Climate Energy Finance
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The LNP nuclear policy will cost the Australian economy at least $4.3 trillion by 2050

Analysis of the whole-of-economy implications of the nuclear pathway modelled by Frontier Economics and cited by the Federal Coalition to defend its nuclear policy reveals a hollowing out of Australian industry, permanently higher energy costs, higher costs from unabated carbon pollution, and trillions of dollars in lost GDP.

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About Climate Energy Finance

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

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

About the Author – Tim Buckley

Tim Buckley, CEF's founder, has 35 years of financial market experience covering the Australian, Asian and global equity markets from both a buy and sell side perspective. Before starting CEF as a public interest thinktank in 2022, Tim founded the Australia and Asian arms of the global Institute for Energy Economics and Financial Analysis in 2013 and was Australasian Director until 2022.

Prior to this, Tim was a top-rated equity research analyst over 2 decades, including as head of equity research in Singapore at Deutsche Bank; MD and head of equity research at Citigroup for 17 years; and head of institutional equities at Shaw & Partners. From 2010-2013, Tim was co-MD of Arkx Investment Management, a global listed clean energy investment start-up jointly owned with Westpac Bank. Tim is widely recognised and extensively published as an expert on Australian and international energy transition and the accelerating shift of global capital to decarbonisation, and is a sought after commentator and advisor.

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Important information

Executive Summary

The LNP's Nuclear Plan to Blow Up Our Economy: $4.3-5.2 Trillion in Damage to the Australian Economy by 2050

A whole-of-economy analysis demonstrates that the implied costs of the Federal Coalition's nuclear plan run well into the trillions of dollars – ranging from $4.3-5.2 trillion by 2050.

The Coalition's nuclear policy was released alongside modelling by Frontier Economics, which the Coalition continues to cite to defend its policy position. This modelling is predicated on advocating for an energy pathway ("Progressive Change") that differs dramatically to the energy pathway ("Step Change") deemed most likely by the Australian Energy Market Operator's (AEMO) Integrated System Plan (ISP) and consistently advocated for by the Labor Government (see Section 1).

To date, both the Coalition's and the Government's estimates of the price tag of building a nuclear industry in Australia restrict their analyses largely to costs incurred in the energy system itself. However, a redirection from a Step Change to a Nuclear Progressive Change energy scenario would, by necessity, impose many further flow-on costs to the Australian economy that are unaccounted for by the Frontier Economics modelling. Combined with Frontier's extreme underestimation of nuclear capex costs, these costs accumulate to $4.3 - 5.2 trillion by 2050, or 13-16 times those assumed by Frontier Economics. These unaccounted-for costs include **at least**:

- **$3.5 trillion** in cumulative undiscounted lost GDP through 2050 in the Progressive Change scenario, rising to $300bn annually by 2051. The GDP difference between Step Change and Progressive Change is so large that it swamps all other costs;
- **$111-332bn** in nuclear capex costs, most of which the Frontier modelling erases by failing to amortise costs incurred after 2050 and failing to account for inevitable expensive mid-life retrofits. If forecasting based on the average capex of the last three nuclear plants built in the US and EU, the total capex would climb to $332bn;
- **$234bn** in higher fuel costs due to slower electrification under Progressive Change, meaning consumers and businesses are forced to rely on higher cost fuel for longer;
- **$72-720bn** in economic damage caused by up to 2.0 billion additional tonnes of carbon emissions that will be released into the atmosphere under the Nuclear Progressive Change, based on a conservative current $36/t ACCU-based estimation and more expensive Direct Air Capture prices of A$360/t of the cost to our economy per tonne of carbon pollution;
- **$100bn** in lost green export revenue from Australia's aluminium industry alone, which would likely collapse under the drastically reduced industrial electricity demand required by the Nuclear Progressive Change scenario. Alternatively, servicing and maintaining the aluminium industry under this scenario would require at least $30bn in cumulative real costs to meet electricity demand.

When these unaccounted flow-on costs are added to the Frontier modelling's baseline cost estimation of $331 billion, the whole-of-economy price tag rises to $4.3-5.2 trillion by 2050. Many of the estimated cost valuations above rely on conservative assumptions around e.g., the economic cost of climate change, reasonable forecast capex for building nuclear

reactors, and potential foregone export revenue from clean export industries. They also exclude other flow-on costs more difficult to estimate, including that of keeping increasingly unreliable coal-fired power plants online for longer–and risking more frequent blackouts and system disruptions–as necessitated by the Nuclear Progressive Change scenario.

All told, though a cost of $4.3-5.2 trillion would represent a monumental contraction of Australia's economy to 2050, the cost of the Coalition's nuclear plan as modelled by Frontier Economics may be higher still if we lose the full opportunities that the Green Energy Export Superpower Scenario entails.

Section 1: The Federal Coalition nuclear policy and the Frontier Economics modelling

In December 2024 the Federal Coalition released additional details of its nuclear energy policy alongside a Frontier Economics consultant modelling report that compares nuclear deployment with the AEMO current 2024 Integrated System Plan (ISP) for electricity system development.

The Coalition's own policy statements [1] contain limited information on policy choices. The main new element is to quantify the capacity of nuclear generation that the Coalition aspires to build: “up to 14 gigawatts” (GW) nationally, across the seven existing coal generation sites previously flagged. Many matters remain to be determined including:

- Whether to use large scale reactors, which are familiar but have a history of significant delays and high costs in delivery in western economies; or small modular reactors (SMR), which barely exist anywhere and have never been built in Western countries, but make unfounded claims of lower cost and easier delivery.
- How to acquire control of the seven coal generation sites, none of which is owned by the Federal Government, and all of whose owners already have plans for different uses (and do not appear to have been consulted [2]).
- By what government subsidy mechanism the nuclear fleet would recover its considerable capital investment, since the existing wholesale electricity market design would be unlikely to produce sufficiently high prices.
- By what mechanism the nuclear fleet would operate as constantly as assumed, since coal generators with similar technical ability to operate steadily are in practice forced by the electricity market to choose between operating less and accepting electricity prices below their costs, thus effectively crowding-out low cost solar generation.
- What would happen with existing transmission, generation and storage projects planned, contracted or underway, including HumeLink, the Capacity Investment Scheme, Snowy 2.0 and more.
- What would be done over the next 10-20 years to deal with skyrocketing electricity prices and diminishing grid reliability while waiting two decades for nuclear to be approved then built, given the crowding-out of private sector investment proposals would inevitably result, estimated at more than $58bn by the CEC in April 2025.[3]
- How the Federal Government would force State Governments to change existing state legislation prohibiting nuclear power, as well as overcoming community opposition, which is likely to be extreme in terms of NIMBY. Dutton said if need be, his government would use constitutional powers to override state opposition to nuclear power. “We will work to find consensus,” he said. “If we can’t find consensus, we will do what is in the country’s best interest.” [4]

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[1] Federal LNP, Our plan for zero-emissions nuclear as part of a cheaper, cleaner and consistent energy future, A Cheaper, Cleaner, and More Consistent Energy Plan for Australia, 13 December 2024

[2] The Guardian, Here’s what we know about the Coalition’s 7 planned nuclear power sites, 19 June 2024

[3] The Guardian, Coalition nuclear plan will plough $58bn wrecking ball through renewable energy projects, analysis warns, 10 April 2025

[4] AFR, Legacy and an apology: Leaders sharpen pitches for final campaign run, 16 April 2025

The consultant report from Frontier Economics,[5] which states they were not commissioned or paid for by the Coalition, does not itself constitute Coalition policy and explicitly says "the modelling approach and assumptions do not necessarily reflect the Federal Coalition's view about how nuclear power would be included in the National Electricity Market". Frontier makes their own assumptions about the matters above and many more, and ignores some Coalition statements (such as their interest in small modular reactors or their ambition to lower gas prices by some means). However, the Frontier Economics report continues to be the central policy and economic analysis cited by the Coalition in defense of its nuclear plan, and should therefore be assessed under the assumption it will inform their policy.

The Frontier modelling looks at the resource costs involved in alternate electricity development pathways - the amounts invested in capital and spent on interest, fuel and so on. It does not attempt to look at electricity prices or the specific costs borne by electricity users. It looks only at costs incurred through 2050 (by definition excluding 87% of the $111bn capital cost amortisation of the nuclear power plants, given their generous assumption of 50 year lifespans, and ignoring the inevitable expensive retrofits required after 25-30 years of operation (Ontario rate payers are facing a C$12.8bn refurbishment cost over 2024-2026 to refurbish its 3.5GW Darlington Nuclear Generating Station, which was commissioned in 1992-93 [6]). Frontier Economics does not put any value on greenhouse gas emissions or abatement, despite wide differences in emissions across its scenarios.

Figure 1.1 details the four scenarios it compares are:

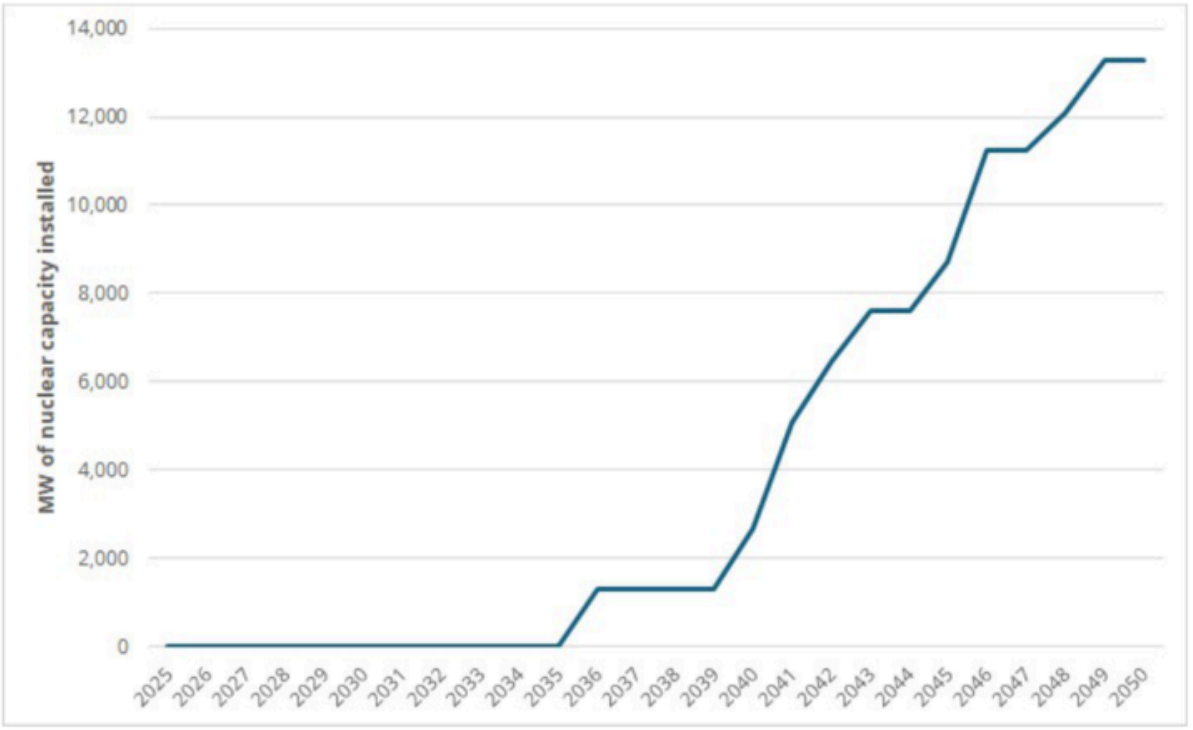
Figure 1.1: Frontier Economics Four Different Scenarios

ISP Step Change Assumed: High electricity demand due to electrification and abatement across the economy Assumed: Rapid coal generator retirement due to market pressures Modelled: NEM reaches 98% renewable energy by 2050	**ISP Progressive Change** Assumed: Lower electricity demand due to slower emissions reductions outside electricity, significant industry exit and lower overall growth Assumed: Slower coal generator retirement Modelled: NEM still 85% renewable by 2050, but with higher emissions along the way
Nuclear Step Change Assumed: Demand is high per ISP Step Assumed: Slower coal retirement than ISP Step Change, nuclear is built as coal retires Modelled: NEM reaches 65% renewable energy by 2051, nuclear is 29%	**Nuclear Progressive Change** Assumed: Demand is lower per ISP Prog Assumed: Slower coal retirement than ISP Progressive Change, nuclear is built as coal retires Modelled: NEM reaches 54% renewables by 2051, nuclear is 38%

[5] Frontier Economics, Report 2 - Economic analysis of including nuclear power in the NEM
[6] Ontario Government press release, Ontario Marks Completion of Darlington Unit 1 Refurbishment Project Five Months Ahead of Schedule, 18 November 2024

While Frontier assumes an initial 1.8GW nuclear capacity is available from 2036 (just 11 years from now), most of their buildout is assumed to be completed in the 2040s (15+ years) – Figure 1.2. Given this extensive delay, there is a long period where our current electricity system relies on extended output from coal generators, in contrast to the steady buildout of renewables through the 2020s and 2030s in AEMO's ISP to prepare for market-driven coal retirements experiencing increasing unreliability and higher costs.

Figure 1.2: Frontier's assumed pattern of NEM nuclear generator commissioning (MW)



Frontier does not model a scenario with high growth in clean energy intensive 'superpower' industries such as green alumina and aluminium, green iron or green ammonia. They are dismissive of Australia's prospects of hosting such industries. As CEF has analysed, failure to develop the industries Frontier ignores presents an extreme downside risk for Australia's trade balance. Should our key trade partners deliver on their Paris Agreements, our $138bn p.a. of iron ore exports could halve as North Asia pivots towards green steel supply chains, and the $160bn of fossil fuels Australia exported in FY2024 could decline precipitously.[7]

The headline comparison emphasised by the Coalition and Frontier is between the ISP Step Change scenario and the Nuclear Progressive Change scenario. Frontier states that "the Federal Coalition confirmed that they consider the demand forecast embodied in the Progressive scenario is more consistent with their view of the most likely transition of the electricity market."

On this basis, Frontier is taken to say that the inclusion of nuclear greatly reduces total system costs that must ultimately be paid by energy users; they declare the costs of ISP Step Change to be $594bn (in cumulative 'real' costs) versus $331bn for Nuclear Progressive Change.

[7] Climate Energy Finance, Green Metal Statecraft: Forging Australia's Green Iron Industry, 15 November 2024

Section 2: Costs of Nuclear Pathway Unaccounted for by Frontier Modelling

2.1 Lost GDP and an Economy that Delivers Less

The GDP difference between Step Change and Progressive Change under the AEMO-modelled scenarios is so large that it swamps anything else – around $3.5 trillion in cumulative undiscounted lost GDP through 2050, which is simply ignored by Frontier.

The largest share of the Frontier-modelled savings in investment come at the cost of delivering much weaker outcomes for Australia. Most obviously, electricity demand is much lower in Progressive Change than Step Change for three reasons:

- There is much lower overall economic growth assumed in AEMO Progressive Change versus Step Change, with Australian GDP up to $300bn annually lower by 2050 than in Step Change.
- There is a significant contraction of large industrial facility demand, likely representing the exit of the aluminium industry given Progressive Change does not deliver sufficient affordable and clean energy to enable that industry to continue beyond its existing electricity supply contracts.
- There is much less electrification of transport, buildings and industry. This means Australia stays largely reliant on importing our current $60bn p.a. of oil needs from the Middle East, a cost externalised from the Frontier 'modelling'.

All of these differences involve broader negative consequences that are not captured in the scope of the modelling, which is limited to the electricity sector. Lower industrial and wider economic output would mean less electricity investment to service it, but also means lost value added, exports, corporate and income tax revenue and so forth.

The consequences of a regression from the current Integrated System Plan Step Change scenario to a Nuclear Progressive Change scenario would have dramatic negative consequences across the Australian economy. This GDP loss reached a staggering $300bn annually by 2050.

The GDP difference between Step Change and Progressive Change under the AEMO-modelled scenarios is so large that it swamps anything else – around $3.5 trillion in cumulative undiscounted lost GDP through 2050 in Progressive Change compared to Step Change. On this basis alone nobody would rationally choose the Progressive Change scenario over Step Change.

It is also worth noting that variables like electricity demand growth are not directly a government policy choice – demand will be mostly determined by economic growth, technological change, rate of electrification of everything to reduce reliance on imported fossil fuels, and market trends, and policy makers and the electricity system will have to meet it. It is therefore unmeaningful to treat this kind of scenario variable as if it was a policy choice and say it is 'cheaper' if there is less demand (unless actual policy choices on energy productivity are being considered, for instance).

2.2 Capital Costs of Nuclear are Understated

Frontier Economics assumes 13.5GW of nuclear capacity is added across Australia over 2036-2050 at a total capex cost of A$111bn (real $ 2025), assuming an average capex cost of just A$8.2bn per GW. This is an exceptionally generous assumption. Assuming the average capex cost of the last three nuclear power plants built in Europe and the US of A$24.6bn/GW (Figure 2.1), the capex cost would be triple at A$332bn. Then Frontier amortises this capital cost of nuclear, deferring 87% of this $111bn cost (i.e. all but $13.5bn) to beyond the period to 2050 such that it is excluded from their total.

Frontier also excludes a First-of-a-Kind (FOAK) capital cost blowout, which would likely add tens of billions of additional cost.

Post approvals, construction to commissioning takes 13-14 years, at least 50% longer than Frontier Economics wistfully assumes.

Frontier Economics Nuclear Capex Assumptions

Frontier state they made the following modelling assumptions about nuclear power:

- Capital costs are $10,000 per kilowatt of capacity, in 2024
- Capital costs improve 1% per year from 2024 based on conservative learning rates for repeated commissioning of a technology type
- Capital costs are amortised over 50 years, meaning $97bn (or 87%) of their total capex costs are excluded from the 2025-2050 period assumed in their analysis.

Frontier says this is conservative and higher than the CSIRO's estimate of nuclear costs. However, CSIRO are clear that their estimates represent the cost of a mature building program after earlier higher cost units for First of a Kind deployments in the local context: "FOAK [first of a kind] premiums of up to 100% cannot be ruled out" for all new technologies in Australia.

These costs might decline significantly with each subsequent unit in a well-coordinated continuous building program. Or they might not; it is not clear how much transferability of workforce and supply chain, and achievement of efficiencies, there would be with a series of builds across widely dispersed Australian geographies over 25 years at seven unique existing industrial sites.

We estimate that Frontier assumes the construction of 13.5GW of nuclear by 2050, at a total real cost of A$110bn or A$8.2bn/GW ($8,200/kW), given most of it is built at an assumed cost deflated by 10-25 years of assumed 1% pa learnings. Given the lack of disclosure of the full modelling by Frontier Economics, fully cross-checking this is not feasible.

European and North American Nuclear Capex Costs

At actual large-scale nuclear builds in Finland, the UK and USA over the past two decades, final costs per kilowatt (kW) ranged from $12,800/kW (Finland) to $29,500/kW (UK), while initially promised costs at the time of approval ranged from $4,800 to $14,000/kW (adjusted for inflation). The Czech Government, currently in discussions with Korean developers about new large-scale nuclear power, is seeking to pay around $12,600/kW. All up, costs for early projects in a seven-site buildout would likely be much higher than assumed.

The 3.2GW gross Hinkley Point C (UK) nuclear power plant has an estimated completion date of 2031 and a capital cost of £35bn in 2015 prices,[8] so £45bn in 2025 prices,[9] the real price time used by Frontier Economics. Planning approvals started in 2007[10] and construction was approved to commence in 2016, giving a likely 14 year construction timeline.

The 2.2GW gross Vogtle nuclear power plant in the US was originally expected to cost US$14bn and begin commercial operation in 2016 (Vogtle 3) and in 2017 (Vogtle 4), but the project ran into nearly a decade of construction delays and with cost overruns seeing the total capital cost almost treble.[11] Georgia Power now estimates the total cost of the project to be US$37bn.[12] Post approvals, construction commenced in 2013, giving a 10-11 year construction time.

Finland's Olkiluoto 3 reactor, Europe's first in 15 years, of 1.6GW capacity, was connected into the Finnish national power grid and commissioned in April 2023 after a delay of 14 years from the original plan, having commenced construction in 2005 – an 18 year construction time. Experts have put Olkiluoto 3's final price tag at around €11bn in 2023 terms— almost three times what was initially estimated.[13]

Figure 2.1: Nuclear Plants – Capex Comparison

Plant	Location	Construction Time Years	Capacity GW	Currency	Capex Cost bn 2025 Terms	Forex rate	Capex Cost A$bn	Capex Cost A$bn/GW
Hinkley Point C	England	14.0	3.2	Sterling	45.2	0.48	94	29.5
Vogtle	Georgia, US	10.5	2.2	US$	36.8	1.57	58	26.0
Olkiluoto 3	Finland	18.0	1.6	Euro	11.6	1.78	21	12.8
Average capex cost per GW		13.8						24.6

Source: Company Accounts, CEF calculations

Small Modular Reactors (SMRs)

SMRs remain an unproven technology, decades after they were first suggested, with none having reached final investment decision and in construction anywhere in the world today. Indeed, the first SMR the U.S. tried to build — by NuScale — was cancelled in 2023 after its cost soared past US$20,000/kW, higher than Vogtle. In 2024, Bill Gates told CBS the full cost of his 375-megawatt Natrium reactor would be "close to $10 billion," making its cost nearly US$30,000/kW — almost twice Vogtle's.[14]

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[8] The Guardian, Hinkley Point C could be delayed to 2031 and cost up to £35bn, says EDF, 24 January 2024
[9] Renew Economy, Cost of UK's flagship nuclear project blows out to more than $A92 billion, 29 January 2024
[10] UK Government, Hinkley Point: nuclear regulation
[11] US EIA, Plant Vogtle Unit 4 begins commercial operation, 1 May 2024
[12] GCV, Report: Nuclear reactors to cost Georgia ratepayers extra $420 annually, on average, 29 May 2024
[13] Reuters, Europe's most powerful nuclear reactor kicks off in Finland, 17 April 2023
[14] Los Angeles Times, Small nuclear reactors are no fix for California's energy needs, 18 April 2025

2.3 Additional Fuel Costs

Australia currently imports some $60bn pa of oil for transport, both a huge drain on our trade balance and energy security risk for our country. Progressive electrification of our transport and mining fleet, plus a gas substitution roadmap for residential and C&I methane gas demand, would progressively eliminate this massive economic headwind, very conservatively adding at least a cumulative $234bn through to 2050.

Slower electrification under the Nuclear Progressive Change scenario means households and businesses incur higher fuel costs for longer, as well as producing higher emissions outside the electricity sector. These fuel costs look to be at least a cumulative $234bn through 2050, when estimating petajoules of additional cumulative gas and transportation fuel use. The consumer and industry savings from moving to domestic renewables powered EVs in both passenger and haulage markets–and hence progressively phasing out entirely Australia's current $60bn annual cost of importing high emissions oil from the Middle East–is huge, but entirely ignored in the Frontier Economics modelling. Frontier also ignores the likely >$1,000 annual value of payments per EV from providing vehicle-to-grid services that BloombergBEF models.[15] On the other hand, there are capital costs outside the electricity sector to electrify vehicles and appliances, though these are evolving too. The Frontier modelling does not involve any weighing of trade-offs on these matters - it simply does not consider them.

2.4 Additional Emissions

Frontier Economics assumes away the massive $72-720bn cost of externalising an additional 1.4-2.0bn tonnes of carbon emissions across our economy by 2050 that result from our failing to act on climate science.

The Nuclear Progressive Change scenario also delivers much less than ISP Step Change on other fronts. Cumulative electricity sector emissions are much higher in the nuclear scenarios due to slower deployment of clean energy and slower retirement of high-emissions generation. Climate change is a problem of cumulative greenhouse gas emissions, just as debt is a problem of the cumulative imbalance between revenue and spending. The trajectory to net zero emissions is at least as important as the destination for whether Australia can contribute to avoiding the most dangerous levels of climate change. Cumulative electricity sector emissions are around 1 billion tonnes higher through 2050 under the Nuclear Progressive scenario than under ISP scenarios.

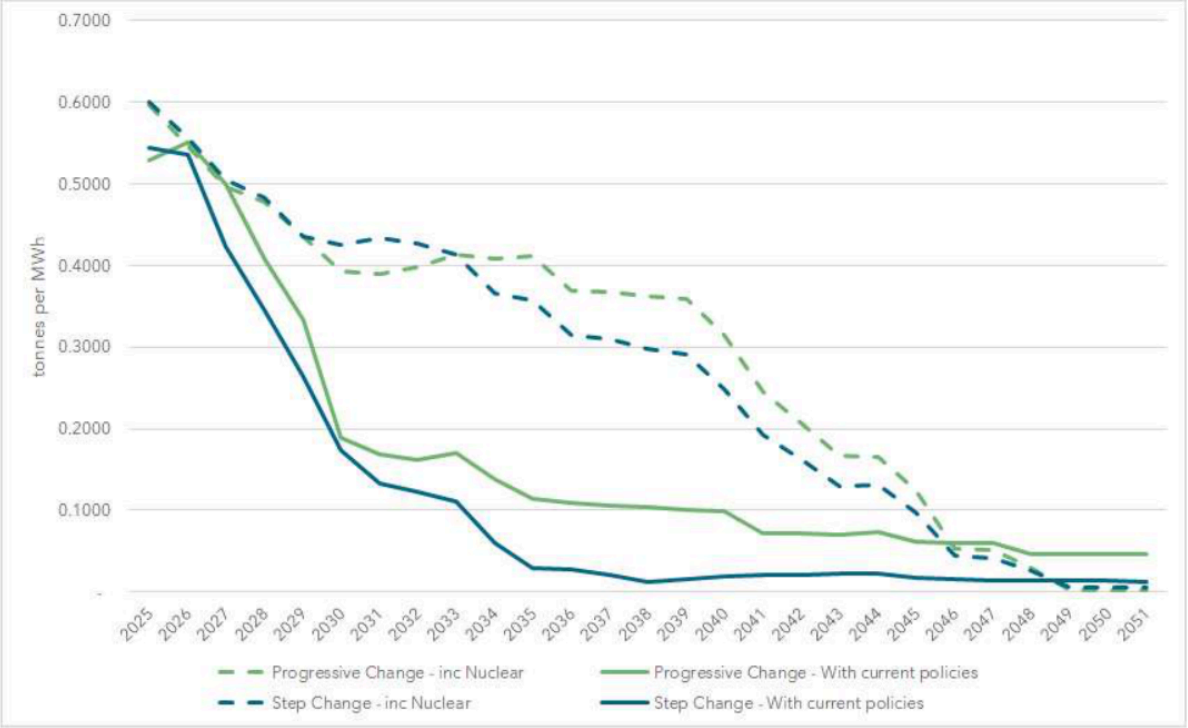
But there will also be higher emissions from the wider economy with the slower transition assumed in Progressive Change (Figure 2.2). Drivers include slower electrification of buildings and transport as discussed above, and slower adoption of renewable fuels. CSIRO and ClimateWorks Centre modelling underpinning the ISP put these wider emissions at 1.4bn tonnes through 2050, whilst the Climate Change Authority estimates them at over 2.0bn tonnes economy wide by 2050.[16]

The nuclear modelling does not assign any financial value to emissions or abatement. This is poor practice for weighing trade-offs, and contrary to Frontier's own approach in assessing

[15] Cleantechnica, V2G Technology Is Getting New Interest In China & Europe, 18 April 2025
[16] Climate Change Authority, Assessing the impact of a nuclear pathway on Australia's emissions, 24 February 2025

the ISP in their previous report. Climate change has serious financial costs, and alternative methods of emissions reduction come with greater or lesser costs. Current Australian carbon offset credits cost $36/t, while the EU ETS carbon price is €60-70t or A$100-125/t. Pulling cumulative emissions out of the atmosphere in the long term using Direct Air Capture – which will be more necessary to the extent that we fail to reduce emissions earlier - appears likely to be very expensive, maybe falling to US$230/t (A$360/t) in the long term.[17]

Figure 2.2: Frontier Economics comparison of electricity sector emissions intensity (tonnes per MWh) 2025-2051 (fig 11 in their report)



Inclusion of an emissions value for extra emissions in electricity and other sectors would add between $72bn and $720bn to the sum of cumulative costs in the Coalition's preferred scenario.

2.5 Lost Green Energy Exports and Decreased Industrial Output

Frontier ignores the Green Energy Exports scenario entirely, along with the downside risks to our iron ore and coking coal sectors as our key trade partners inevitably adopt decarbonisation strategies of their own to act on their Paris Agreement commitments. CEF notes that industry exit drives around a quarter of the total demand difference between Step Change and Progressive Change, but conservatively only includes a $100bn cumulative differential for loss of green aluminium exports to avoid double counting.

The latter scenario would result in widespread manufacturing and industry job losses if enacted, including the almost certain closure of Australia's mainland aluminium smelters by 2030. Frontier's energy modelling shows that under the proposal, industrial electricity use would collapse from the current level of 45.4TWh per year down to 22.8TWh by as early as

[17] Bloomberg, Big Bets on Speculative Carbon Capture Tech Ignore Today's Solutions, 18 April 2025

2035 – a 50% drop. A collapse in energy usage of this magnitude is equivalent to the closure of Australia's four aluminium smelters, which currently use 23.5TWh pa of electricity. Nuclear's higher prices and slow development timeline also place Australia's smelters at risk. Australia's aluminium smelters in Tomago in NSW's Hunter region, Gladstone in Central Queensland, Portland in Victoria and Bell Bay in Tasmania rely on low-cost energy in order to be economically viable. Australia's aluminium industry currently supports 7,594 direct jobs and 5,886 jobs indirectly, 13,500 jobs in total.[18] Australia's aluminium industry also brought in $5.3bn in export revenue in 2023. With the loss of that industry, Australia would forego, at a conservative estimate, $100bn in export revenue out to 2050.

Alternatively, based on Frontier's costing for a Nuclear Progressive Change, servicing continued aluminium demand would require at least around another $30b of 'cumulative real costs' to scale up assumed electricity supply. It might require much more, or be infeasible without renewables expansion, given nuclear capex and lead times, and the unviability of aluminium production at the full cost of new Australian fossil electricity. This 'market choice' has been made crystal clear by Rio Tinto in 2024 and 2025.[19] [20]

The industry exit necessitated by the Nuclear Step Change scenario resonates with a deeper problem. Frontier explicitly considers that Australia has no plausible future comparative advantage in energy intensive industries. The Coalition's energy policy effectively does the same, by shifting focus from solar and wind where Australia could be one of the cheapest and most scalable energy producers, to nuclear where Australia would struggle to match other nuclear nations and have no prospect of undercutting them. The LNP appears focussed on ensuring Australia remains on our current trajectory of ever-diminishing domestic industry, increasing our dependence on our dig-and-ship zero domestic value-add mining and fossil fuel exports. This will progressively worsen our already well faded economic complexity, with Australia already ranked an exceptionally vulnerable 99th out of 145 countries, down 8 positions over the last decade.[21]

By foreclosing all possibility of Australia fulfilling AEMO's "Green Energy Exports" scenario, the Frontier Economics modelling also foregoes the massive revenue potential of industries like green hydrogen, green metals, critical minerals, and renewable componentry. Estimates have forecast that these industries could produce $314 billion annual gross value added to the Australian economy by 2040. This additional economic activity will by necessity be foregone under the Nuclear Progressive Change scenario.[22]

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[18] Renew Australia For All, Nuclear places australia's aluminium smelters and its 13,500 jobs at risk: new analysis shows, 22 April 2025

[19] AFR, CEO Jakob Stausholm confirmed that progress on "repowering" Tomago had been slow and there were "significant hurdles" still to overcome. "The problem we are facing with a place like Tomago right now is it might take us a longer time to get renewables, and the electricity from coal-fired power, what we have been quoted, is extremely expensive.", Rio says 'extremely expensive' power could seal Tomago fate in 2029, 20 February 2025

[20] AFR, Rio's Australian operations CEO, Kellie Parker, said the Edify deal was "integral to repowering our Gladstone aluminium operations with affordable, reliable and lower carbon energy for decades to come". "For the first time, we have integrated crucial battery storage in our efforts to make the Boyne aluminium smelter globally cost-competitive, as traditional energy sources become more expensive." Rio Tinto solar, battery deal in Queensland to spur $2b investment, 13 March 2025

[21] Harvard Growth Lab, Australia

[22] Accenture, Sunshot: Achieving Global Leadership in Clean Exports, September 2023

2.6 Deferring End-of-Life Coal Plants and Other Issues

We have not included the inevitable extensive costs of refurbishing the current end-of-life coal power plant fleet for unexpected but inevitable unplanned outages from operating these coal plants decades beyond their planned useful life.

The Frontier Economics modelling assumes automatically replacing life extended coal generators with nuclear capacity when these coal generators permanently close, presuming end of life coal plants can be extended 1-2 decades beyond their useful life without putting grid reliability under extreme pressure. This assumption is in CEF's view entirely unrealistic. Deferring the closure of coal-fired generators shows up as a saving in Frontier's model because replacement investment is not required. However, there are at least three drawbacks to deferral beyond higher emissions:

- Existing coal and gas generators are delivering uncomfortably high electricity prices to consumers due to high fuel prices. Deferring new investment reduces 'resource costs' but leaves actual energy prices experienced by consumers at high levels. Frontier speculate that electricity market reform could sharply lower electricity prices, and note the Coalition's ambition to lower gas prices, but do not model either or describe any means of achieving them.
- It is not clear if or how extension costs are included in Frontier's estimates. Extending the life of coal generators may come at significant cost, given their age and the market pressures they are under, as has been the experience across Australia:
    - Extending NSW's Eraring generator for two years required a commitment from the State Government to pay up to $450m, although sustained high electricity prices mean Origin did not take this offer up in 2025/26.[23]
    - The Callide C power plant explosion in 2021[24] [25] cost Queensland tax payers $400m and 3 years to repair,[26] only to explode again in April 2025.[27] [28]
    - Muja AB in West Australia in 2017-2019 proved a >>$300m debacle. [29] [30]
- Extended reliance on end-of-life coal generators may not provide the full reliability sometimes assumed – ageing coal plants are generally not available when most needed.[31]

The pace of the nuclear plant approvals process then subsequent buildout is also significant to the costing. Given real-world experience in developed countries, it is unlikely that the

[23] Renew Economy, Origin spares taxpayer the tab for Eraring coal plant extension, because the consumer will pay, 1 April 2025
[24] ABC, Damning report into 2021 Callide C power station explosion finds CS Energy failed to implement 'effective safety practices', 25 June 2024
[25] ABC News, Damning report into 2021 Callide C power station explosion finds CS Energy failed to implement 'effective safety practices', 25 June 2024
[26] Leading edge energy, Callide C3 Unit returns to service, 24 April 2024
[27] Renew Economy, Heads roll at Callide and CS Energy as LNP coal plant extension explodes into high farce, 15 April 2025
[28] Renew Economy, Callide unit shut down by "blast" just days before Queensland LNP reveals life extension for coal plants, 10 April 2025
[29] The West Australian, Collie's Muja AB power station to close in multi-million dollar loss, 14 September 2017
[30] Renew Economy, WA to close Muja coal units – to lower power bills, stabilise grid, 6 August 2019
[31] Climate Council, Research reveals our aging coal fleet is unreliable and risks energy security, 23 January 2025

buildout could deliver any material new electricity generation in the next fifteen years. While Frontier's model assumes initial capacity is delivered by the end of 2035 per Coalition ambitions, this is just 1.8GW. Most of the buildout is assumed to be delivered in the 2040s. Frontier states that they amortise the costs of nuclear over 50 years. However they only report costs incurred through 2050. It appears that the combined effect may be to exclude 87% of capital costs of the nuclear buildout from the main comparison.[32] Amortisation of long-lived assets is also used in AEMO's analysis for the ISP, though with much ISP investment taking place relatively soon, and Frontier's scenario for nuclear deployment significantly delayed, the effect appears to be to greatly exaggerate savings. In practice the costs of nuclear buildout – in the deployment of real resources and the incurring of large debts – will take place right away.

The Coalition have claimed nuclear power would bring down the cost of living, yet the Coalition has provided no evidence to back up its claim that its proposal could bring electricity prices down. Dutton has claimed that modelling by Frontier Economics judged the Coalition's plan to be 44% cheaper than Labor's policy of running the grid overwhelmingly on renewable energy, and that this meant power bills would be cut by 44%. This claim has no basis in fact. Frontier's own modelling report said it had not modelled the impact of a nuclear plan on prices. The modelling used by the Coalition is based on an electricity system producing 31% less electricity than Labor's preferred renewables-based approach.[33]

The issues of capacity factor (how much of its rated capacity a generator is actually able to produce in use) and ability to recover costs through electricity prices have been much discussed but do not play much role in the Frontier modelling. Frontier are only considering resource costs – cumulative total investment and operation – rather than whether assets can pay for themselves. They assume that something is done to energy markets to enable cost recovery of the assets they model, and move on. In practice it would seem difficult for nuclear and renewables at large market shares to both achieve their full physically possible capacity factor at the same time as assumed.

[32] The exclusion would be ~85% at the low capital cost assumed by Frontier. If actual delivered costs were as high as the UK's Hinkley Point C project, the excluded costs would be ~96% of the total.
[33] The Guardian, Nuclear curious? Here's what you need to know about the Coalition's energy claims, 4 February 2025

Section 3: The Real Cost to Australia of Nuclear is >10 times Frontier's costings

CEF estimates that the nuclear Progressive Change Scenario has massively understated the full costs, which we estimate at $4.3 – 5.2 trillion, more than ten times Frontier Economics' $331bn – in fact 13-16x, as per Figure 3.1.

Figure 3.1: Indicative cumulative impact of missing elements on Frontier costings (A$)

	Integrated System Plan, Step Change	Nuclear Progressive Change
Costs Presented by Frontier	$594bn	$331bn
Costs with missing elements	$594bn	$4.3 - 5.2 trillion

In light of the above, the Frontier modelling is not necessarily a useful guide to the full costs and benefits to the economy or energy users of a turn towards nuclear generation. Figures 3.2 and 3.3 provide a preliminary and indicative guide to the potential full costs.

Figure 3.2: Scenario comparisons with additional or improved elements

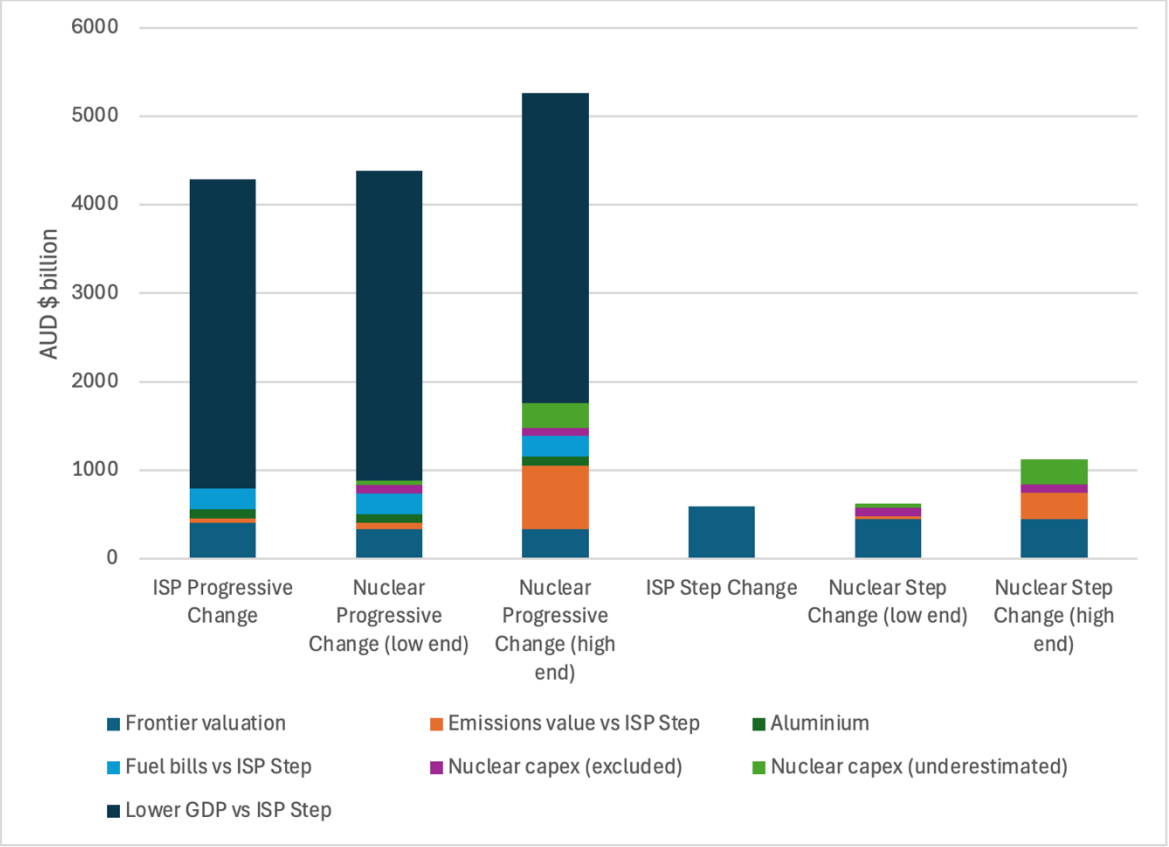

Figure 3.3: Missing elements of Frontier costings

	Indicative Missing Costs	Basis for estimation
GDP lower than in ISP Step Change	A$3.5 trillion to 2050	ISP scenario assumptions
Nuclear capex costs	A$111 - 332bn total capex less $13.5bn amorisation	CEF uses a A$8.2-24.6bn/GW range of capex costs for nuclear & incldes all capex costs incurred
FOAK capex blowout	100% of a $15-44bn facility	
Additional Fuel Costs	A$234bn to 2050	Backing out data of CSIRO / Climateworks ISP modelling shows 980PJ of cummulative higher gas use through 2050 & 4,200PJ of additionla transport oil
Additional Emissions	A$72-720bn	1.4-2.0bn extra CO2 emissions with ACCU of A$36/t and DAC at US$230/t
Green Energy Exports loss	100	Cost of loss of green aluminium exports to 2050. Green iron not included.
Deferred coal retirement capex cost	Uncosted	Massive grid reliability threats.
Add in Frontier Nuclear Est.	A$331bn	
Costs with missing elements	$4.3 - 5.2 trillion	

Note that the above costs are indicative. Some relate to issues that would require multiple partial equilibrium models beyond electricity to consider. Others would benefit from a general equilibrium model of the Australian economy or an integrated assessment model of climate and economic interactions. Discounting the full stream of future costs and benefits to a net present value would be more meaningful than a 25 year sum, though summing is the preferred Coalition comparison.

Section 4: Australia Needs a Clear Strategic Vision

Asked during the debate if the impacts of climate change – including in his home state of Queensland – were worsening, opposition leader, Peter Dutton said: "I'll let scientists pass that judgment. I don't know because I'm not a scientist and I can't tell you whether the temperature has risen in [outback Queensland town] Thargomindah because of climate change or the water levels are up." [34]

Undertaking an entirely unbelievable backflip, Dutton the next day insisted he "believes in climate change". Whilst most in the Federal LNP claim they remain committed to net zero emissions by 2050, we note the reality is very different. The Climate Change Authority estimates their state energy policies will add an additional 2 billion tonnes of carbon emissions by 2050 relative to our existing national plan, a total abrogation of responsibility in CEF's view. For example, the Federal Coalition plans to undermine Australian energy independence and increase emissions by committing to water down our national New Vehicle Efficiency Standards.[35]

Defaulting to a "gas-fired recovery", when nuclear proved unsaleable, calls to mind Scott Morrison's mercurial government. Gutting the vehicle efficiency standard, undermining our Climate Finance Taxonomy implementation and the Safeguard Mechanism — which Labor strengthened to force emissions cuts on industry — and welching on the Paris Agreement revive bad memories of Tony Abbott's climate wars.

Australia needs a long term energy and climate vision. This is critically important for preparing for the inevitable decline in both our fossil fuel exports and our world leading iron ore exports as our key trade partners deliver on their Paris Agreement commitments. To assume they will abrogate their Treaty obligations leaves the Australian economy exceptionally exposed. The risks for Australia are profound, and are being well illustrated in real time in the US, which has been captured by its fossil fuel vested interests and their climate science denying lobbyists and politicians. Trump's climate denial is a gift to China.[36]

Australia's mining, industry and financial sectors can't prepare for the fundamentally different world of zero-emissions economic activities without leadership that accepts the climate science and has a clear strategic vision to act accordingly.

[34] The Guardian, Peter Dutton insists he 'believes in climate change' after refusing to say if impacts of global heating worsening, 17 April 2025
[35] AFR, Coalition to water down vehicle efficiency scheme, 10 April 2025
[36] Noema, Trump's Climate Denial Is A Gift To China, 15 April 2025