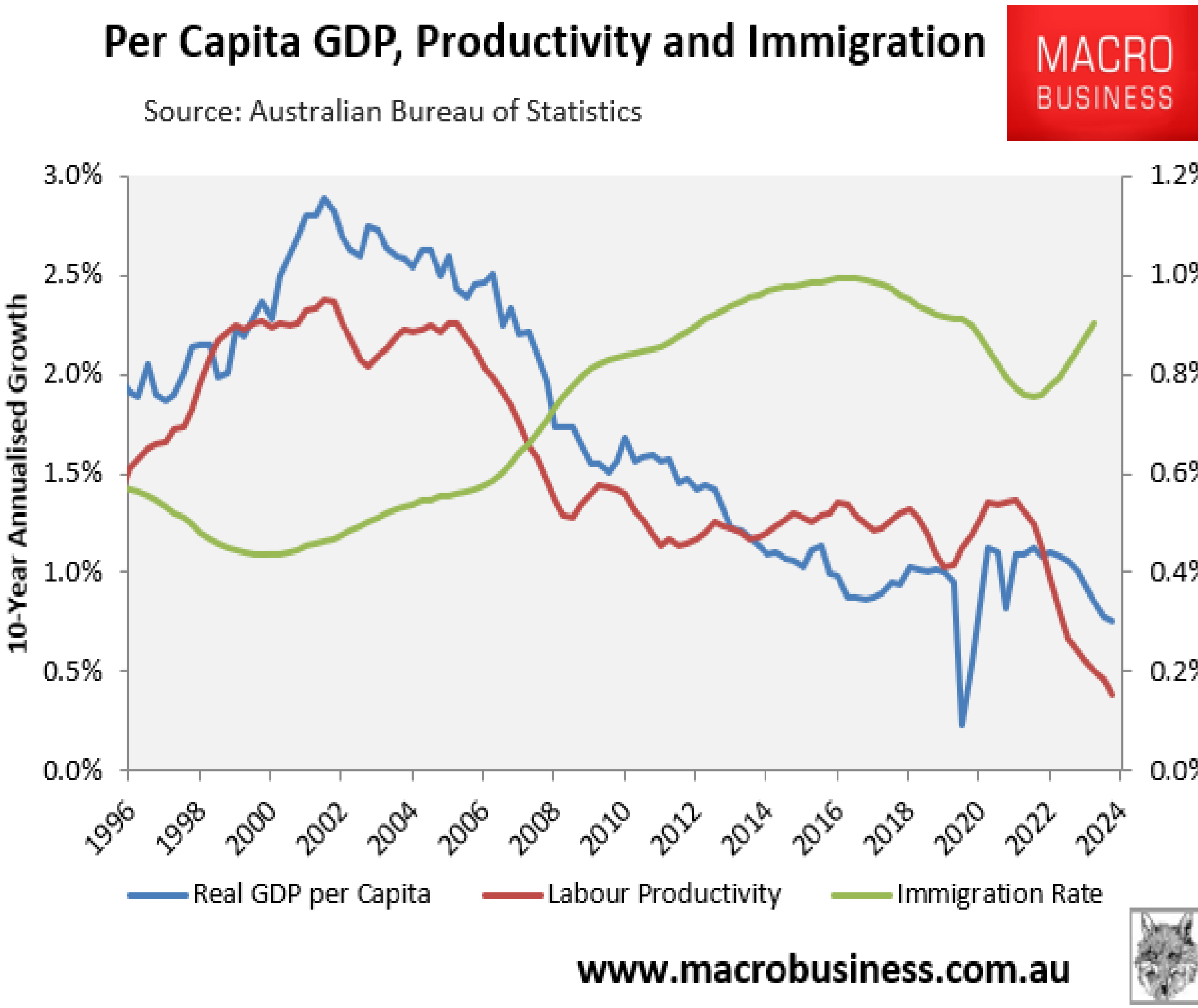
[3] By the early 2000s it was clear that this program had very perverse incentives; the situation has since deteriorated. See https://www.econ.queensu.ca/sites/econ.queensu.ca/files/qed_wp_1080.pdf



Australian Net Overseas Migration
Sources: Australian Bureau of Statistics; 2023 Federal Budget; 2023 IGR
MACRO
BUSINESS
Annual
560,000
520,000
480,000
440,000
400,000
360,000
320,000
280,000
240,000
200,000
160,000
120,000
80,000
40,000
0
-40,000
-80,000
-120,000
This is "normal" immigration
1900
1910
1920
1930
1940
1950
1960
1970
1980
1990
2000
2010
2020
NOM
Average NOM (1946 to 2004)
www.macrobusiness.com.au


Population Change (2000 to 2023)
Source World Bank Development Indicators
MACRO
BUSINESS
Euro Area
8%
OECD - Total
16%
United States
19%
United Kingdom
16%
New Zealand
35%
Canada
31%
Australia
40%
0%
5%
10%
15%
20%
25%
30%
35%
40%
45%
www.macrobusiness.com.au


HOUSEHOLD DISPOSABLE INCOME
(real per capita, 2018 = 100, smoothed)
Index
Index
120
115
110
105
100
95
OECD Countries
US
G7 Countries
Canada
NZ
UK
Australia
2018
2019
2020
2021
2022
2023
2024
Source: OECD, CBA, Macrobond


Per Capita GDP, Productivity and Immigration
Source: Australian Bureau of Statistics
MACRO
BUSINESS
10-Year Annualised Growth
3.0%
2.5%
2.0%
1.5%
1.0%
0.5%
0.0%
1.2%
1.0%
0.8%
0.6%
0.4%
0.2%
0.0%
1996
1998
2000
2002
2004
2006
2008
2010
2012
2014
2016
2018
2020
2022
2024
Real GDP per Capita
Labour Productivity
Immigration Rate
www.macrobusiness.com.au

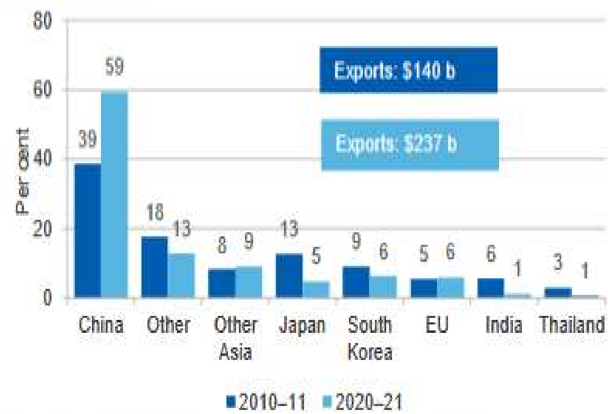
1.3 Australian Exports

The large mining and commodity sectors dominate Australian exports, with major markets being China, Japan, India and other Asian countries. The following graphs and tables provide details.[4]

Figure 16.1: Industry shares of GDP

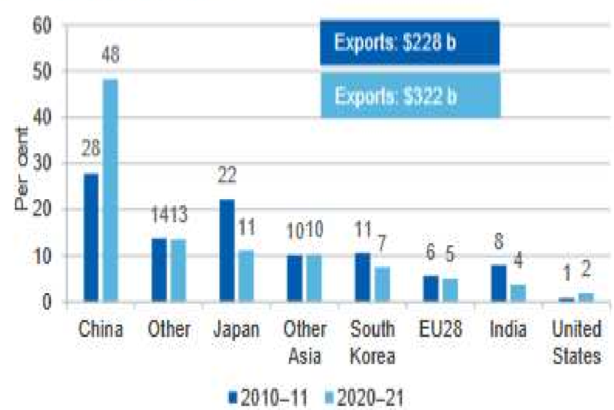
Source: ABS (2021) Australian National Accounts, National Income, Expenditure & Production, 5204.0

Figure 16.3: Principal markets for Australia's resources exports, 2021–22 dollars



Source: ABS (2022) International Trade in Goods and Services, 5368.0

Figure 16.2: Principal markets for Australia's resources and energy exports, 2021–22 dollars



Source: ABS (2022) International Trade in Goods and Services, 5368.0

Figure 16.4: Principal markets for Australia's energy exports, 2021–22 dollars

Source: ABS (2022) International Trade in Goods and Services, 5368.0

[4] Table and charts from the Australian Department of Industry Science and Resources: https://www.industry.gov.au/sites/default/files/minisite/static/b3caf4fd-b837-4cc5-b443-38782298963a/resources-and-energy-quarterly-june-2022/documents/Resources-and-Energy-Quarterly-June-2022-Trade-Summary-Charts.pdf

Table 16.1: Principal markets for Australia's thermal coal exports, 2021–22 dollars

	Unit	2016–17	2017–18	2018–19	2019–20	2020–21
Japan	$m	9,167	10,744	12,495	8,850	7,313
South Korea	$m	2,854	3,245	4,096	3,014	2,679
Taiwan	$m	2,515	2,807	3,397	2,530	2,150
Vietnam	$m	162	139	714	1,104	742
Malaysia	$m	717	816	972	567	584
Thailand	$m	324	405	430	458	541
Total	**$m**	**21,041**	**24,667**	**27,890**	**21,603**	**16,694**

Source: ABS (2022) International Trade in Goods and Services, 5368.0

Table 16.2: Principal markets for Australia's metallurgical coal exports, 2021–22 dollars

	Unit	2016–17	2017–18	2018–19	2019–20	2020–21
India	$m	9,316	10,356	12,079	7,941	7,908
Japan	$m	7,724	7,933	8,227	6,451	4,949
South Korea	$m	4,107	4,005	4,323	3,216	2,850
China	$m	8,520	9,148	10,625	10,366	1,741
Taiwan	$m	2,028	2,111	2,790	2,113	1,390
Netherlands	$m	2,100	1,956	1,925	1,316	924
Total	**$m**	**39,334**	**41,274**	**46,884**	**36,308**	**24,192**

Source: ABS (2022) International Trade in Goods and Services, 5368.0

Table 16.4: Principal markets for Australia's LNG exports, 2021–22 dollars

	Unit	2016–17	2017–18	2018–19	2019–20	2020–21
Japan	$m	12,592	15,848	22,789	21,128	12,179
China	$m	6,349	10,441	18,783	17,257	11,879
South Korea	$m	2,844	4,027	5,702	5,472	3,495
Taiwan	$m	283	816	2,518	2,749	2,339
Singapore	$m	1,592	1,240	1,329	1,102	861
Malaysia	$m	233	397	937	1,543	521
Total	**$m**	**24,833**	**33,754**	**53,428**	**50,388**	**31,782**

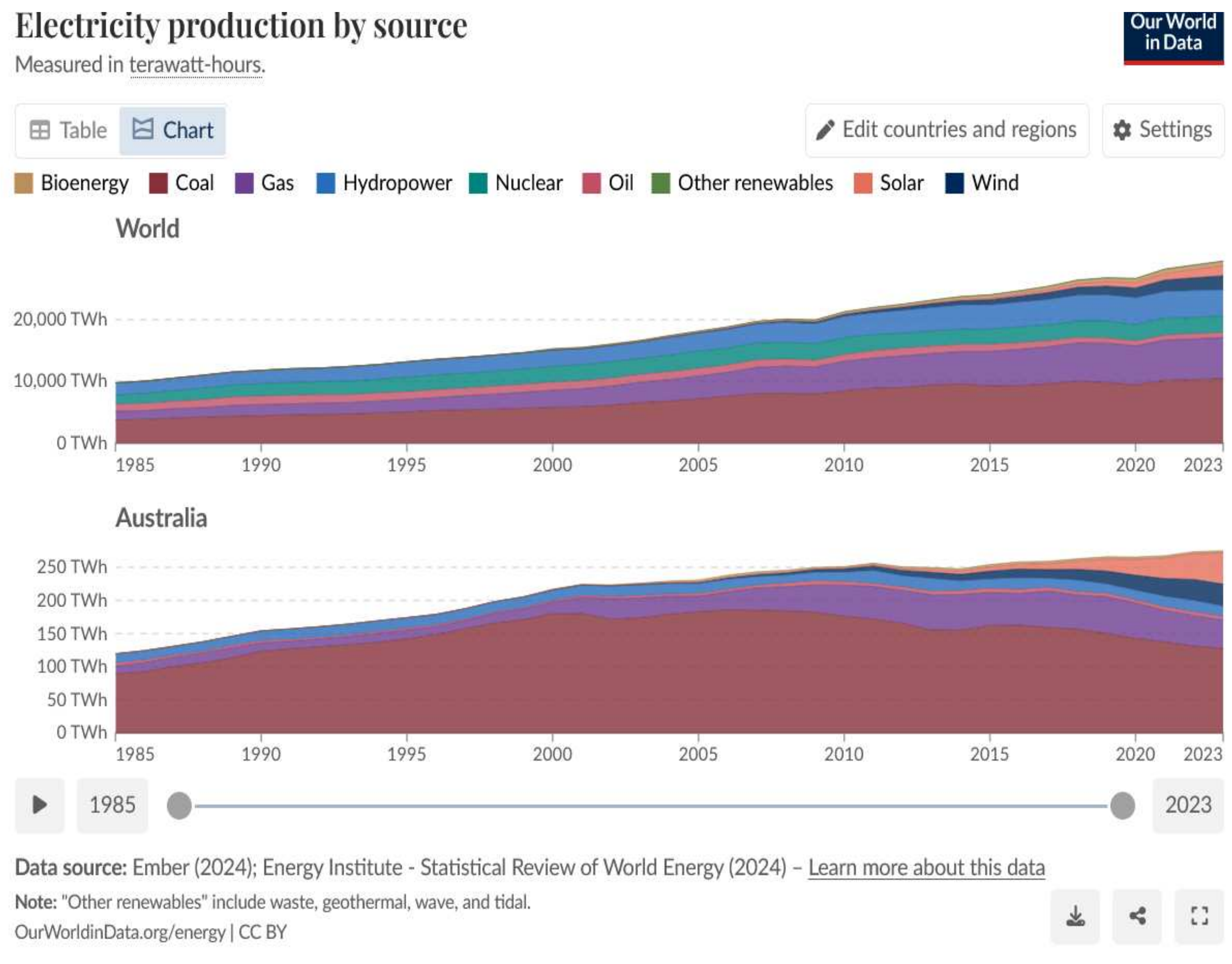
Notes: Department of Industry, Science and Resources estimates based on International Trade Centre data, except for 2016–17 where ABS trade data is available.

Source: ABS (2022) International Trade in Goods and Services, 5368.0; International Trade Centre (2022) International Trade Statistics

2. Recent History of the Electricity Market in Australia

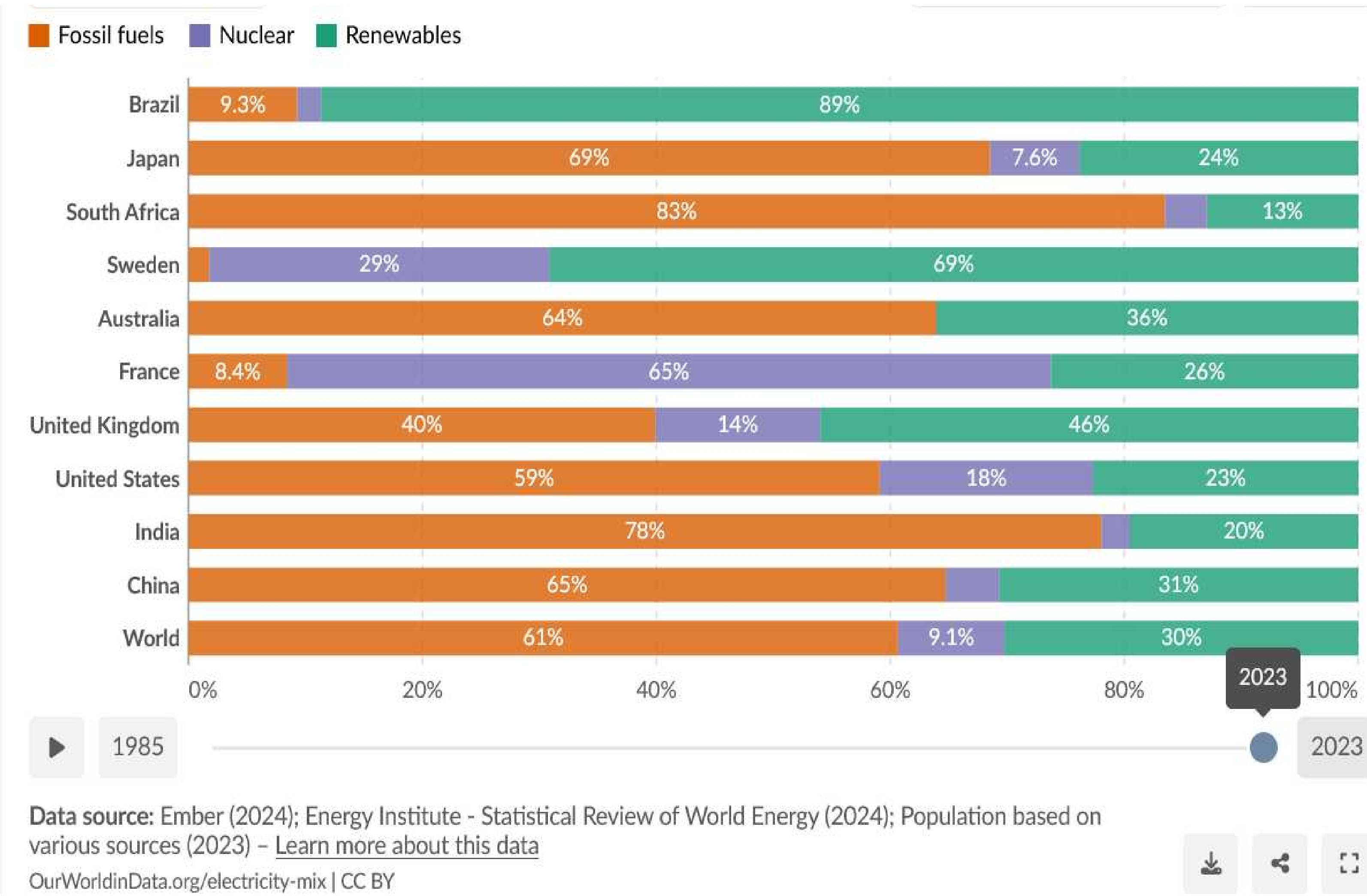
Since the 1950s, Australia's electricity generation has been dominated by brown coal plants in Victoria and black coal plants in the other States. These sources were supplemented by hydro electricity generated largely by the Snowy Mountains Dams and Hydro system. Since the 1980s, natural gas has been the third source, and this has gradually increased in subsequent years. Notice that Australia has no nuclear generation – that source of power was banned in 1998.[5] Beginning in 2010, government policies at the Federal and State levels have responded to political calls to phase out fossil fuels and replace them with wind and solar generation (see the following chart). More recently, the ALP State and Federal governments (with support from minor Green parties) have tried to implement an NZ policy requiring 80% RE by 2030.

[5] https://www.energycouncil.com.au/analysis/nuclear-power-for-australia-a-potted-history/



Equally interesting is the composition of electricity generation in a selection of other countries compared to that in Australia. The graph below shows that there is wide variation in sources of generation across countries.[6] Observe that large importers of Australian fossil fuels are China, Japan and India.

[6] In this graph, observe that renewables will include hydro electricity generation and biomass. The latter is significant in developing countries.



3. Australian Domestic and Export Energy Resources

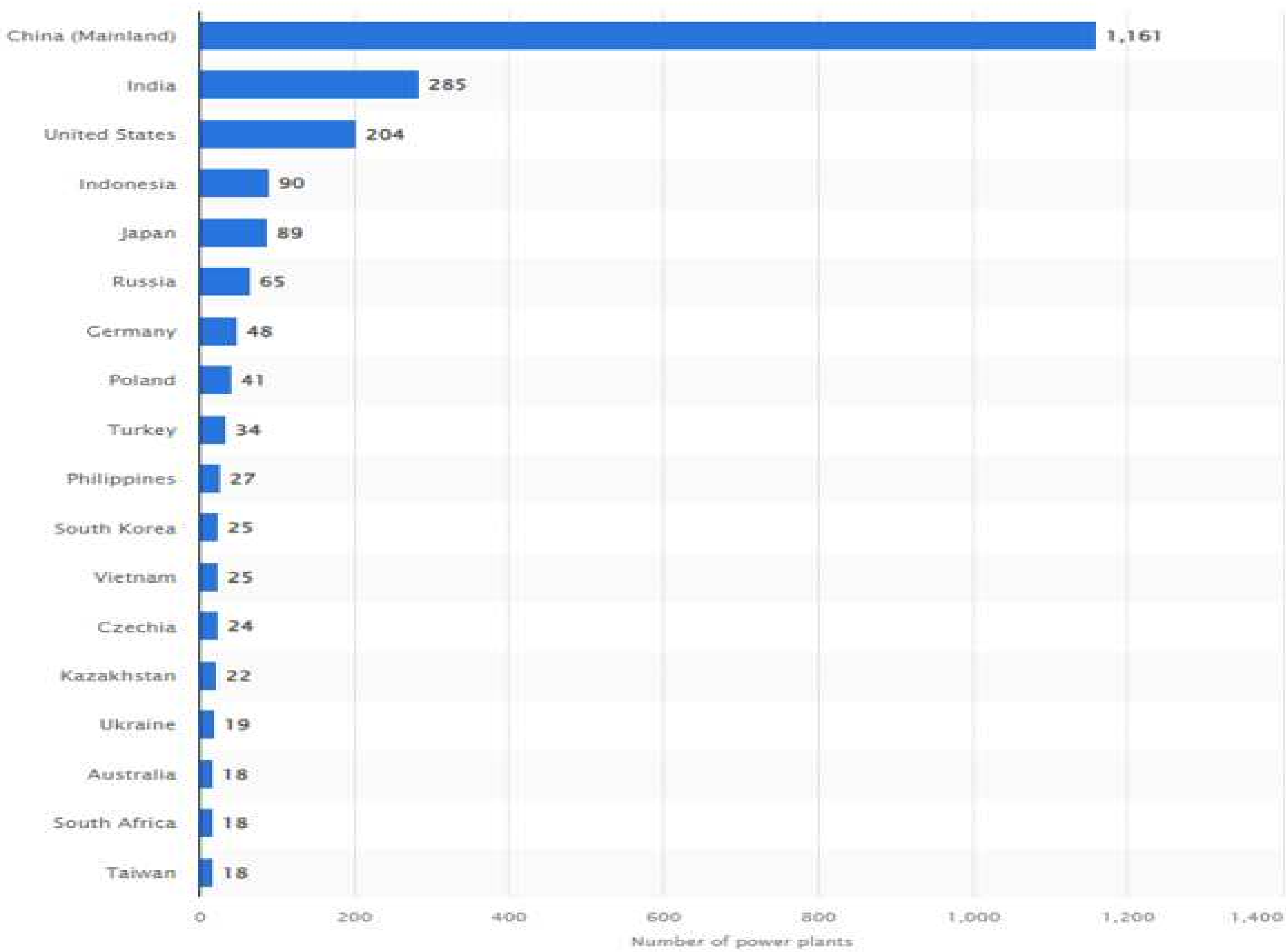
3.1 Coal Generation[7]

For many decades, coal has been the main fuel source for Australian electricity generation. Victoria has very large deposits of brown coal in the Gippsland region, and this has been the main source of electricity generation for the State. The generators are located close to the brown coal deposits. Brown coal is difficult to transport as it has relatively high-water content and suffers from the risk of

[7] For a comprehensive discussion of the Australian coal industry, see https://www.ga.gov.au/education/classroom-resources/minerals-energy/australian-energy-facts/coal

spontaneous combustion. Other States have relied largely on significant deposits of black coal, which can be transported over large distances, including exports. Many Australians are unaware that their country has a tiny percentage of the world's coal-fired power plants, dwarfed by China, India, USA, Indonesia, Japan and many others. Shutting down the Australian coal-fired plants would have negligible impact on world CO_2 production.

Number of Coal Fired Power Plants



Source: Statista

3.2 Natural Gas

Australian official sources have provided a good description of the gas industry:[8]

"*Since the early 1970's, following the discovery of the supergiant (>10 trillion cubic feet 'Tcf') and giant (>3 Tcf) gas fields on the Northwest Shelf, Australia's identified conventional gas resources have grown substantially – increasing fivefold. About 93 per cent of conventional gas resources are located on the Northwest Shelf with gas produced from the Northern Carnarvon, Browse and Bonaparte basins providing feedstock to seven LNG projects (Gorgon, Wheatstone, Northwest Shelf, Pluto, Prelude, Ichthys and Darwin).*

CSG is largely methane gas that is extracted from shallow coal seams (<1,500 m depth) using hydraulic stimulation. Most of Australia's CSG resources are produced in Queensland, where they form feedstock for three major LNG projects ((Queensland-Curtis LNG (QCLNG), Australia Pacific LNG (APLNG) and Gladstone LNG (GLNG))."[9]

Other smaller gas resources are scattered around the country. For example, the offshore gas field in Gippsland, Victoria, has operated for decades, supplying the State with natural gas for households and manufacturing. That field is now largely exhausted. When the gas industry claimed that there was extensive onshore gas fields close to the brown coal generating plants, the Victorian State government passed a bill banning exploration of this field. But in 2020, the government changed course:

"*The Victorian government has lifted the moratorium on exploration for conventional oil and gas resources, at the same time placing a permanent ban on hydraulic fracturing and on coal seam gas exploration in the state.*

Victorian Premier Daniel Andrews said the government has introduced two bills into the state parliament to give effect to the actions.

Hydraulic fracturing was banned in Victoria in 2017… During the 2018 election campaign, the Andrews-led Labor Party promised to enshrine that ban in the Constitution to make it harder for any future government to overturn.

The decision to allow a resumption of conventional onshore exploration follows 3 years of detailed investigations by the Victorian Gas Program which found an

[8] For a detailed discussion of the Australian gas industry, see https://www.ga.gov.au/digital-publication/aecr2023/gas

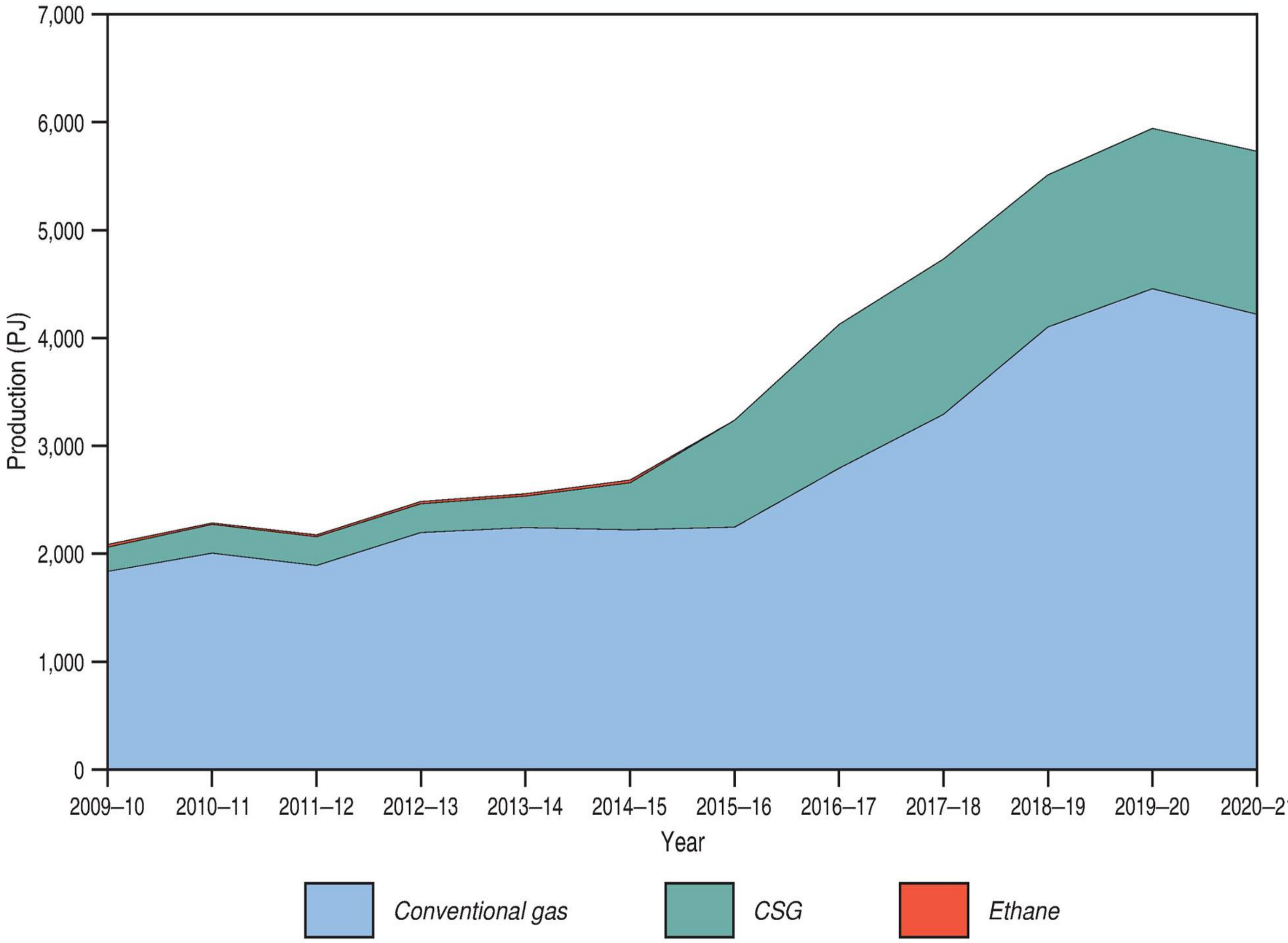
[9] Extract from the Summary: https://www.ga.gov.au/digital-publication/aecr2023/gas

onshore conventional gas industry would not compromise the State's environmental and agricultural credentials."[10]

The State is now facing a gas shortage. The Victorian government has announced plans to install an LNG storage terminal in Corio Bay: Australia will ship LNG from Western Australia to Victoria.[11] Ships will travel thousands of kilometres, requiring extra costs to liquefy and deliquefy the LNG, while onshore gas lies idle only 300 kilometres away from Melbourne.

The following graph provides a time series of production of conventional and methane gas. There was a dramatic increase in production beginning in 2015, more than doubling in total by 2020. The increase in LNG production has roughly tripled!

[10] https://www.ogj.com/general-interest/government/article/14169897/victoria-lifts-moratorium-on-onshore-conventional-exploration
[11] https://www.abc.net.au/news/2025-05-30/viva-energy-gas-terminal-project-approved-victoria/105356430

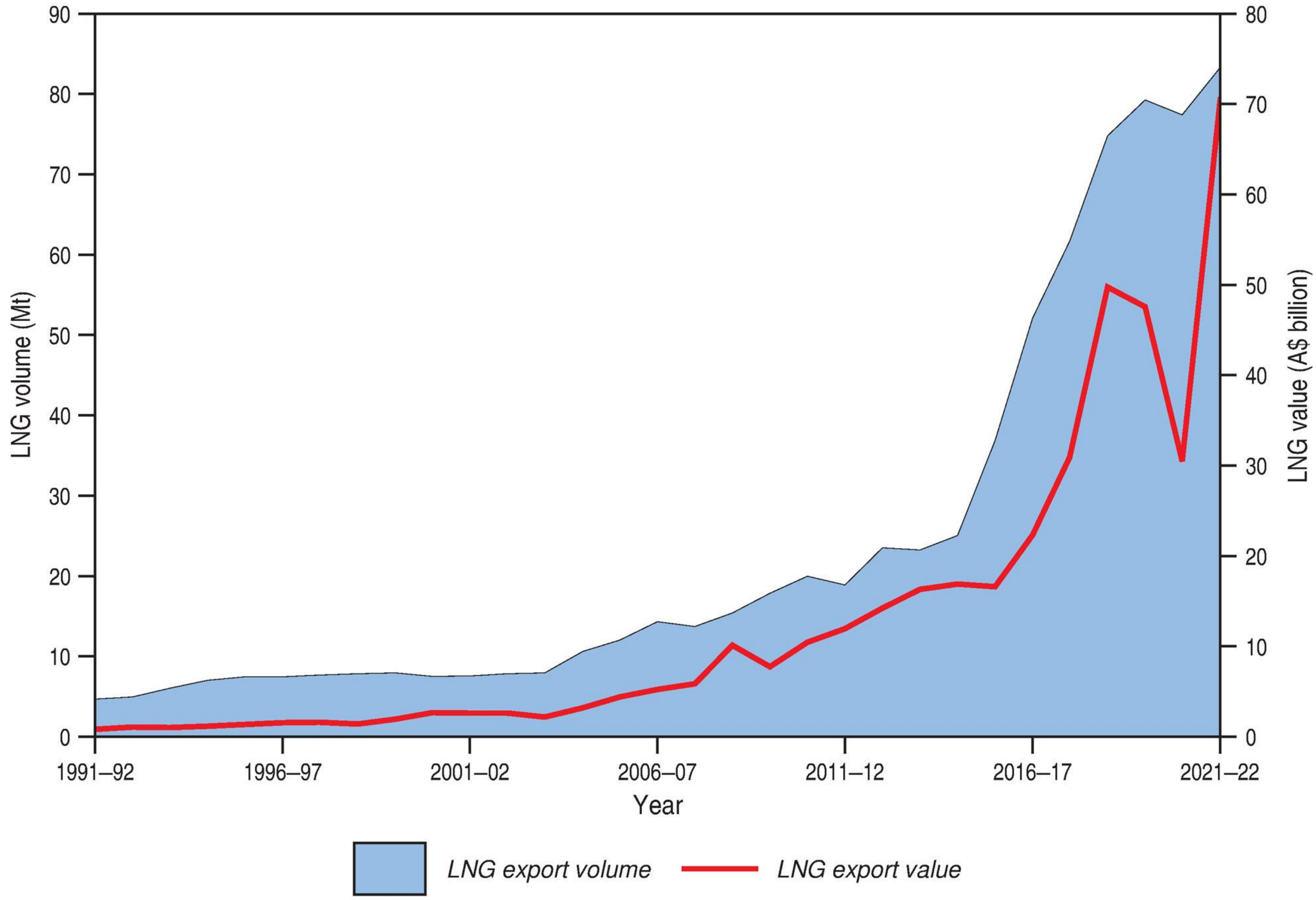


Source: Department of Climate Change, Energy, the Environment and Water, Australian Energy Statistics, Table Q3, September 2022.
Note: CSG = coal seam gas. PJ = petajoules. Ethane data is included with the conventional gas from 2015–16 onward to protect confidentiality. AECR 2.8

As indicated in the graphs below, Australia is a major exporter of LNG, largely sourced from the offshore fields on the Northwest Shelf.

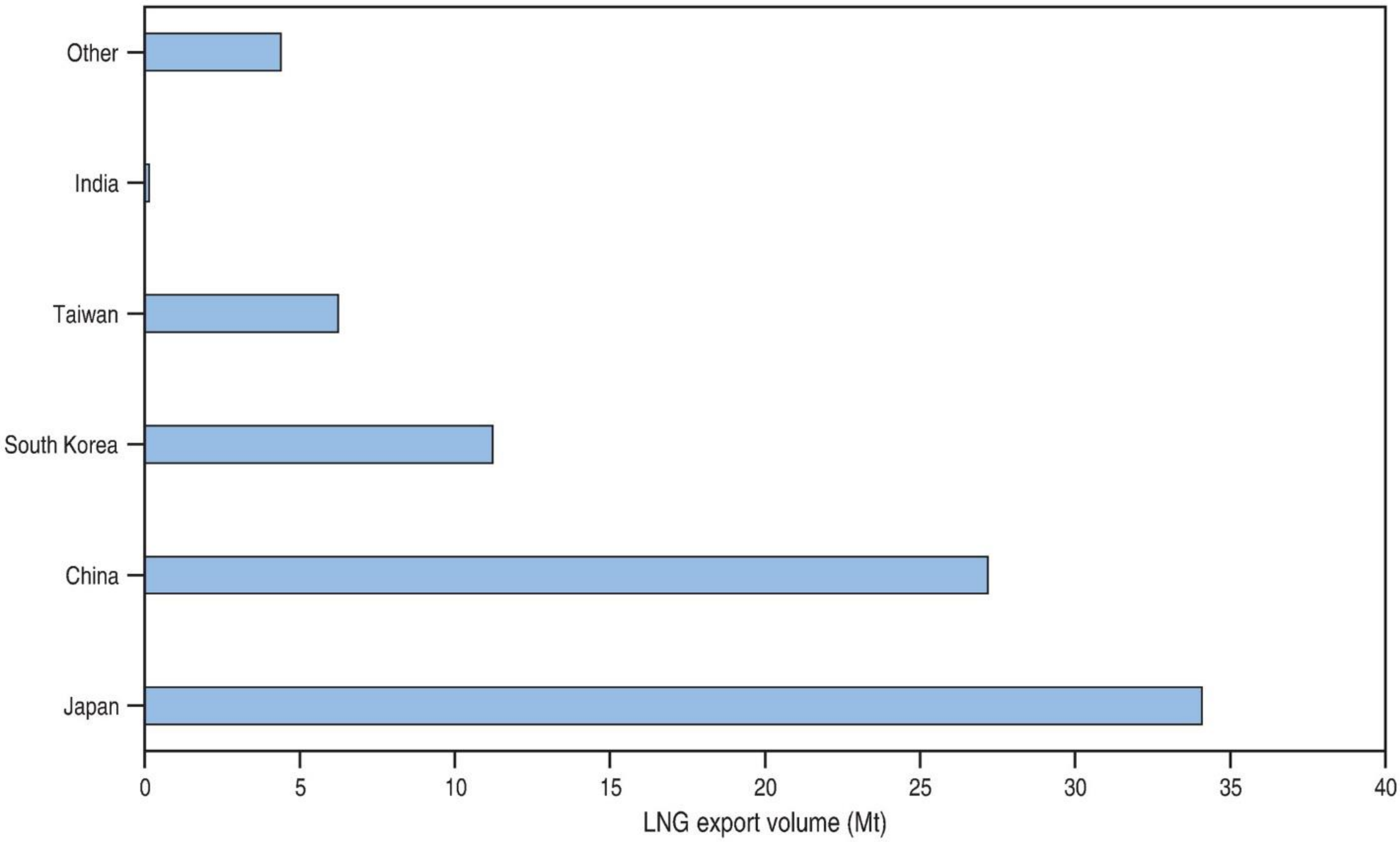
"*Nearly all of Australia's LNG exports were delivered to Asian markets in 2020–21… Japan accounted for 41 per cent (equivalent to 34.1 Mt), followed by China (33 per cent, equivalent to 27.2 Mt) and the Republic of Korea (13 per cent, equivalent to 11.2 Mt; Department of Industry, Science and Resources, 2022)*."[12]

[12] Extract from the Trade section: https://www.ga.gov.au/digital-publication/aecr2023/gas



Sources: Department of Industry, Science and Resources, Commonwealth of Australia Resources and Energy Quarterly September 2022., Tables 1 and 2(2).
Note: LNG = liquefied natural gas. Mt = million tonnes. A$ billion = billion Australian dollars.

AECR 2.10



Sources: Department of Industry, Science and Resources, Commonwealth of Australia Resources and Energy Quarterly December 2022, Table 38.
Note: Other = all other countries. LNG = liquefied natural gas. Mt = million tonnes.

AECR 2.11

4. The Impact of NZ Policies on the Australian Coal and Gas Industries

Australian Federal and State governments, to varying degrees, have followed Western governments on climate policies. Over the past two decades, these policies have demonized carbon dioxide as a "pollutant", a major factor increasing global warming, creating various negative consequences (e.g. extreme weather). Tragically, what should have been a careful theoretical and empirical investigation of complex climate dynamics has degenerated into an ideological political crusade, with abuse and punishment for careful scientific, technological and economic analysis that questions various CC hypotheses. Often, discussion is silenced by CC proponents saying that "*the science is settled*".[13] Unfortunately, the foundation for recent policies advocating RE is based on very shaky ground.

Assuming the hypotheses that carbon (dioxide) is a *significant* driver of CC, and that its human production must be greatly reduced, much of the policy discussion has limited understanding of the quantitative and technical issues concerning the operation of electricity systems. For example, the dominant MSM and political discussion has no idea of the relevant magnitudes of CO_2 production across countries. As the chart below demonstrates, Australia's production of CO_2 relative to major emitters is negligible. *If* this empirical evidence is quoted, it is usually dismissed using the second line of defence, claiming that the reduction of CO_2 is "*a great moral challenge*"[14] and so the empirical evidence should be ignored.

An additional concern is the low level of scientific, engineering and economic knowledge of most politicians and the MSM. For example, public discussions on energy usage concentrate on household consumption, largely ignoring the importance of energy in commercial, manufacturing and transport industries.[15] Furthermore, indirect usage of major oil, coal and gas inputs into other products (e.g. fertilizer, plastics, cement) are ignored in political and MSM discussions.[16]

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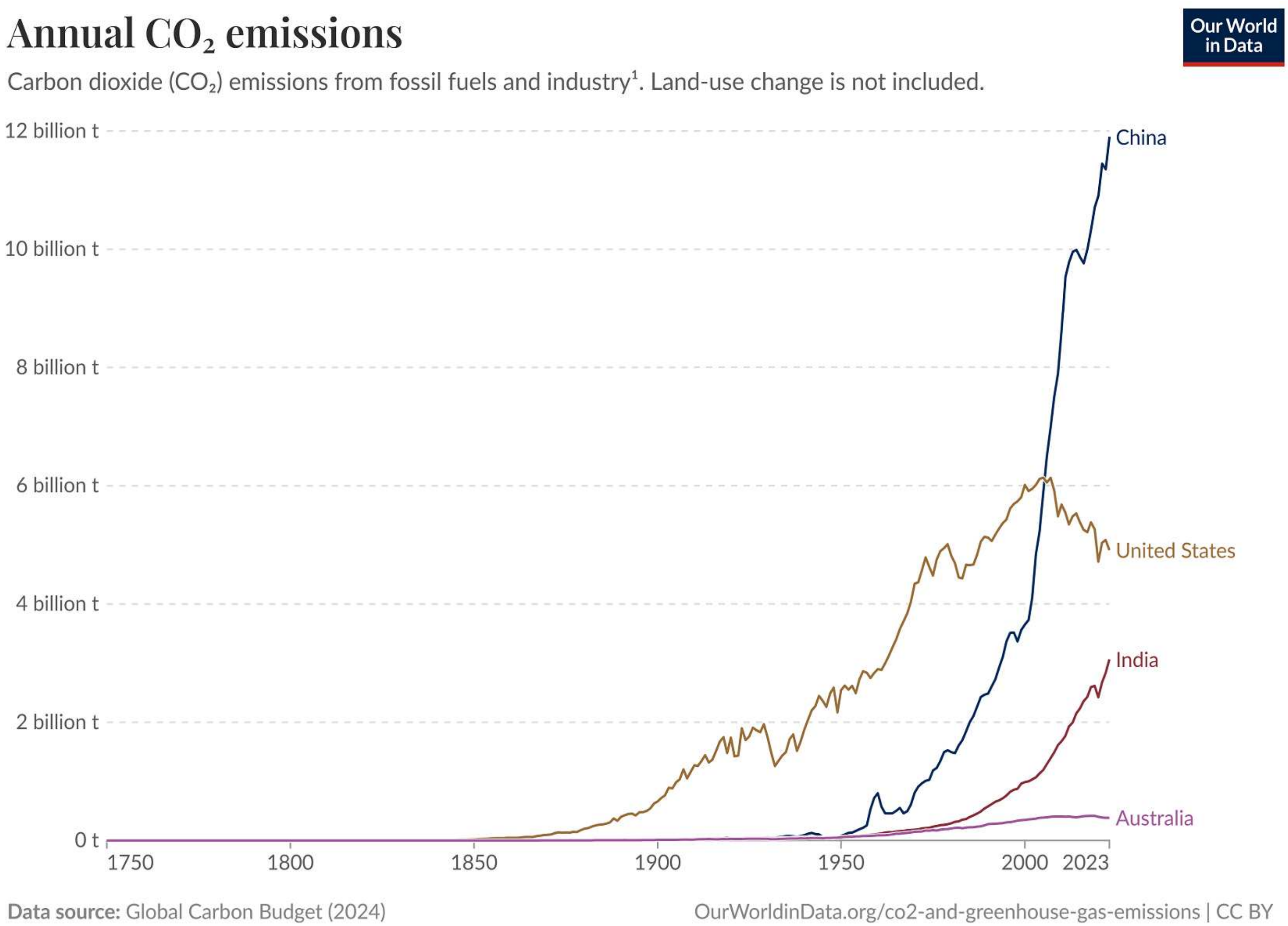
[13] There is a significant technical literature that critiques various empirical and theoretical claims of CC hypotheses. For a recent book that summarizes the known evidence, unsolved puzzles and complexity of the science, see Koonin (2024). See also the report from the US Dept of Energy (Christy et al., 2025). For a shorter survey, see DeAngelo and Curry (2025) and the accessible discussion in Shellenberger (2020).

[14] See an excerpt from a 2007 speech by Australian Prime Minister Kevin Rudd: https://www.youtube.com/watch?v=CqZvpRjGtGM

[15] An exception is automobiles, where there is widespread discussion of electric vehicles replacing cars that use petroleum. The MSM seldom discuss the dependence of aircraft, shipping, agriculture machinery, long-haul road and rail on petroleum.

[16] See Smil (2022) for a detailed discussion of the few major inputs on which modern civilization depends: concrete, steel, ammonia and plastic. Each of these products require a heavy reliance on fossil fuels for their manufacture.



Assuming that CO_2 is to be reduced, certain industries have been targeted. Coal and natural gas have been central to electricity generation in Australia over the last century and in the early decades of this century. In what follows we will discuss recent policy decisions impacting both industries, their changing role in Australian electricity generation and the relatively recent widespread introduction of wind and solar RE.

5. NZ Policies and the Mass Introduction of Solar and Wind Generation

Over the past two decades, Australian governments have provided a range of incentives, both regulatory and financial, to replace fossil-fuel-powered electricity generation with RE generation, primarily solar and wind. The LNP has been divided between proponents and opponents of rapid RE adoption. The ALP has been an enthusiastic supporter of the rapid introduction of RE generation and the Net Zero Paris requirements. The current Federal ALP government first elected in 2022 (and re-elected in 2025) has accelerated RE adoption with aggressive policies aimed at having 80% RE generation by 2030.[17] Before it was elected in 2022, the ALP repeatedly claimed that with its policies, average annual domestic electricity bills would fall by AUD 275. It became obvious over the following three years that those bills from the grid *rose* by several hundred dollars per household per annum. But this was just a symptom of more serious issues. In this section we will explain how the NZ/RE policies have failed by ignoring careful scientific, technological (electrical systems engineering) and basic principles of economic project analysis and evolving international experience with RE systems.

5.1 Rooftop Solar

The Australian Federal and State governments have encouraged rooftop solar installation for households using various subsidy schemes.[18] Rooftop solar is claimed to provide an increasing supply of cheap domestic electricity.[19] These schemes encourage the domestic installation of batteries that allow consumers to buy and sell from the grid. These claims confuse installed capacity with electricity delivery and avoid discussing the added cost of intermittency imposed on the baseload power grid. Householders with solar panels claim they are saving electricity costs, while ignoring their large subsidies paid through general taxation and the intermittency costs imposed on the grid, and, by implication, on those

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[17] See https://www.aph.gov.au/About_Parliament/Parliamentary_departments/Parliamentary_Library/Research/Chronologies/2022-23/climatechange2021 for a history of CC/RE policies up to 2021. On the new government's Climate Change Act passed by the Senate in September 2022, see https://www.aofm.gov.au/sites/default/files/2024-02-02/Climate%20change%20slides%20updated%20February%202024.pdf (AOFM, 2024) and https://cer.gov.au/news-and-media/media/2021/november/australia-reaches-3-million-solar-milestone

[18] See https://minister.dcceew.gov.au/bowen/media-releases/australias-rooftop-solar-revolution-reaches-astonishing-new-heights and https://cleanenergycouncil.org.au/news-resources/rooftop-solar-generates-over-10-per-cent-of-australias-electricity

[19] With the 2025 re-election of the ALP government, it pledged to accelerate the introduction of renewable energy so that Australia will become an "RE superpower": https://theconversation.com/australia-is-set-to-be-a-renewables-nation-after-labors-win-theres-no-turning-back-256081

households and industries who rely on baseload power. The same issues occur with solar farms.

5.2 Solar Farms

The election of the ALP government in 2022 accelerated the introduction of large-scale solar farms in rural areas. Subsidies and regulations were imposed to dramatically increase their installation.[20] To connect these land-intensive solar farms to the grid requires a large network of new transmission lines. Most cost analyses used by the government to promote these installations ignore a full analysis of the costs of system-wide transmission, intermittency, etc. Invariably, these costs appear in an increasing tax burden and electricity pricing. (We will explore these costs of RE below.)

5.3 Wind Farms

Support for large-scale onshore and offshore wind farms follows the same policy strategy as solar farms. Various subsidies and government-sponsored investment schemes make private onshore windfarms profitable to the private investors. However, cost-benefit studies show that the profitability of these same windfarms for society, after taking into consideration the subsidies required from government, were negative.[21] Even more disturbing is the construction of some very land-intensive wind farms and their transmission lines, violating standard environmental regulations. A particularly egregious example was the destruction in 2023–24 of a large area in a national park, angering local Indigenous people and environmentalists; the Federal government ignored them.[22]

The government has heavily promoted offshore wind farms, ignoring international evidence that these wind farms (and deep-water wind farms in particular) are significantly more expensive than onshore wind farms.[23] There are some indications that private investors in the EU, UK and Australia are becoming wary of these projects.[24]

5.4 Pumped Hydro Storage

[20] For some indication of the myriad schemes see https://arena.gov.au/funding/ and https://arena.gov.au/renewable-energy/large-scale-solar/
[21] See https://arena.gov.au/assets/2024/09/ARENA-Investment-Plan-2024.pdf
[22] https://stopthesethings.com/2023/08/06/habitual-habitat-destruction-wind-industry-wiping-out-vast-tracts-of-virgin-rainforest/
[23] For a recent summary of UK empirical research see Darwell (2023), section 3.3.
[24] Darwell (2023), section 3.4.

Australian governments have acknowledged that wind and solar power are intermittent. They argue that this deficiency can be solved by storing excess RE energy in peaks and releasing it in lower generation periods. The two main solutions in operation are pumped hydro and batteries. The economic feasibility of large pumped hydro schemes is sensitive to several factors, including the geography of potential sites and requirements for domestic, industry and agriculture water demand. There are some small Australian pumped hydro projects, but by far the largest is the Snowy 2.0 project currently undergoing construction.[25] While originally planned in 2018 with a claimed cost of AUD 3.62 billion, to be completed in 2024, the project has run into difficulties, with major cost increases (some estimate AUD 12 billion) and a completion date of 2028.[26] It has become obvious that the scheme was not adequately researched and planned. It was a political decision that has become a project planning embarrassment.[27]

5.5 Large Battery Storage Plants

Large-scale battery storage plants have been proposed and subsidized by various schemes. Many plants are in the planning stage.[28] Most existing battery systems are relatively small, introduced in isolated communities. An exception is the large plant in Hornsdale, South Australia, designed as back-up to a dominant RE system.[29] Planned large battery plants are designed as supplements to wind and solar plants to create a stable baseload electricity system. The costs of RE supplemented by many battery plants are prohibitively expensive.[30]

5.6 RE Intermittency and Gas Turbine Generation

Another solution to RE intermittency is to introduce natural-gas-powered turbines. Gas turbines have a relatively low initial capital cost, but high running costs, given recent international gas prices. They are flexible enough to produce electricity when RE supply declines. Australian and State governments have confusing (even incoherent) policies concerning the use of natural gas. Some States (for example Victoria) wish to phase out gas completely.[31] Other States (Queensland and

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[25] https://www.power-technology.com/projects/snowy-2-0-hydropower-project/?cf-view
[26] https://www.abc.net.au/news/2023-08-31/snowy-hydro-reset-project-to-cost-12-billion/102797650
[27] https://theconversation.com/pushing-water-uphill-snowy-2-0-was-a-bad-idea-from-the-start-lets-not-make-the-same-mistake-again-216170
[28] https://reneweconomy.com.au/big-battery-storage-map-of-australia/
[29] https://hornsdalepowerreserve.com.au/
[30] https://www.mackinac.org/blog/2024/better-batteries-wont-save-the-energy-grid
[31] As the Victorian offshore gas reserves are almost exhausted, the ALP State government banned onshore gas production – even though there are claims that large reserves of gas are located close to existing large brown coal generators.

Western Australia) are major producers of gas for domestic use and exports. Constant policy changes and confusion have endangered natural gas investment, given the costs of regulatory risk. As a result, Australia, which is a major exporter of LNG from Western Australia, is contemplating importing LNG for its regulatory constrained East Coast. An additional cost is that increasing sovereign risk is worrying major international LNG customers.[32] (Sovereign risk denotes the economic risk to private sector agents when a government breaks or alters a previous contract. Once a government breaks a contract, then for new contracts, the private sector will include that risk and demand higher compensation.)

5.7 Green Hydrogen

To complete the government's energy transition policies, it provides subsidies for hydrogen production generated by solar and wind power – this is called green hydrogen.[33] The government claims:

"*Australia has an ambition to be a global hydrogen leader. Alongside renewable electricity, hydrogen will play a significant role in decarbonising our economy. It will support the export of hydrogen embodied locally manufactured products.*

We can use hydrogen:

- *as a source of heat or chemical for producing green metals*
- *as a fuel for hydrogen fuel cell electric vehicles, buses, trucks, planes and shipping*
- *as a source of energy storage and generation*
- *as a chemical feedstock to make zero carbon chemicals, such as clean ammonia methanol, and low carbon liquid fuels*
- *as a source of tradeable clean energy that other countries will need to decarbonise their own economies.*"[34]

There is little discussion of costs (subsidies are promised[35]) or technological constraints on producing green hydrogen – although chemical engineers have long known that with existing technology it is prohibitively expensive at scale to

[32] https://www.woodmac.com/news/opinion/japan-australian-lng-exports/
[33] https://www.dcceew.gov.au/energy/hydrogen
[34] Ibid.
[35] https://arena.gov.au/funding/hydrogen-headstart/

produce and transport due to large energy losses.[36] Many green hydrogen projects have been announced, but the initial enthusiasm has disappeared, with many projects cancelled.[37] The original claims by the government and major investors were based on engineering/economic fantasy and hype. One cannot deny that a major technological breakthrough may one day reverse this conclusion. But this implies that waiting for a breakthrough is the best strategy.[38]

In the next two sections, we discuss cost-benefit studies of wind and solar generation in Ontario and the UK.[39] Because the engineering issues are common to these countries and Australia, they demonstrate that Australian RE policy problems are in no way unique.[40]

6. Costs and Benefits of Ontario RE Electricity Policies

In this section we explore cost-benefit studies of Ontario RE systems. Cost analyses of RE systems fall into two basic classes: 1. micro studies of specific wind and solar plants; and 2. macro studies that consider the whole power system. Micro studies can be very misleading if they do not include their interaction with the whole system and ancillary operations required to deal with intermittency, taxes and subsidies. Credible micro studies are hybrid micro–macro analyses. This is a complex topic that requires a long survey to explore the problems in detail. Here we will provide a summary of major studies. These Ontario publications provide a framework that could (given adequate data) be implemented in Australia.

6.1 Two Ontario Micro Studies of Wind Farms

There are many micro studies of wind farms. Here, we summarize two related studies that try to integrate the micro data with related costs, subsidies and taxes over the 2015–2018 period in Ontario. The first study considers the net monetary cost/benefit of Ontario wind farms. The results are startling.

"*The displacement impacts of wind power generation on other generation technologies are estimated for Ontario. In addition, their annual financial benefits, costs, and international stakeholder impacts are measured. For every100 MWh*

[36] See Schernikau and Smith (2024), section 2.5, for a good summary of the issues.
[37] https://www.miningday.com.au/green-hydrogen-hopes-up-in-smoke/
[38] In economic theory this is called exploiting a real option.
[39] For the USA, see the interesting discussions by Mills (2023a, 2023b).
[40] Germany's experience with RE is another example. An early warning about the heavy costs of the German *Energiewende* policies are summarized by Vahrenholt (2017). The predictions were prescient.

generated, almost 53 MWh of gas output is displaced, and 19 MWh of power is exported. Due to inadequate storage capacity hydro power generation is reduced by 23 MWh. Ontario on average loses about 859 million USD annually from having wind power generation in the system, while the US gains approximately 10 million USD through electricity exported from Ontario. Wind power generation has produced an estimated 109 million USD of benefits by reducing CO_2 emissions in the US and Ontario through displacing thermal generation. Comparing the environmental benefits with the net cost to consumers shows the promotion of wind power generation to be largely a waste of Ontario's resources."[41]

Just as startling are the distribution of costs and benefits among stakeholders:

"*This study uses an ex-post evaluation of the grid-connected wind projects in Ontario, Canada, to quantify the stakeholder impacts of such renewable energy projects. Our study includes a financial, economic and stakeholder analysis of a sample of three wind farms. The analysis sheds light on the distributional impacts that arise when there is a significant gap between the incentives created by the financial price paid for electricity generation and the economic value of the electricity generated. The analysis shows that the negotiated power purchase agreements (PPAs) have resulted in a negative outcome for the economy in all circumstances. It is found that the present value of the economic costs is at least three times the present value of the economic benefits, including the global benefits from the reduced CO_2 emissions. This loss is borne by all the stakeholders of the electricity system, except the private owners of the wind farms. The losers are primarily the electricity consumers followed by the governments. The Ontario Electricity Rebate (OER) programme, which is financed by increased government borrowing, has the effect of transferring a large share of the costs incurred to promote investments in wind power to future generations of taxpayers in Ontario.*"[42]

Although these are Canadian studies, the same methodology could be applied to Australia, given micro data. As far as we can discern, similar results could be obtained.[43]

[41] Abstract from Bahramian, Jenkins and Milne (2021a).
[42] Abstract from Bahramian, Jenkins and Milne (2021b).
[43] Similar negative results are obtained in the UK using various methodologies. For a survey, see Darwell (2023), section 3.3, and the earlier government report by Helm (2017). Note that developments since 2017 require some caveats on some of Helm's recommendations.

6.2 Ontario Rooftop Solar Systems

Using a similar methodology to the wind projects, these two Canadian studies explore the cost/benefits and stakeholder benefits from rooftop solar projects.

"*This paper develops a framework for a financial, economic, and stakeholder analysis of a residential rooftop solar net-metering program. The empirical focus of the paper is the net-metering program in Ontario, Canada, but the methodology is applicable to evaluating other public programs. The results highlight that without the Federal Government's subsidy for the initial investment cost, net-metered solar systems are not financially viable for representative households. Moreover, the stakeholder analysis reveals that for each additional net-metered system installed in Ontario, non-net-metered households experience financial losses of six times the benefits to the net-metered households. The net losses to the Federal Government of Canada and the Canadian economy are five and nine times the benefit to the net-metered households, respectively. The only stakeholder who benefits marginally is the Government of Ontario. In terms of environmental benefits, our estimate of the cost of greenhouse gas abatement by residential net-metered solar is 325 CAD per ton of CO_2, which is significantly higher than the current (65 CAD in 2023) and future (170 CAD by 2030) national carbon price set by the Government of Canada.*"[44]

Secondly:

"*This study develops a generalized evaluation framework that can be used to quantify the financial, economic, stakeholder, and environmental impacts of renewable energy support programs. The application of this framework is demonstrated by evaluating the feed-in tariff (FIT) program for solar distributed energy resources (DER) in Ontario, Canada. Our analysis reveals that Ontario's FIT program has successfully promoted the adoption of solar DER across communities. However, the program has caused inequitable societal outcomes through a cross-subsidization with a present value of 9 CAD billion, paid for by the electricity consumer base for the benefit of only the 0.06 percent of electricity consumers who could install solar systems. The cost imposed on the Canadian economy ranges from 2.86 to 5.37 CAD billion, depending on the discount rate applied. The sensitivity analysis results indicate that the burden of this program on*

[44] Abstract from Hashemi, Jenkins and Milne (2023).

the Canadian economy would have been reduced by 50 percent if the program had been delayed and implemented in 2016 instead of 2010 due to the declining trend in solar system investment costs. The lessons from this analysis provide insights for designing future environmental and emission reduction policies."[45]

One might object that these studies are not applicable to Australia because it has a sunnier climate and Ontario has different RE policies than Australia. But are the policies substantially different? Have there been Australian studies using similar methodologies? Are there Australian studies providing results consistent with the Ontario results? And, more broadly, are studies in other countries consistent with the Ontario results? The next section addresses the last question by summarizing electricity policies in the UK, while Section 8 summarizes relevant Australian studies.

7. UK Studies of RE and NZ Costs

Before we discuss the problems associated with the UK electricity system, we summarize some empirical evidence on the efficiency and costs of UK solar and wind farms.

7.1 UK Solar Farms

Hughes (2023) provides one of the few thorough empirical analyses that discuss the costs of solar farms in the UK. His analysis relies on data collected from various sources, often concealed from the public. Here is a selection of observations from the conclusion of his findings:

"*The analysis in this paper demonstrates that solar generation is not the special case which many policymakers and investors appear to believe it to be. The actual capex cost per MW of capacity for plants built in the middle of the last decade was nearly twice the level assumed by BEIS in its cost projections for 2025. The evidence available suggests that actual capex costs declined by about 10% between 2015 and 2020 even though the cost of PV modules fell sharply. This highlights the simple point that more than 50% of the total cost of building a new solar plant is spent on civil works, mounting structures, cable, grid connections and similar items. These items are not new technology whose real costs might fall*

[45] Abstract from Hashemi, Jenkins and Milne (2024).

rapidly and, indeed, their real costs may increase if there is a boom in new solar construction.

Actual opex costs per MW of capacity are nearly double the level assumed by BEIS but even more important it appears that they should be expected to increase over time. The rate of increase observed in the data collected for this study may be atypical, perhaps reflecting the immature state of the solar industry. Even so, a real increase of 2.5% to 3% per year as solar plants age is entirely consistent with the experience for onshore wind generation and it is certainly unwise to assume that real opex costs will remain constant over the life of solar plants…

Enthusiasts cite various reasons why the prospect for solar generation is very good. Some of these reasons may even be correct in some circumstances, but they run against the inescapable economic reality of conditions in the UK: solar resources are relatively poor, land is expensive, and labour costs are high. What may be true for desert areas in Mexico or Chile is irrelevant in the UK. My conclusion is that the solar industry in the UK is little more than the product of an excessively generous set of subsidies. It has no firm foundation for operating on a large scale without subsidies or without a demand for greenwashing. Investors should be aware that they are doing little more than buying a stream of future subsidy payments. Once those subsidies cease, mostly around 2035, they will have assets that are effectively worthless. As a matter of public policy this may be deplorable. As an investment decision, this may be understandable so long as participants are clear-sighted about what they are getting."

He ends with a trenchant criticism of the UK Solar Farm policy (page 32):

"*This leads us to what may be the most important lesson that should be learned from both the Energy Security Strategy and the AR4 CfD bids. This concerns the issue of accountability. In both cases the public is being asked to accept goals and policies that are based on little more than optimistic fairy stories. Politicians and bureaucrats are willing to accept such fantasies because they do not expect to bear any accountability for the achievement of those goals or the consequences of the policies. Investors and operators go along with this because either (a) they too do not expect to have to account for the consequences, or (b) they are convinced that the level of political or public commitment will ensure that they will be bailed out if things go wrong*."

7.2 UK Wind Farms

Hughes (2020a) undertook a similar analysis of the economics of UK wind farms. Here is a lengthy summary from his paper (pp. v and vi):[46]

"*Almost every report or lengthy article on the future role of renewable energy is accompanied by a chart which claims to show the rapid decline of the costs of renewable electricity generation over the last one or two decades, perhaps with projections forward to 2030 or 2040. The problem for any non-technical reader is simple: Are these claims and projections plausible? We should note as a warning sign that these optimistic scenarios almost always come from corporate or governmental sources that have no personal wealth at stake and cannot be taken on trust. This leads us to the obvious and most important substantive question: Do those asserting large and likely further reductions in the cost of wind generated electricity, rely on empirical data about present or past circumstances which they have compiled and manifestly understand? As anyone familiar with literature will know, it is extremely rare to find a study that presents any, let alone an adequate, quantity of primary data and attempts serious analysis on that basis. This paper attempts to remedy that unsatisfactory situation and presents findings based on a statistical and econometric analysis of a database compiled by the author of the actual capital and operating costs for a large majority of the onshore and offshore wind farms built in the United Kingdom since 2002 and with a capacity of at least 10 MW. The database covers more than 350 wind farms, all commissioned before or in 2019 – a much larger sample than for any previous study. The findings are complex but sobering:*

(1) The actual costs of onshore and offshore wind generation have not fallen significantly over the last two decades and there is little prospect that they will fall significantly in the next five or even ten years.

(2) While some of the components which feed into the calculation of costs have fallen, the overall costs have not. For example, the weighted return for investors and lenders has declined sharply, especially for offshore wind, because of a fall in the perceived risk. In addition, the average output per MW of new capacity may have increased, particularly for offshore turbines. However, these gains have been offset by higher operating and maintenance costs (O&M).

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[46] See https://www.ref.org.uk/Files/performance-wind-power-uk.pdf. For a similar analysis of Danish wind farms, see Hughes (2020b): https://www.ref.org.uk/Files/performance-wind-power-dk.pdf

(3) Far from falling, the actual capital costs per MW of capacity to build new wind farms increased substantially from 2002 to about 2015 and have, at best, remained constant since then. Reports discussing the construction of new offshore wind farms in the early 2020s imply that their costs may fall by 2025, but such reports are consistently unreliable as well as being incomplete. Final costs tend to be significantly higher, so little weight can be attached to forecasts of future costs.

(4) Far from falling, the operating costs per MW of new capacity have increased significantly for both onshore and offshore wind farms over the last two decades. In addition, operating costs for existing wind farms tend to increase even more rapidly as they age. The cost increase for new capacity seems to be due to the shift to sites that are more remote or difficult to service. Much of the increase with age is due to the frequency of equipment failures and the need for preventative maintenance, both of which are strongly associated with the adoption of new generations of larger turbines – both onshore and offshore.

(5) Turbine manufacturers and wind operators appear to be relying on an increase in load factors via (i) an increase in hub heights to take advantage of higher wind speeds, and (ii) changes in the engineering balance between blade area and generator capacity. However, the inferior reliability of new turbine generations leads to a more rapid decline in performance with age, so that the ultimate effect on average performance over the lifetime of new turbines is unclear.

(6) The combination of increasing operating and maintenance costs with lower yields with aging means that at current market prices the expected revenues from electricity generation will be less than expected operating costs after the expiry of contracts guaranteeing above-market prices. The length of these contracts has been reduced, implying a need to recover capital costs over a shorter economic life, which pushes up the effective capital charge.

There is an important corollary to these findings. The current set of offshore projects being constructed and planned in Northwestern Europe are closely akin to speculative property development. They are high risk projects that will only be able to repay lenders and offer a return to equity investors if the average wholesale market prices of power rise to at least 3 to 4 times their current level throughout NW Europe. Such a price surge would require a large and permanent increase in the market price of gas, which experience suggests is very unlikely, or carbon taxation at 8 to 10 times current levels, rising to at least €200 per tCO2 at 2018 *prices in 2030. Such a tax would place an insupportable burden on the economy and therefore also seems very unlikely*."

7.3 The Implications of UK NZ Policies for the Electricity System and Prices[47]

In a detailed government report, Helm (2017) analyzed and critiqued UK energy policy. The report was ignored, but it proved prescient in predicting the problems with RE and subsequent NZ policies. Darwell (2023) cites Helm and updates the critique in a lengthy survey exploring the empirical data and economic implications of NZ. Here is a lightly edited extract from Darwell's overview (p. 9):

"*Since the 2008 financial crisis, the British economy has performed badly; it has been afflicted by unprecedently poor productivity growth. The same year, Britain's political elite decided to turn Britain into a test bed for radical climate policies when Parliament wrote an 80 percent decarbonization target into law. The Climate Change Act was presented as Britain showing climate leadership ahead of the 2009 Copenhagen Climate Conference, one of many UN climate conferences that was going to save the planet. In 2019, the target was raised to the elimination of 100 percent of net emissions by 2050 and became law after an 88-minute debate in the House of Commons.*

Net zero had been sold to politicians on the basis that the falling costs of renewable energy meant that the costs of net zero would fall within the envelope of the previous 80 percent target. The narrative of a dramatic and sustained fall in the costs of renewable energy also underpinned governmental analyses of the economic consequences of net zero that promoted the fiction that the cost of net zero is trivial and could even act as fairy dust boosting Britain's abysmal lack of productivity growth.

Thus, Britain's decision to adopt net zero was based on false claims about the cost of offshore wind and wishful – indeed, nonsensical – optimism about the economic consequences of net zero. At a virtual UN climate summit in December 2020, then prime minister Boris Johnson spoke of turning Britain into the Saudi Arabia of wind power. It is delusory to equate production of a commodity that yields more government revenues than any other with one that, as the International Energy Agency's May 2021 (report) shows, requires more inputs of labor, capital, and land

[47] This section draws on Darwell (2023), who provides an excellent summary of the history and a detailed critique of UK RE electricity policy since 2008.

to produce less energy. Net zero therefore constitutes an antigrowth economic strategy that near-zero growth Britain can ill afford.

This, then, is a story of a massive deception practiced by Britain's governing class, leading to the biggest resource misallocation in British history – done in the name of saving a planet, which the vast majority of its inhabitants has no intention of emulating."

Darwell is not alone. Hughes (2025) has a similar critique, analyzing the UK government claim that NZ policies imply that electricity price will fall 10–20% by 2030. Hughes' calculations, based on more realistic assumptions, predicts major increases in electricity prices of 50–70%.

7.4 UK Renewable Penetration and Blackout Risk[48]

As we have seen above, RE electricity costs that ignore the added costs of new transmission lines and back-up installations (e.g. gas, pumped hydro, batteries, interconnectors, etc.) due to intermittency are extremely misleading in understating the costs of RE generation.

An additional problem associated with greater penetration of RE generation is the increased likelihood of blackouts. When the proportion of RE in the system is relatively low, baseload power generation can cope with weather-related fluctuations in RE supply. But as RE penetration increases, the fluctuations become larger. Legacy baseload power generation creates stability using large generators rotating to producing alternating current (AC) at a frequency of 50 hertz (50 cycles per second). The power grid and electrical equipment are very sensitive to fluctuations in frequency and can automatically disconnect. As Porter (2025a) explains, the UK system has become increasingly susceptible to the risk of blackouts. With planned increases in RE, the likelihood of future outages has increased.

The UK is not alone in facing this problem. The Iberian Peninsula blackout on April 28, 2025, has all the hallmarks of this problem.[49] The Iberian system is highly reliant on RE power generation. Apparently, fluctuations related to solar generation (at the time producing 78% of total power) rapidly destabilized the grid,

[48] See Porter (2025a) for a more detailed discussion of the issues and UK problems. See also Schernikau (2025a) for a discussion of the engineering complexities in operating a stable grid with significant RE generation.
[49] See Buenestado (2025).

and through interconnectors with Southern France, precipitated a blackout lasting for several hours, causing major economic and social disruption.

Because solar panels produce direct current (DC), they require grid-following inverters to convert to AC power. There are major engineering problems in designing and constructing a decentralized inverter system to avoid a rapid automatic shut-down.[50]

7.5 The Cost of NZ

As we reported above, the costs of NZ through direct and hidden subsidies to RE and the additional costs and regulations imposed on fossil fuel generation appear in UK household and industrial electricity prices. In a recent detailed study, Porter (2025b) explains the sources of these very high electricity prices. This short extract from Porter's introduction summarizes the results.

"*My report reviews in depth the costs of renewable generation and their impact on our bills, driving British industrial electricity costs to the highest in the developed world, and our domestic costs to fourth highest. We're told this is due to the cost of gas, yet our gas bills are only 15th highest in the world. According to international energy price statistics published by the UK Government, as of June 2024 (the last month included in the dataset), large British firms were paying 27.91 p /kWh for electricity while those in the EU paid just 10.80 p /kWh. But this was not always the case. Back in July 2011 there was almost no difference between the price paid by industrial consumers in the UK versus those in the* [EU:] *€7.48 p /kWh compared with 7.04 p /kWh.*

My report sets out all of the additional costs applied to bills as a result of net zero policies which in 2023–24 amounted to over £17 billion are projected to increase to over £20 billion per year in 2029–30. My analysis indicates that had Britain continued with its legacy gas-based power system in the period since 2006, consumers would have been almost £220 billion better off (2025 money) even taking into account the impact of the gas crisis.

Other countries have fewer costs and levies – the UK chooses to not only subsidise renewables but also impose other levies and taxes which are designed to encourage a move away from carbon intensive energy. Unfortunately, this is often impractical, meaning that households and businesses effectively pay additional taxes on their energy without being able to receive any associated benefits. These

[50] See Gawhade and Ojha (2021) and Schernikau (2025a) for surveys of the issues.

are clear policy choices, in part driven by the Government's determination to 'lead the world' on climate."

No matter how complex and byzantine the UK RE/NZ system of taxes, subsidies and legal constraints, the consequences are summarized in the retail price of electricity and increased government expenditures to pay for subsidies. The consequences are borne not just directly by households, but also indirectly through commodity, labour and capital markets as industries reliant on electricity prices increase output prices, and/or relocate to countries with cheaper electricity fuelled largely by coal.[51]

8. Australian NZ, RE Electricity Policy and its Costs

Australian RE policy has followed the UK and Germany, with predictable results. In this section we will review recent estimates of the cost of NZ and RE policies. The estimates are consistent with the results we discussed for Ontario and the UK. Because the underlying engineering and economic analyses are the same for Australia, it would be very surprising if the Australian results were inconsistent with similar policies in other countries. These estimates are difficult to construct, given the large number of Federal and State regulations and subsidies supporting RE, and taxes and regulations on fossil fuels. Government sources are often unreliable and secretive, omitting important costs and pricing contracts with solar and wind operators.

8.1 Moran's Cost-Benefit Results

Moran (2020) has estimated the annual costs of NZ policies. This is an extract from the executive summary of that report. Moran does not pull his punches:

"*Australia's excessively high electricity prices are undermining our economic resilience and competitiveness and cutting our standards of living. Since 2002 Australian governments, in a misguided quest to reduce carbon dioxide, have introduced climate policies at the expense of cheap coal and gas power. Our electricity prices, once the lowest in the world, have become one of the most expensive.*

[51] A similar conclusion can be drawn from German experience of deindustrialization, with major manufacturers leaving the country complaining about the high cost of electricity. Germany's electricity and energy policies have been a costly fiasco.
https://www.adlittle.com/sites/default/files/viewpoints/ADL%20Deindustrialization%20threat%202025.pdf

This report… undertakes a comprehensive analysis of climate policies and renewable energy subsidies. Australians will be shocked to know the true financial burden of these policies on households and industry. These hidden costs drive up all costs of living, including electricity, food, water and transport.

In summary, the report states the financial impact of climate policies and renewable subsidies:

· costs households at least $13 billion annually, or around $1300 per household;

· accounts for 39% of household electricity bills, not 6.5% the Government typically quotes;

· causes a net loss of jobs in the economy; with every green subsidized job created, 2.2 jobs are lost.

This analysis shows the cost of these climate policies to household electricity bills is an extra $536 per annum, significantly more than the touted $90 per household per annum. In effect the government-imposed climate policies and renewable subsidies account for 39% of householders' electricity costs. The total cost to households, if we add the higher electricity costs passed on through businesses, equals $13 billion or $1300 per household…

Investment in supposedly green energy is a malinvestment. Governments have taken liberty and license to both blatantly distort and exclude key facts to keep Australians literally in the dark about the inflated costs and future unreliability of our electricity system.

It defies all sense that Australia's average price per kwh for electricity is three times that of India and China when they are using our coal. All Australians have a right to benefit from our rich natural resources and governments have an obligation to foster high growth environments for Australian industry and support high standards of living for all of us. The parasitic and hapless renewables industry will provide neither."

More recently, Moran has updated his estimate of annual cost to be $16,088 billion.[52]

8.2 Holland and Tunny (2025)

[52] Private correspondence with Alan Moran.

Holland and Tunny take a different approach, emphasizing the cost impact of various policy combinations of baseload power generation and RE. Their calculations are striking:

"*We have developed four scenarios, and found that there are diverging possible futures which reflect the reality of the cost trade-offs:*

1. The 'No Net Zero' scenario, relying on ultra-supercritical coal, presents the lowest (total) capital expenditure at $103 billion and offers wholesale electricity prices between $50 and $100 per megawatt-hour ('MWh'). Retail prices could drop by as much as 25%, delivering short-term economic relief.

2. A technology-neutral approach that incorporates nuclear power presents a compelling alternative. With a (total) capital expenditure of $163 billion, nuclear provides a relatively modest retail price impact – ranging from a 4% decrease to a 35% increase – and wholesale prices between $100 and $150/MWh. While the upfront costs are significant, nuclear offers a stable, low-emission energy source. However, the lack of political and regulatory appetite for nuclear energy in Australia makes this pathway an uphill battle.

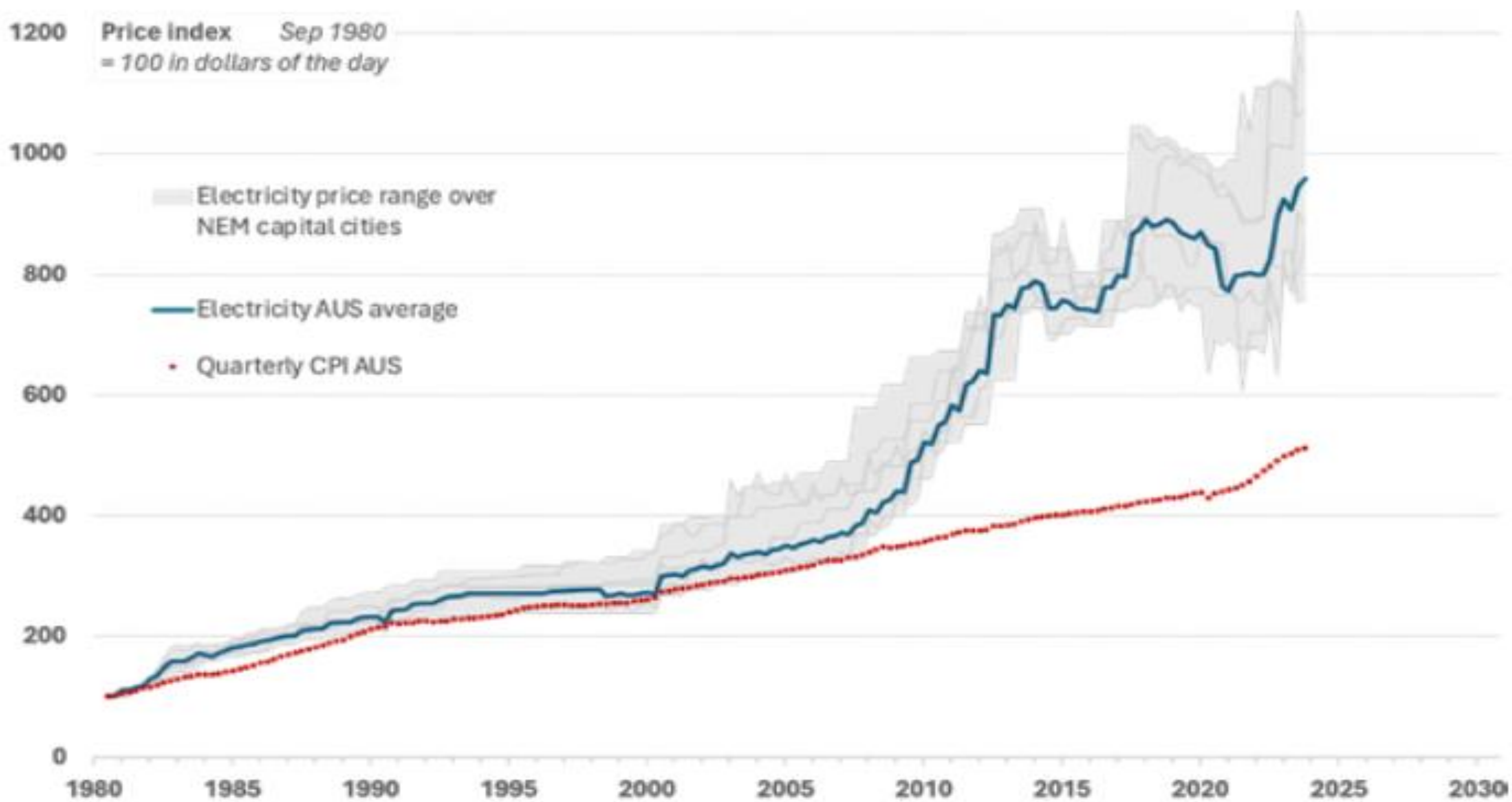
3. Australia's current policy direction favours a blend of offshore wind, solar, and battery energy storage systems ('BESS'). This approach carries a hefty price tag: $198 billion in (total) Capex and an additional $30/MWh in transmission costs, bringing the total to $261 billion. Retail prices are likely to continue to rise between 30–69%, with wholesale prices ranging from $150 to $200/MWh, which could mean a further reduction of 1.44% to 3.31% of Australia's future GDP and living standards. Alarmingly, this pathway may fall short of achieving net zero while compromising energy security – a sobering prospect given the stakes.

4. The most ambitious option – a 100% renewable grid – commands an eye-watering $255 billion in (total) Capex to replace current baseload power generation and $77 billion in additional transmission costs, totaling $332 billion. Retail electricity prices could soar by up to 69%, mirroring Australia's current pathway, with similar concerns about energy reliability. While this scenario aligns with Australia's long-term climate goals, the trade-offs in affordability and grid stability raise serious questions about its feasibility."

8.3 Wilson (2024)

Wilson comes to similar conclusions and observes that any calculation of costs of components of the system will be reflected in retail prices. Market prices should aggregate the component costs. As RE has increased its penetration into the Australian electricity system, real prices have risen dramatically. The following graph illustrates electricity prices.[53]

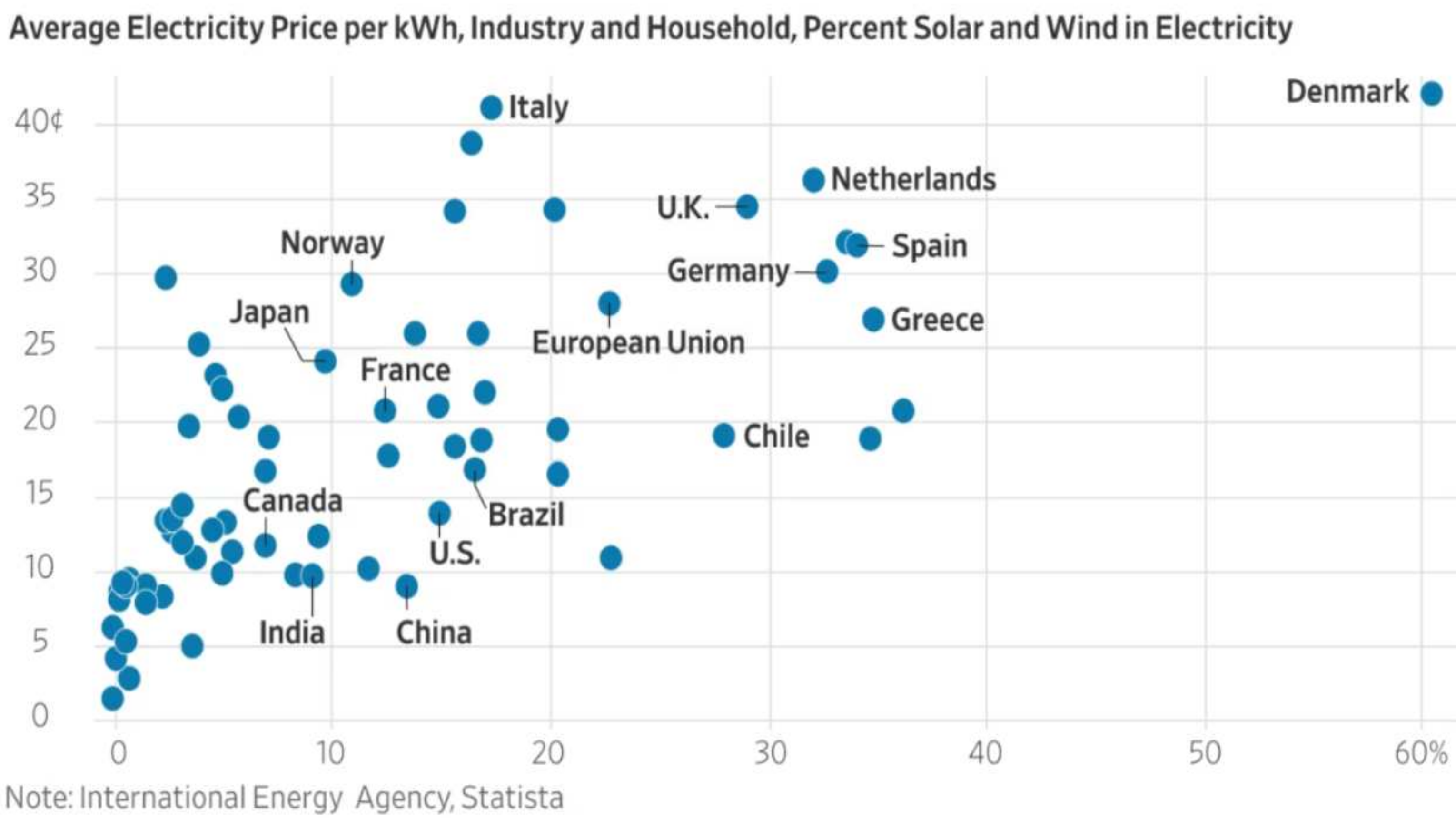
Figure 1: History of consumer retail electricity prices in capital cities.



A drawback of this analysis is that the retail price of electricity is heavily distorted by various subsidies and regulatory restrictions; Moran, and Holland and Tunny try to take those subsidies into account. Nevertheless, the major political parties are finding it increasingly difficult to hide the economic costs of their NZ policies without massive subsidies that impact the State and Federal government expenditures and budgets.

[53] See Wilson (2024), page 3.

Australia is not alone in facing large increases in (real) retail electricity prices: the following graph shows country electricity prices related to RE penetration. The positive relationship is striking. Although correlation does not imply causation, taken with the previous evidence discussed above, it is difficult to avoid the conclusion that higher electricity prices are driven by increasing RE penetration in the electrical system.



8.4 Rooftop Solar and Cross-Subsidies

In a recent paper, Hilton, Wu and Morrison (2025) analyze the impact of differential electricity pricing on households with rooftop solar panels versus the costs borne by households relying on the power grid – the latter users are paying a cross-subsidy to rooftop solar households:

"Rooftop solar has been lauded by energy market bodies, policymakers, the media and environmental groups as a great way to lower bills, help the environment and help the grid. But while rooftop solar may have lowered bills for homeowners able to install it, it has done so by increasing bills for everyone else. As more consumers respond to distorted price signals by installing rooftop solar, the paradise that has been promised is being lost.

Over the past 15 years, rooftop solar has enjoyed rapid growth in Australia due to its historically high return on investment for households. In 2011, government rebates covered more than 75% of installation costs for a 1.5 kW system, coinciding with the highest installation rate to date. Although direct government subsidies have declined in recent years, rooftop solar systems still offer households substantial financial benefits. In New South Wales (NSW), this amounts to a return on investment of well over 200% and a payback period of less than 6.5 years.

However, these financial returns do not reflect the value that rooftop solar provides the grid. CIS analysis suggests rooftop solar generation saves the electricity grid at most only 4c/kWh in averted variable operating and fuel costs for coal and gas plants. This is before including any additional network upgrade costs that arise when the grid is stressed by a glut of rooftop solar output in the middle of the day; so actual system savings may be much lower.

Using conservative assumptions, the CIS estimates rooftop solar owners in National Electricity Market (NEM) states are currently receiving bill savings of 8–18c/kWh for their solar generation, including both exports and self-consumption. This means rooftop solar owners are receiving savings 2–4.5 times higher than the value their solar generation is providing the grid.

In the Ausgrid network in NSW, solar customers are earning, on average, $705 to $1,186 more than the cost savings their generation provides the grid… These outsized savings have arisen because solar customers are paying much less than non-solar customers for their use of the network, despite imposing similar or even higher costs on the network.

Distribution Network Service Providers (DNSPs) must recoup this lost revenue by charging other customers more, which creates substantial cross-subsidies from those who do not own rooftop solar to those who do. Rooftop solar owners tend to be older and wealthy enough to own a house, meaning those who are less wealthy – particularly young renters and apartment dwellers – are effectively paying part *of their energy bills. This 'reverse Robin Hood' – taking from the poor to give to the rich – is increasing bill stress for the most vulnerable consumers."*[54]

This conclusion is consistent with the findings of Hashemi, Jenkins and Milne (2023) using Ontario data.

8.5 The End of the RE Honeymoon

In a recent paper Hilton, Lubberink, Wu and Morrison (2025) demonstrate using international studies that as electricity systems are increasingly reliant on RE they become far more expensive and unreliable:[55]

"The belief that Australia can decarbonise its economy by relying on the wind and the sun rests on a misplaced conviction about what the renewables rollout will entail. The idea that our previous accomplishments should encourage further persistence depends on the presupposition that the transition to renewables benefits from gathering momentum. Advocates point to the increase in wind and solar from 1.5% of our electricity share in 2010 to around 33% today as a success, and evidence that the buildout can be further accelerated to achieve nearly twice this rollout in one-third the time, to meet targets set for 2030.

This assumption is flawed. The intrinsic nature of uncontrollable, weather-dependent energy introduces faster growth in costs at higher penetrations, which mean the rollout gets harder as it proceeds, rather than easier. What we have experienced thus far is the renewable energy 'honeymoon' period, during which things were unnaturally simple. The true nature of the longer journey is one of formidable challenges, which we are only beginning to encounter.

This paper explores the nature of these challenges in three different ways.

It first examines the international evidence of the relationship between electricity prices and weather-dependent generation. An undeniable trend has emerged. No country has reached wind and solar penetration levels above 90%,

[54] Extract from the Executive summary of Hilton, Wu and Morrison (2025).
[55] Taken from the Executive Summary of Hilton, Lubberink, Wu and Morrison (2025).

and those that come closest have some of the highest electricity costs in the world. Very few countries have exceeded around 40%, and those that do end up with elevated electricity prices. This challenges the idea that renewable energy integration is only a 'last mile' problem, i.e. that storage and firming challenges only become more difficult at penetrations above 90%.

Second, it undertakes a first-principles exploration of what drives higher integration costs for uncontrollable wind and solar electricity generation, which is gathered from the places and times in the environment where it appears in accordance with the weather and the earth's orbit and rotation. Clear-cut mathematical boundaries can be established around when additional costs must be incurred, as determined by the local demand saturation point. At this point, an increasing share of new uncontrollable generation must be either wasted or moved through time or space to continue displacing thermal, controllable generation. In an idealised model, Australian wind and solar generation must reach this point between 30% and 60%, but many real-world constraints make earlier onset inevitable.

Finally, it outlines the evidence in Australia that these additional costs are already being encountered, at renewable energy penetration levels at or below 30%. The demand for massively expanded transmission networks, battery storage, and high levels of constrained generation demonstrate clearly that increasingly more energy must be either moved or wasted, and the costs associated with these additional systems to move energy will only continue to mount. Other factors, such as the exhaustion of ideal wind and solar sites, and the growing backlash from regional communities, will cause other costs to increase as well. As falling capture prices lead to declining private investment in renewables, governments are now attempting to prolong the honeymoon period through subsidies and taxpayer underwriting, which will greatly increase the tax burden on Australians and do nothing to lower electricity prices in the long term.

Rather than continuing to insist that renewable energy is about to cross some threshold where things become magically easier, and costs reduce, Australian politicians and renewables advocates must confront the inevitable. The honeymoon is over and, from here on, things will only get harder. A serious *rethink of our commitment to pursue current policy at any cost is urgently required*."

8.6 Flawed Government Modelling Favouring RE

The government justifies its policy that RE is cheaper than coal, gas and nuclear by citing modelling by the Commonwealth Scientific and Industrial Research (CSIRO) and the Australian Energy Market Operator's (AEMO) Integrated System Plan (ISP). But these models have faced serious criticism that they have numerous problems that skew the result toward RE. A detailed critique is contained in the report by Hilton, Morrison, Bainton and Wu (2024):[56]

"The outcomes of these reports are frequently conflated, but careful reading exposes two distinct claims for which each are used as evidence:

1. GenCost:

That renewable energy is cheaper than alternatives, including fossil fuels, regardless of any cost of carbon or other policy constraints.

2. Integrated System Plan:

That the planned transition is the cheapest pathway to reach Australia's emission reduction targets.

The key distinction between the two is that the ISP's claim of economic superiority is confined to act within the boundaries of existing carbon budgets and renewables targets. However, GenCost is used to support the stronger claim that the renewables system is cheaper overall. In doing so, it relies to a significant extent on some of the ISP's more comprehensive modelling undertaken for the integration of generation with transmission and storage. Indeed, GenCost is a collaboration between AEMO and CSIRO, and a significant part of the funding for GenCost comes from AEMO.

Consequently, the merits and flaws of the reports are intertwined. The net effect is that these reports have succeeded in creating a general aura of economic superiority for renewable energy over any alternative – including both the fossil-fuelled status quo or nuclear – with the overarching suggestion that our most respected technical and scientific institutions agree about this. This report contends that neither GenCost nor the ISP credibly supports the two specific

[56] The following is a direct quote from page 3 of Hilton, Morrison, Bainton and Wu (2024).

claims they each purport to make, and the contention that renewables are clearly cheapest is not just unsupported but untrue.

This paper outlines six fatal flaws of logic that have allowed two major public institutions to continually repeat an incorrect statement. There are many other lesser problems with both reports which are not addressed in detail here.

The six flaws are not minor ones, and are contradictory to the objective, evidence-based analysis that should underpin policy. Everyone, of all political persuasions – including ardent supporters of renewable energy, fossil fuels or nuclear energy – should be concerned with ensuring each of these is resolved.

Each of these six flaws are independently capable of collapsing the integrity of one or more of the formal claims of GenCost and the ISP. Taken together, they show that the overarching claim about the economic superiority of renewables in Australia's energy transition plan is incorrect."

8.7 More General Consequences for Households

Households observe their increased electricity bills from the grid. But what they seldom understand is that electricity costs are crucial in manufacturing, retailing, transportation, food production, distribution and refrigeration. These electricity costs are not distributed evenly across industries. For example, increased electricity for refrigeration in supermarkets is passed on in the price of food.

Over the past two years, there have been vocal complaints about a "cost-of-living crisis" and increased electricity (and natural gas) prices. Very high immigration rates have led to a major housing shortage and very high house prices. In the MSM there has been much discussion of inflation driving the cost-of-living crisis. But few seem to understand that the real crisis is in a large change in *relative* prices, where real wages and salaries have not kept pace with housing costs, and goods and services prices have been driven higher by increasing electricity and gas prices.

An additional concern is the adverse impact on income and wealth distribution, whereby poorer members of the Australian population face very significant increases in the proportion of their income devoted to housing and energy costs. Added to this are increased prices for food and other consumer products that flow from increases in energy prices. Thus, the cost-of-living crisis is a direct consequence of misguided government policies.

8.8 Consequences for Manufacturing

Germany has been deindustrializing, and one of the causes is high electricity and gas prices, driven by the country's heavy reliance on RE.[57] Major manufacturing companies are relocating to countries with lower electricity prices, ironically generated by fossil fuels. The UK has similar problems, with manufacturers complaining of high energy costs.[58] Australia is now facing the same problem: manufacturers that are heavily reliant on electricity and gas have left the country or are threatening to leave.[59] The government has responded with subsidies for key manufacturing.[60] More broadly, Australia has been deindustrializing for many decades. There are multiple causes (competition from China, increasing mechanization,[61] shortages of skilled labour in key industries),[62] but more recently increased electricity and gas prices have played an important role.

As van Onselen has observed:[63]

"*According to ASIC (Australian Securities and Investments Commission), around 1400 manufacturers have collapsed since 2022–23. Over the last few years, major Australian manufacturers have downsized or closed completely.*

Incitec Pivot slashed fertiliser output in response to increased energy prices. It closed its Gibson facility in Queensland in 2022, affecting 170 employees. Incitec's Geelong fertiliser company also shuttered last year, costing 40 jobs.

Incitec Pivot Fertilisers' Phosphate Hill factory continues to harvest phosphate rock and manufacture ammonium phosphate fertilisers. However, this is also being reviewed from a strategic standpoint.

Dyno Nobel sold Incitec Pivot for a fire sale price on Monday due to high gas prices. However, Dyno Nobel CEO Mauro Neves noted opportunities in Western Australia, where gas is cheap due to its domestic reservation policy.

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57 https://internationalbanker.com/finance/germany-has-an-escalating-deindustrialisation-problem/
58 https://makeuk.org/insights/reports/tackling-electricity-prices-manufacturers
59 https://www.macrobusiness.com.au/2025/05/how-australia-killed-its-manufacturing-industry/
60 For example, early in 2025 the Federal government introduced large subsidies to maintain aluminium smelters in operation. The subsidies are marketed as schemes to convert the smelters to "Green aluminum" production. https://theconversation.com/making-aluminium-uses-10-of-australias-electricity-will-tax-incentives-help-smelters-go-green-247794
61 https://asiasociety.org/australia/looking-ahead-manufacturing-australias-future-not-its-past
62 https://www.linkedin.com/pulse/labour-crisis-australian-manufacturing-looming-threat-abhishek-sehgal-guusc/
63 https://www.macrobusiness.com.au/2025/05/how-australia-killed-its-manufacturing-industry/

'You have a successful energy policy [in WA], you can support local manufacturing,' Neves said.

'If you don't, we end up losing manufacturing towards a very liquid global market.'

Qenos, Australia's only major plastics plant, closed down last year due to expensive energy costs.

Oceania Glass, Australia's only architectural glass firm, closed down in March 2025 after 169 years of operation.

Oceania Glass required a significant amount of energy, particularly gas, to power its 2000-tonne furnace at the heart of its Victorian operations. As East Coast gas and energy prices skyrocketed, the company's profitability plummeted alongside its viability.

As a result, Australia will need to purchase all of its glass and plastics from China.

Orica, the world's largest manufacturer of mining explosives, chemicals, and agricultural fertilisers, and BlueScope Steel have threatened to reduce or close their Australian operations due to rising energy costs.

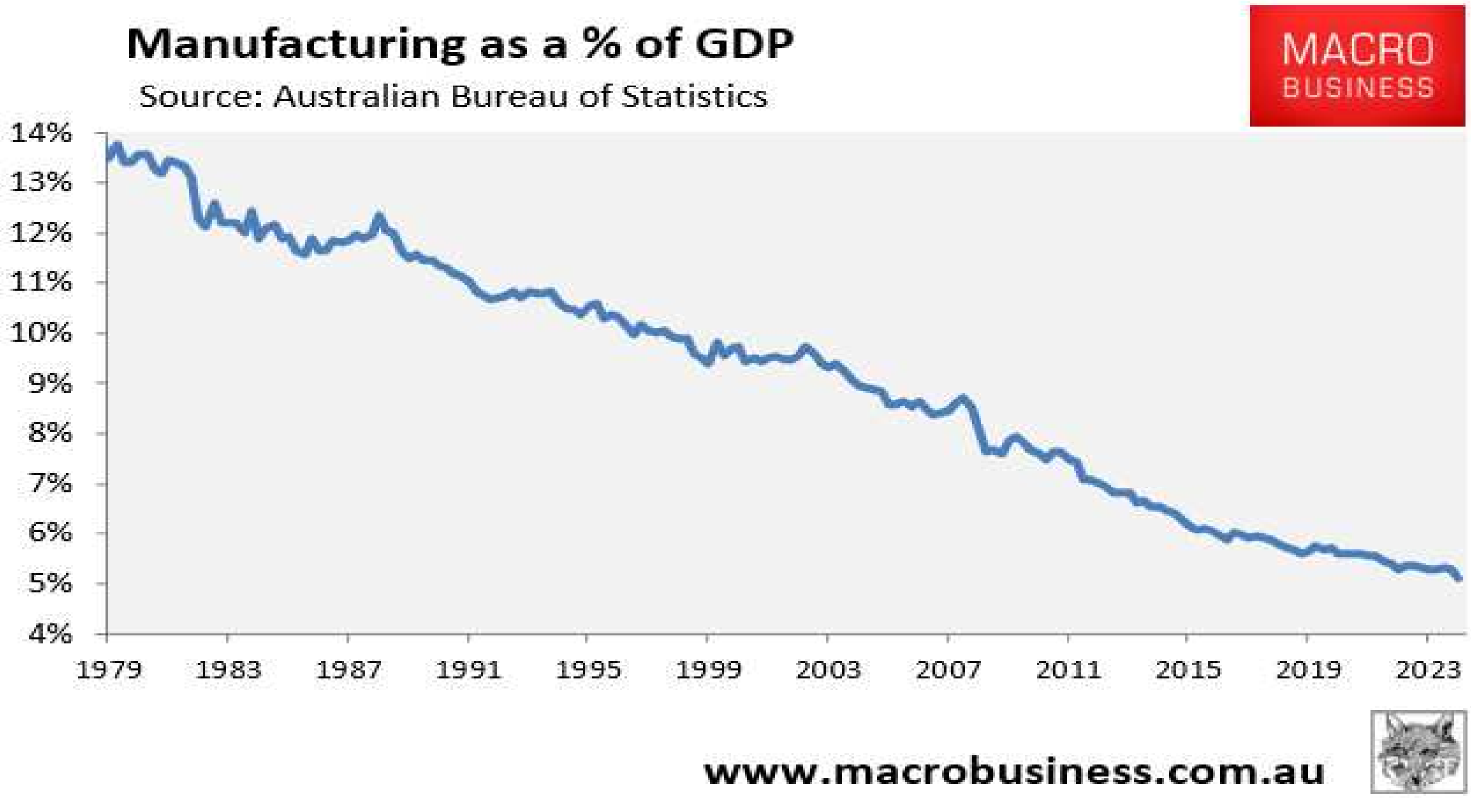
Orica's CEO Sanjeev Gandhi says there are far better opportunities in the United States, where energy is cheaper and policy is manufacturing friendly.

'Just look at what's happening in the United States. They are pro-manufacturing, they are pro-mining, they are for infrastructure. All of that is where Orica plays and they've got very, very cost competitive energy prices,' Ghandi said.

'So given a choice, my incremental dollar would always go first to the United States and Australia doesn't come on the top of the list.'

'If we can get enough gas supply at cost competitive prices, my next dollar comes into Australia… So it's all a matter of getting the policy right.'

'If you want to have a future made in Australia, manufacturing very clearly needs cost competitive energy, electricity prices, cost competitive natural gas, and enough availability of gas and obviously skilled labour.'"



Australia's share of manufacturing is the lowest in the OECD. There are multiple reasons for this low performance.

Australia has the lowest share of manufacturing of any OECD country

Note: Employment is measured as the total number of persons engaged. Sufficiently long time series are not available for all OECD countries.
Source: OECD STructural ANalysis (STAN) database; and authors' calculations.

Green (2024) observes:

"*While real incomes in Australia were cushioned by our recent commodity boom thanks to the accompanying boost to the terms of trade, this provided a merely temporary 'sugar hit' that was superseded by current ongoing wage stagnation. The impact on the Australian workforce has been compounded by a lower share of the more limited productivity gains as companies seek to maximise profitability through price inflation.*

The commodity boom also rendered our trade-exposed industries less competitive – or in some cases uncompetitive – in global markets through appreciation of the dollar. This was the 'resources curse' in action, which along with tariff reductions in the 1980s and '90s reduced manufacturing to six per cent of GDP, compared with around 30 per cent in the 1960s and '70s. As a result, Australia is now the least self-sufficient economy in the developed world.

While the Norwegians imposed a 76 per cent resource rent tax on their North Sea oil and gas assets, which enabled them to invest in a more resilient, diversified future through the world's largest sovereign wealth fund, we followed the UK's dismal market-driven North Sea experience by squandering our windfall gains on a short-lived consumption boom. This had the further effect of reinforcing our narrow trade and industrial structure."

A squandered commodity boom, highly restrictive regulations and misguided NZ energy policies have created a greatly diminished manufacturing sector.

8.9 Strategic Implications

Australia is an island continent that relies on air and sea transport for its material exports and imports. During World War II, Australia was under threat from the rapid advance of the Imperial Japanese military. US strategy in the Pacific was a direct thrust toward Japan in an island-hopping campaign. Australian forces fought in New Guinea, blunting the Japanese southern advance. The USA used Australia as a secure logistic base supplying food and light manufacturing products. In the post-WWII period, Australia has relied on the ANZUS treaty for protection. It has been obvious that Australia has had a free ride on defence, with a small military and low expenditures.[64] That is now under serious review.

The Chinese Communist Party under the leadership of Xi Jinping has become increasingly aggressive and expansionist, enlarging its armed forces, threatening to annex Taiwan, building bases in the South China Seas and undertaking grey-zone operations[65] against several countries – including Australia and Canada.

During the Obama administration, the USA pivoted its defence toward the Pacific and reduced its exposure to Western Europe. This policy has been reinforced by the recent Trump administration, demanding increased expenditure by NATO countries and US allies in the Pacific.

Australia has serious strategic problems: it is geographically isolated from the USA and other Western allies, relying heavily on international trade to maintain its standard of living. As we observed above, Australia is a major exporter of LNG, coal and iron ore to Asian countries – especially China. Australia imports large quantities of manufactures, largely from China.

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[64] Many NATO countries (including Canada) have been under-investing in defence.
[65] This is an expression used in strategic conversations describing activity that is not outright warfare, but uses propaganda, espionage, economic blackmail and deniable cyber-warfare to advance a national strategy.

There are scenarios in which Australia could find itself under threat.[66] The Australian government's own security advisors are warning that the country should prepare its military for serious conflicts.[67] Although the Australian military is better prepared than the Canadian military, defence/strategic advisors are warning that the government and defence department are too lethargic, are mired in bureaucracy, and have over previous decades produced periodic official reviews that have resulted in few tangible results. More recently, the government has been accused of using rhetoric that has not been matched by financial resources. Furthermore, the government should design and implement a national plan including manufacturing logistics, supply chain vulnerabilities, etc.[68]

A weakened and expensive energy system reduces the country's manufacturing, transport and infrastructure sectors. In turn, that weakens the country's strategic resilience.

9. An Alternative Future?

Given that large-scale changes to electricity systems created by RE are very expensive and disruptive, what are plausible alternatives?

(a) We have observed for decades that predictions of catastrophic CC have subsequently proved false – and some of these predictions can only be described as hysterical.[69] Careful analysis of statistics has revealed predictions of doom to be extremely pessimistic or absurd: CC changes relatively slowly over many decades. There has been serious debate over the degree of warming over the past two hundred years caused by human production of CO_2. Given the slow observable changes in temperature and extreme weather events, we have time to adapt to any changes in climate.[70]

(b) A strategy that is far less disruptive and costly is to adapt, exploring technological alternatives, with carefully designed pilot programs to test

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[66] See Babbage (2023) for a thorough analysis of scenarios of grey and kinetic warfare between China versus the USA and its allies (including Australia).

[67] See Jennings, Shoebridge and Hellyer (2025) for a detailed analysis and recommendations.

[68] For a discussion, see https://aspi.s3.ap-southeast-2.amazonaws.com/wp-content/uploads/2025/05/29090046/The-cost-of-Defence-2025-2026-1.pdf

[69] See Koonin (2024), showing that past predictions have been falsified by more recent observations. For example, many models predicting world temperatures have significantly over-estimated temperature increases; past predictions of more extreme weather have not been borne out by the data. For an example of a hysterical prediction, see the speech by UN Secretary General Guterres, "The era of global boiling has arrived": https://www.youtube.com/watch?v=xyacrd1d-cU

[70] See Koonin (2024) for a careful analysis of the scientific evidence, limitations of CC models, etc. For the adaptation approach, see Lomborg (2020) and Koonin (2024).

their economic, technological, environmental and social consequences. These programs require serious auditing and analysis to avoid escalating problems. Objective, honest criticism must be acted upon, and failure admitted and corrected.

(c) One obvious deduction from (b) is to subsidize research into technology that saves the use of fossil fuels and other scarce resources. Well-operating market systems provide signals of scarcity through increased prices. In turn, the increased prices induce incentives to find cheaper alternatives or cost savings through innovation. The public seldom recognizes that continual improvements in the efficiency of electricity generation, internal combustion vehicle engines and jet engines have created significant fuel efficiencies and cost reductions.

One must be wary of claims that the production of so-called green machinery (wind, solar, batteries) will reduce the use of fossil fuels. Careful analysis reveals that many of these claims are misleading or even false: their manufacture and installation require large amounts of energy, often provided by fossil fuels. Their claim to be environmentally friendly with reduced CO_2 is largely illusory (see Mills, 2023a and 2023b).

Many countries are exploring the design and manufacture of modular and small nuclear reactors. Large-scale nuclear reactors have evolved with various designs – can we improve the designs to make them safer and less costly? Recent research is exploring thermal storage technology that can be added to baseload nuclear or coal generation so that they can vary their generation of electricity to more closely match demand.[71]

Another example is developing improved batteries for electric vehicles and hybrid vehicles that are not so reliant on rare earths, the production of which is expensive and environmentally harmful.[72]

(d) As Smil (2024) wisely observes, the fossil fuel revolution, beginning in 1800, is still evolving. It transformed modern society to provide standards of living undreamed of in previous human history, releasing billions of people from grinding poverty, increasing life expectancy and allowing scientific and

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[71] For nuclear, see https://art.inl.gov/Meetings/Heat%20Storage%20for%20Gen%20IV%20Reactors%20Workshop%20July%2023-24/Resources/LWR%20Heat%20Storage%20NT.pdf and https://www.energy.gov/ne/articles/3-ways-nuclear-more-flexible-you-might-think

For coal, see https://www.energieforschung.de/en/home/project-insights/2018/coal-fired-power-plant-fit-for-the-future-with-thermal-storage

[72] See Schernikau (2025b) for an analysis of electric vehicles and their limitations.

engineering innovations that once would have seemed miraculous. Innovation takes time: premature adoption of new technology has increased risks of unintended consequences.[73]

(e) We have summarized evidence that NZ policies have been introduced without careful consideration of the costs for the whole electrical system of RE intermittency and for the back-up systems required for a reliable power supply.

Conclusion

We argue that Australia has followed an international political fashion to replace electricity generated by fossil fuels with RE (solar and wind) generation. This policy is part of a larger objective of NZ whereby human emissions of CO_2 are to be greatly reduced. Claims that RE reduces electricity prices were based on a superficial understanding of the complexities and costs of electricity generation and transmission systems. As these new RE systems have become a larger share of the total generating system, the escalating costs have become harder to disguise. Greatly increased electricity (and domestic gas) prices have decreased the standard of living (especially for the poor) and have reduced key manufactures.

An additional burden has been the consequence of large subsidies for RE. These are a cost to society; they claimed to be providing incentives for the rapid introduction of new technologies in a CC emergency. The cost of subsidies was said to be offset by reduced electricity costs by RE technology that harnessed "free" sunshine and wind. But empirical evidence demonstrates this claim to be false. The costs of collecting and transmitting reliable electricity from "free wind and solar" have been greatly underestimated. Having created an RE industry heavily reliant on large subsidies, the recipients have strong incentives to lobby the public, political parties and government to continue their subsidies.[74]

The Australian political parties and many in the MSM have been hoist by their own petard. Rather than calmly reviewing international experience, and changing policy, they have shown a combination of arrogance and scientific, technical and

[73] A simple example of the costs of rushing to innovate were policies to replace incandescent with florescent lamps. The new lamps were expensive and environmentally harmful for disposal (they contained mercury). In a short period of time, LED lights were introduced. They became far cheaper, used far less electricity and had longer lives. With shrewd understanding of ongoing innovation, regulations to force florescent lamps onto consumers should never have been introduced.

[74] Economists have long warned of rent seeking and its costs to society. For a thought-provoking analysis of the role of rent seeking by redistributive coalitions, see Olson (2022). Unrestrained rent seeking can wreak havoc on an economy and a nation.

economic ignorance that has badly damaged the country's standard of living, needlessly deindustrializing and endangering strategic resilience. As the evidence of this policy debacle accumulates, public criticism is escalating.[75]

If this policy debacle was an isolated example in a well-governed society, then one would assume that a policy reversal was imminent. Sadly, that is not so. Australian society is in deep trouble on many fronts, a victim of poor governance that is revealed in failing institutions, a stagnating economy and very poor-quality political leadership.[76]

[75] See these recent discussions: https://johnanderson.net.au/the-great-energy-deception-the-true-cost-of-renewables-chris-uhlmann/ and https://www.youtube.com/watch?v=4xBGcjIXgHU
[76] For a sample of recent highly critical analyses, see https://static1.squarespace.com/static/563997f0e4b0d7adb678285e/t/6625da11c8f8d371b24314d8/1713756689615/Road+Ahead+final.pdf and https://quadrant.org.au/news-opinions/australia/australia-crumbles/

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