

Submission: Technology Investment Roadmap Discussion Paper

The Roadmap is no substitute for credible emissions policy in the near-term, nor a long-term strategy, the delay of which breaches international commitments. The Roadmap is based on assumptions that are held secret. Claims about the role of gas appear to contradict sources cited in the paper. Technology priorities should be renewables integration, residential upgrades, electric vehicles, industrial electrification and green hydrogen. Carbon capture and storage has a dismal track record and does not justify new fossil consumption.

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The Australia Institute welcomes the opportunity to comment on the Technology Investment Roadmap Discussion Paper. The Discussion Paper is a desktop study of concepts of technology development and specific abatement opportunities across many sectors. It presents estimates of scale and cost of current and future abatement.

This information may be useful in future government efforts to pursue abatement in all sectors. It could form a basis for integrating abatement objectives into a broader national industry policy that develops strategic industry opportunities that reduce emissions by capitalising on Australia's competitive advantages and seeking to export these technologies and the outputs of new production to other countries.

However **the paper is not a policy or strategy**. Nor does the paper present any clear policy or strategy. There is still no effective national climate change policy in Australia.

There is no trend for emissions reduction and, with the exception of the electricity sector, emissions levels are problematic. Policy to support technology investment in all sectors must include policies that *require* emissions reductions or the uptake of abatement technology. Without them, deep cuts in emissions, as promised, will not occur.

ROLE OF ROADMAP UNCLEAR

At the official Roadmap webinar on 12 June, it was concerning to hear the Roadmap described as helping determine the feasibility of abatement ambition.

The Australian government has set climate goals, both for 2030 and implicit through the Paris Agreement, of net-zero in the medium term. The roadmap should serve those goals, not the other way around.

Australia's commitment is inadequate to the Paris goal of limiting global warming to 1.5 degrees above pre-industrial levels. Australia's target is not a 'fair share' whether on metrics of population, historical emissions or wealth.¹ Worse, on current policy Australia's target will not be met through real abatement over the next decade but through carryover credits from the Kyoto Protocol. This approach is legally baseless.² Australia is the only country seeking to use these types of Kyoto credits and as seen at the Madrid Climate Conference, has little diplomatic support to do so. Relying on the credits would make abatement harder in later years beyond 2030, including to reach higher ambition targets to which Australia has already committed through the Paris 'ratchet mechanism'.

In the *2017 Review of Climate Change Policies*, the Commonwealth committed to a "whole-of-economy emissions reduction strategy for 2050" by 2020.³ This was scheduled for release prior to climate conference held in late 2020. Despite more than two years work, in May 2020 the Energy Minister quietly delayed it to November 2021 "ahead of COP26", itself delayed due to the pandemic.

This announcement is a breach of a commitment made by the Prime Minister with our Pacific Island neighbours. In 2019 at the Pacific Island Forum, the Prime Minister

¹ Campbell, Merzian (2018) *Advance Australia's Fair Share* <https://www.tai.org.au/content/advance-australias-fair-share>

² Climate Analytics Australia (2019) *No Legal Basis for Australia's Use of Kyoto Credits*, <https://www.tai.org.au/content/no-legal-basis-australia-s-use-kyoto-credits>

³ Department of Industry, Science, Energy and Resources (n.d.) *2017 Review of Climate Change Policies*, <https://publications.industry.gov.au/publications/climate-change/climate-change/publications/final-report-review-of-climate-change-policies-2017.html>

agreed Australia would “*formulate and communicate mid-century long-term low greenhouse gas emissions development strategies by 2020*”.⁴ That commitment still stands and the Australia Government should release the long-term strategy, even as an interim report, for public consultation alongside the roadmap.

There is a dangerous precedent relying on just technology to shape climate policy and diplomacy. Australia’s previous experience with the ‘technology not targets’ was under the Howard Government. When the Howard government rejected the Kyoto Protocol and any emissions target, it instead established the Asia Pacific Partnership for Clean Development and Climate. The Partnership, much vaunted by government at the time, was widely criticised and achieved so little it is scarcely remembered.⁵

RELEASE THE DATA AND ASSUMPTIONS

Much of the roadmap consists of colourful ‘bubble’ graphs presenting abatement scales, cost and commercial readiness for technologies over different time frames.

The Australia Institute has requested the data and assumptions behind these graphs numerous times and have not received any response.

We made requests for this information from the Department

- 22 May, by email to the roadmap taskforce
- 11 June, again by email
- 12 June, by phone and email to the Department’s switchboard, and
- 12 June to the Department’s media contact, who could find no relevant contact,
- 12 June on the Roadmap consultation webinar,
- 12 June on the ANU Energy Change Institute webinar, and
- by email to the Department representative on the taskforce.

We have received no response to any of these requests for information. We have now requested this information under Freedom of Information but we would be pleased to withdraw that if our requests are addressed.

⁴ Pacific Island Forum (2019) *Communique* <https://www.forumsec.org/wp-content/uploads/2019/08/50th-Pacific-Islands-Forum-Communique.pdf>

⁵ Climate Institute (2006) *APP Progress Report* <http://www.climateinstitute.org.au/articles/publications/first-progress-report-on-the-asia-pacific-partnership-on-clean-development-and-climate.html>

On the 12 June ANU organised webinar, the Department representative stated that abatement figures would not be released, because the Department did not want people to add up estimated abatement to produce totals, as the estimates were produced 'individually' and did not consider interaction effects.

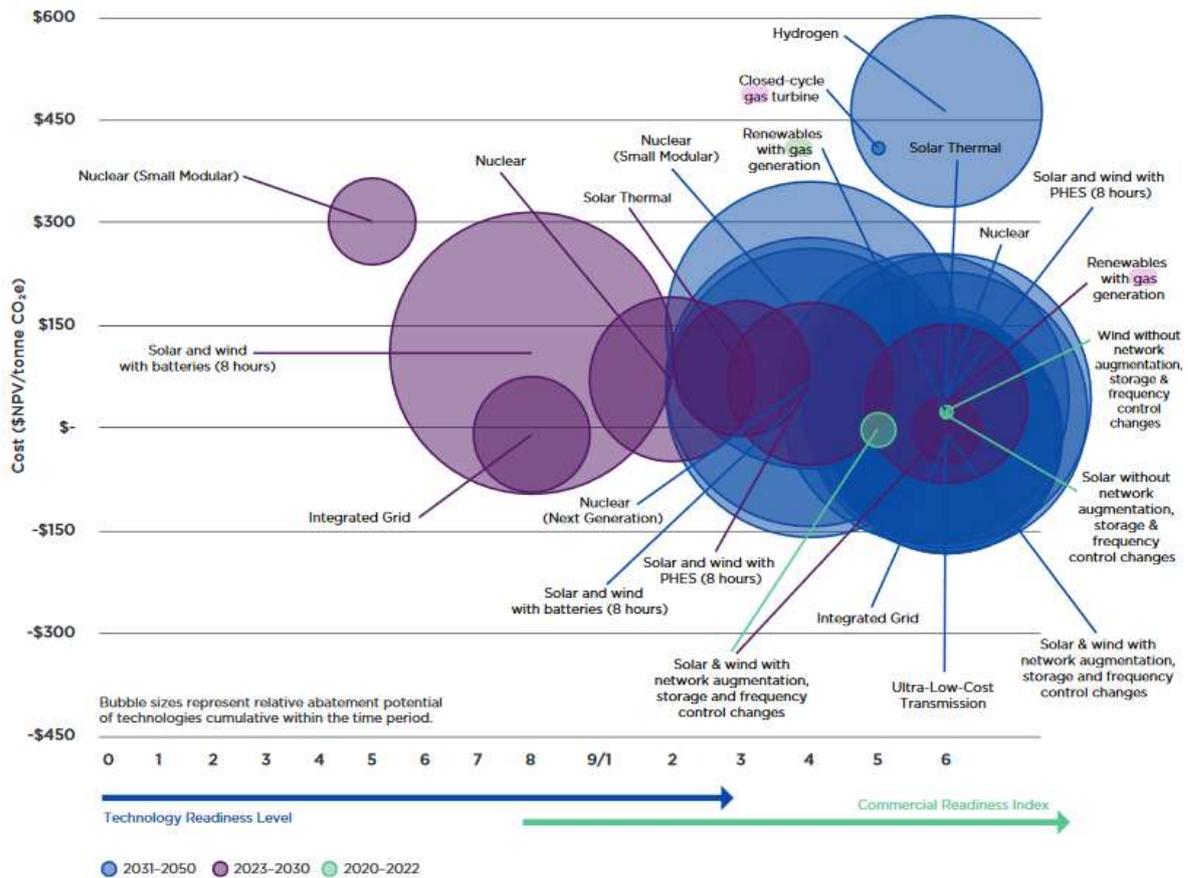
While important to note and in itself no criticism of the estimates, it makes little sense as a rationale for not releasing the data. The graphs are very confusing in their own right. A reader can estimate the data from the charts and the misinterpretation would then be amplified. Moreover, risks of misinterpretation of confusion are explicitly ruled out as grounds for not releasing documents under FOI. So it is unclear why the Department would invoke such a consideration at all.

Of more significance than the data behind the graphs are the assumptions. Graphs with no disclosed data or assumptions are no basis for a credible consultation on what is unfortunately Australia's primary climate change policy document.

RENEWABLES AND GAS

As an example, we draw attention in particular to *Electricity Supply (Figure 13)*, reproduced below. This is especially important as it underlies opportunities in other sectors for electrification using low cost renewable energy.

Figure 13: Electricity generation technologies, 2020-2050



Notwithstanding the confusing mode of presentation, close attention shows a few matters of note:

“Solar and wind with network augmentation, storage and frequency control changes” offers negative-cost abatement over 2020-22. Over 2022-2030, a period four times longer, the same ‘technology’ offers about three times more abatement at the same cost (saving). This is surprising, given the ongoing reductions decrease of the costs of these technologies.

For 2020-22, “renewables with gas generation” is not legible on the graph.

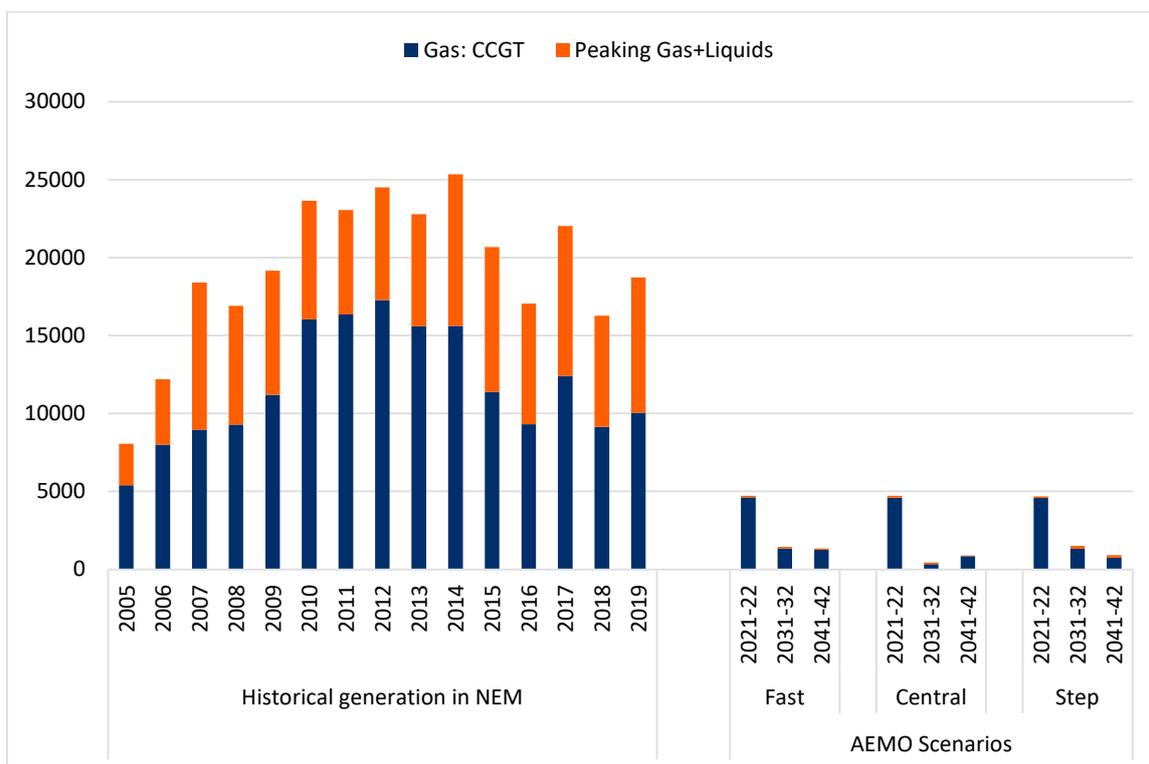
For 2020-30, the abatement with gas appears five- or six-times larger than renewables without gas in the same period, at a slightly higher (positive) cost.

How much gas is being used in these scenarios and at what cost? There is no indication.

Apart from some general commentary, there is one reference to AEMO and the CSIRO GenCost study⁶. The Roadmap appears inconsistent with both.

The AEMO Integrated System Plan shows the “Optimal path” (lowest cost) for ‘Central’, ‘Fast’ and ‘Step Change’ scenarios involve a large uptake in renewables and a large reduction in gas generation, compared with the last 15 years (see Figure 1).⁷

Figure 1: Gas and liquids generation – NEM historically and in AEMO ISP scenarios



Source: OpenNEM (2020) *OpenNEM: An Open Platform for National Electricity Market Data*, AEMO (2020) *2020 Integrated System Plan (ISP)*, Draft 2020 ISP Generation Outlooks, Scenario 2 for “optimal path” in each case

Similarly, the CSIRO GenCost study shows renewables with 6 hours of storage are *already* comparable to closed cycle gas and far cheaper than peaking gas, and will get cheaper still in later years. Renewables are far cheaper on a standalone basis. Note all

⁶ Graham, Hayward, Foster, Story, & Havas (2018) *GenCost 2018*

⁷ OpenNEM (2020) *OpenNEM: An Open Platform for National Electricity Market Data*, <https://opennem.org.au/energy/nem/>, Generation by year across NEM, CCGT, all other gas and liquids combined; AEMO (2020) *2020 Integrated System Plan (ISP)*, [https://aemo.com.au/Energy systems/Major publications/Integrated System Plan ISP/2020 Integrated System Plan ISP, Draft 2020 ISP Generation Outlooks, Scenario 2 for “optimal path” in each case](https://aemo.com.au/Energy%20systems/Major%20publications/Integrated%20System%20Plan%20ISP/2020%20Integrated%20System%20Plan%20ISP,%20Draft%202020%20ISP%20Generation%20Outlooks,%20Scenario%202%20for%20%20optimal%20path%20in%20each%20case)

renewables will need storage and overbuilding renewable capacity will often be cheaper than storage.

Figure 2: CSIRO: levelised cost of electricity in 2020, orange is gas, blue is renewable,

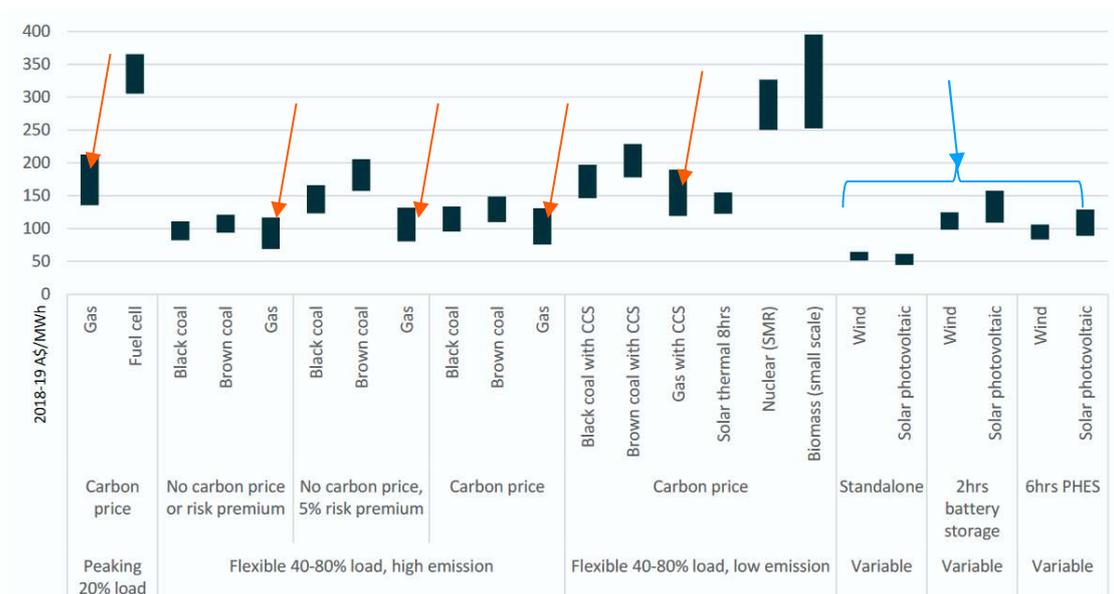


Figure 4-2: Calculated LCOE by technology and category for 2020. Notes: Ranges are primarily based on differences in carbon prices, capital costs, fuel costs and capacity factors (see Apx Table B.2 in Appendix B). PHEs is pumped hydro energy storage; CCS is carbon capture and storage; SMR is small scale modular reactor. The gas peaking technology is an open cycle turbine, other flexible gas refers to a combined cycle gas turbine. Flexible coal refers to a supercritical pulverised fuel plant.

Source: modified from Graham, Hayward, Foster, Story, & Havas (2018) *GenCost 2018*

Additionally, ARENA-commissioned work by ITP conducted extensive technical analysis of “the cost of firm energy from dispatchable renewable generation” and “found it comparable to new build fossil-fired generation.” They concluded “a range of proven and affordable options is available to more than adequately cater for significantly increased levels of renewable energy in the Australian electricity mix” including “an eventual net zero emission technology mix by 2050”.⁸

This raises deep doubts about the credibility of the roadmap’s presentation of gas as a source of power sector abatement.

OTHER COMMENTS ON POWER

The treatment of nuclear power as a source of low-cost abatement is puzzling. The industry is nowhere profitable without substantial state subsidy and costs generally

⁸ Lovegrove et al. (n.d.) *Comparison of dispatchable renewable electricity options*, p. 107, <https://www.arena.gov.au/assets/2018/10/Comparison-Of-Dispatchable-Renewable-Electricity-Options-ITP-et-al-for-ARENA-2018.pdf>

escalate where it is deployed due to a litany of problems: scale, complexity and danger, construction and financing blowouts and risks the private sector will not fully insure.⁹

A technology that should be but does not appear to be included is offshore wind. Offshore wind has higher capital costs but also higher potential capacity factors and diversity in generation profile from other renewables. This should be included as the first offshore wind project continues to progress.¹⁰

The roadmap should consider abatement costs in the context of market design to enable existing and new technologies. The recent approval of a wholesale demand response rule in the NEM will help reduce costs of managing peak demand and variable supply. So will movement towards a five-minute settlement rule, which will enable greatest value from batteries.¹¹

Finally, technology cost and uptake projections are often biased and should be continually reviewed in light of actual experience. The graph below shows projected vs actual uptake of solar under the International Energy Agency's central scenarios over time. Systematic pessimism overestimates effort needed to achieve deeper cuts.

RESIDENTIAL

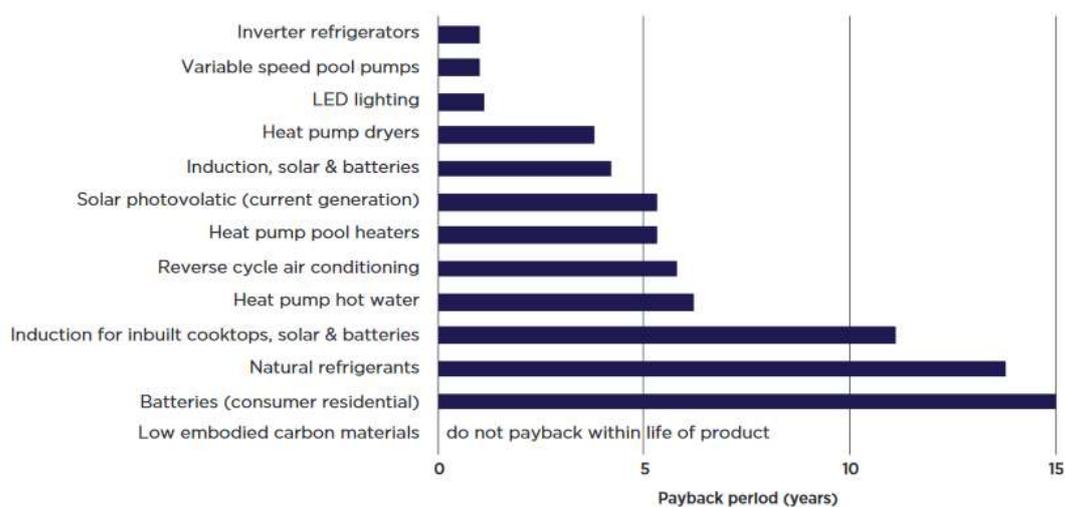
Australian homes are on average very energy inefficient. The Roadmap shows available residential appliances or upgrades to reduce emissions with short payback periods.

⁹ Swann & Quicke (2019) *Over Reactor: The economic problems with nuclear power*, <https://www.tai.org.au/sites/default/files/P782%20Over%20Reactor%20%5BWEB%5D.pdf>

¹⁰ Vorrath (2020) *Australia's first offshore wind farm gains ground with new contract* <https://reneweconomy.com.au/australias-first-offshore-wind-farm-gains-ground-with-new-contract-30180/>

¹¹ Cass & Merzian (2020) *Energy giants want to thwart reforms that would help renewables and lower power bills* <https://theconversation.com/energy-giants-want-to-thwart-reforms-that-would-help-renewables-and-lower-power-bills-140640>

Figure 18: Consumer payback periods (years) for residential technologies



Short term government policy to realise these opportunities through retrofitting and new-build standards could create jobs and reduce household bills, freeing household expenditure for other consumption, while reducing emissions.

Such assessment should also include household weather-proofing like draught sealing and insulation.

ELECTRIC VEHICLES

The Roadmap lists EVs as “on track” as a technology¹² based on the IEA’s *Tracking Clean Energy Progress* report and based on international progress. But in EV uptake Australia is *far* behind comparable countries.

The roadmap acknowledges the need to support consumer choice in the Australian EV market,¹³ the need to support charging infrastructure,¹⁴ and the potential grid-firming benefits of EVs.¹⁵

Yet the government’s EV strategy has been forthcoming now for more than a year and repeatedly delayed. The strategy was first announced in February 2019, but soon said

¹² Roadmap, p 42

¹³ Roadmap, p 12

¹⁴ Roadmap, p 60

¹⁵ Roadmap, p 61

it wouldn't be developed until mid-2020.¹⁶ Recently the Minister confirmed that the Strategy wouldn't be finalised until the end of the year.¹⁷

Under the Climate Solutions Package, the EV strategy was expected to reduce emissions by up to 10MtCO₂e by 2030.¹⁸ However, the estimated emission reduction from this strategy is not included in Australia's 2019 emissions projections.¹⁹

INDUSTRIAL

The Roadmap correctly identifies many industrial alternatives to fossil fuel use, which are mostly for heat. Much of this industrial heat can be supplied through electrification. The Roadmap also identifies that electrification of industrial processes is “a key opportunity to deliver both affordability and emissions benefits.”²⁰

The Roadmap notes heat pumps are competitive for low temperature industrial heat.²¹ As Beyond Zero Emission has shown, the very high efficiencies of electrical heating create significant opportunities for industrial energy cost savings.²²

The Roadmap does not include important alternatives to fossil fuel for high process industrial heat including “plasma arc furnaces, electric arc furnaces and microwave assisted heating”. The roadmap omits these as they would only result in emissions reduction if the electricity is supplied with renewable energy.

This is puzzling. The scale of abatement for all electrified options depends on input carbon intensity.

Moreover, the roadmap should distinguish average from marginal intensity. Switching from gas will increase electricity demand. Additional generation is very likely to be

¹⁶ Schmidt (2019) *Coalition says no plans for electric vehicle strategy until mid-2020*, <https://thedriven.io/2019/03/26/coalition-says-no-plans-for-electric-vehicle-strategy-until-mid-2020/>

¹⁷ Minister for Energy and Emissions Reduction Angus Taylor (2020) *Supporting new technology to drive uptake of electric vehicles*, <https://www.minister.industry.gov.au/ministers/taylor/media-releases/supporting-new-technology-drive-uptake-electric-vehicles>

¹⁸ Department of Environment and Energy (2019) *Climate Solutions Package*, p. 8, <https://www.environment.gov.au/system/files/resources/bb29bc9f-8b96-4b10-84a0-46b7d36d5b8e/files/climate-solutions-package.pdf>

¹⁹ Department of Environment and Energy (2019) *Australia's emissions projections 2019*, <https://publications.industry.gov.au/publications/climate-change/system/files/resources/4aa/australias-emissions-projections-2019-report.pdf> page 6.

²⁰ Beyond Zero Emissions (2018) *Electrifying Industry*, p 30, <https://bze.org.au/wp-content/uploads/electrifying-industry-bze-report-2018.pdf>

²¹ Technology Investment Roadmap Discussion Paper, p 55

²² Beyond Zero Emissions (2018) *Electrifying Industry*, Table B1.1 p 52

renewable. The excluded process heat options, powered by renewables, should be included.

BZE shows in 2018 that at high levels of renewable power there are large emissions and cost savings at offer across the spectrum of industrial processes.²³

A major barrier to uptake is the capital cost. Assisting Australian industry with electrification, for example through loans, is a major opportunity for economic recovery from the pandemic: creating jobs, reducing emissions and saving on energy.

HYDROGEN

The recent flurry of hype in Australia has been premised on export opportunities, based on claims about demand and associated economic benefits that can be traced to projections in a single report published by ACIL Allen. Those projections assume high carbon prices and exceed import targets in key markets like Japan by up to a factor of 11.²⁴ Official Japanese targets would see 2030 imports of Australian hydrogen be worth less than current imports of Australian barley, or of machinery and equipment.

Hydrogen production is already a large mature industry mainly used in oil refining and chemical production, almost entirely made with fossil fuels with significant associated emissions of around 830Mt CO₂e per year, larger than the UK and Indonesia combined.²⁵ Costs are unlikely to fall.

Costs of renewable-powered, zero emission electrolysis are current higher, but are widely predicted to become competitive over the next decade. Australia is in a prime position to drive and capitalise on this industry development.

A near term rush to support expanded fossil fuel powered hydrogen would lock in new high carbon infrastructure. Infrastructure and facilities for fossil hydrogen are likely to be technologically and geographically incompatible with renewable hydrogen. Capital sunk into fossil hydrogen will block rather than facilitate zero emissions hydrogen.

²³ Beyond Zero Emissions (2018) Op.cit.

²⁴ Kaitsu, Swann & Quicke (2019) *Hy-Trojan: Is Hydrogen the New Clean Coal?*

<https://www.tai.org.au/content/hydrogen-haste-australia-institute-research-reveals-highly-inflated-figures>

²⁵ International Energy Agency (2020) *Hydrogen - Fuels & Technologies*, <https://www.iea.org/fuels-and-technologies/hydrogen>

Technology investment support should be restricted to renewable hydrogen. It should focus on domestic demand before exports. This should include cleaning up existing hydrogen production in Australia.

CARBON CAPTURE AND STORAGE (CCS)

The Roadmap finds CCS for electricity generation is not a priority technology. However CCS is considered in the Roadmap for hydrogen production from fossil fuels, and for industrial processes.

There are abundant of opportunities for electrification of industrial processes with renewable energy. These should be pursued in preference to CCS.

CCS has been more successful as a marketing tool for fossil fuels than as a technology. A good example is Coal21, the industry research fund for CCS which has allocated a growing share of its levies to simply marketing coal rather than develop the technology.²⁶

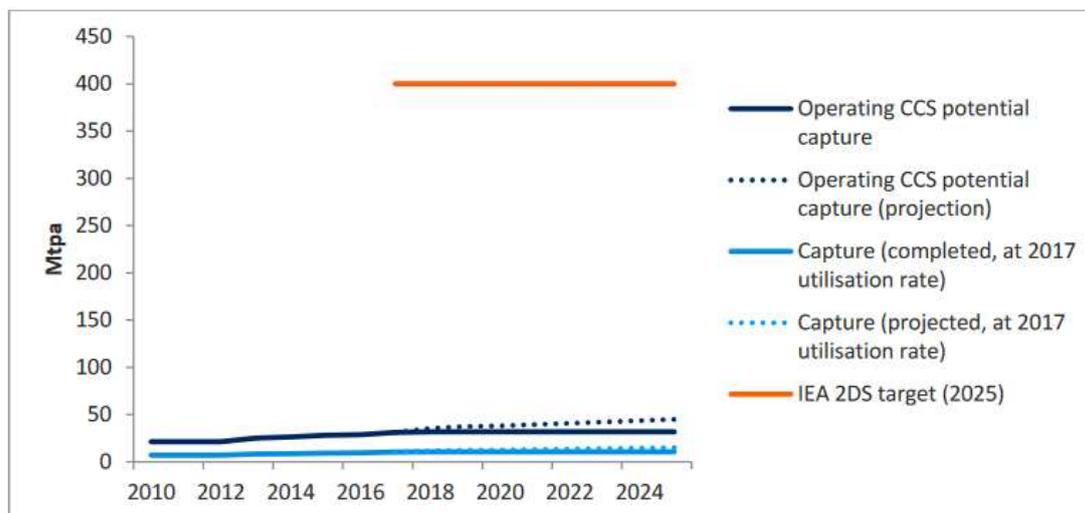
The real concern is the existing expenditure from Australian governments of more than \$1.3 billion on CCS, with almost nothing to show for it.²⁷ CCS has fallen far short of all targets set for it by multilateral organisations, under achieving on both capacity and actual utilisation (see e.g. Figure 3).²⁸

²⁶ Long (2019) *Coal research group turns hand to advertising in bid to make Australians 'feel proud' about rock* <https://www.abc.net.au/news/2019-08-07/coal-lobby-hopes-to-make-australians-proud-about-coal/11388830>

²⁷ Browne & Swann (2017) *Money for nothing*, <https://www.tai.org.au/content/money-nothing>

²⁸ Browne (2018) *Sunk costs: Carbon capture and storage will miss every target set for it*, <https://www.tai.org.au/content/sunk-costs-carbon-capture-and-storage-will-miss-every-target-set-it>

Figure 3: New and existing capture capacity and utilisation - IEA 2017 2DS.



IEA (2017) Tracking clean energy progress 2017, p 11, <https://www.iea.org/publications/freepublications/publication/TrackingCleanEnergyProgress2017.pdf>; Global CCS Institute (2018) Large-scale CCS facilities, <http://www.globalccsinstitute.com/projects/large-scale-ccs-projects>

Note: The IEA projects 45 Mtpa capacity in 2025. This figure assumes a steady increase between 2020 and 2025 to reach that volume. In practice, it would increase in steps as projects are completed.

The flagship industrial CCS project in Australia is the Gorgon LNG project off WA. The project’s approval being conditional on sequestering 40% of its emissions. Despite this, and \$60m in government funding, the project captured no CO₂ emissions for its first 3 years, resulting in millions of tonnes of excess emissions.²⁹ It has so far faced no penalty.

To enable Gorgon’s CCS the Federal Government had to indemnify the WA Government for long-term risks from CO₂ leaks from Gorgon. This appears in every federal budget as a ‘contingent liability’.³⁰ Such costs are real, should be borne by projects themselves, and must be included in the technology cost assessment.

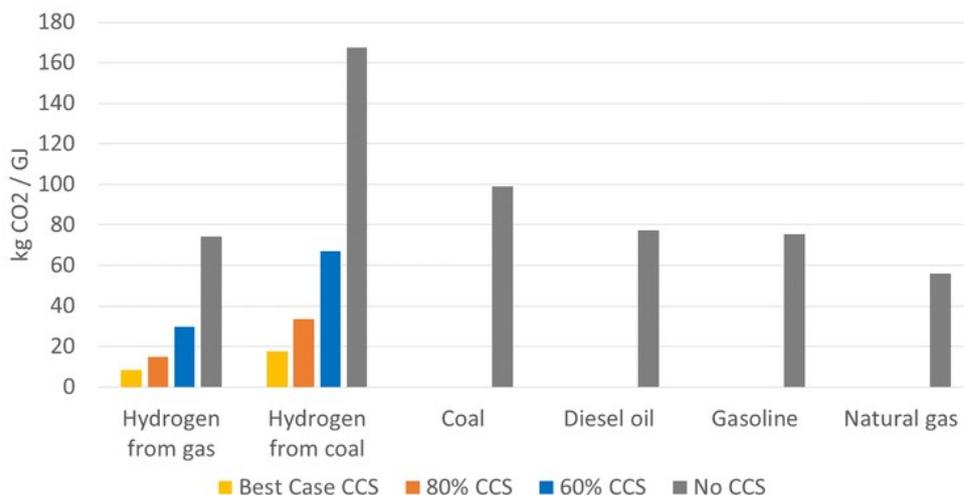
Claims that fossil fuel hydrogen with CCS is a viable near-term opportunity should be met with scepticism, especially given its absence in current hydrogen production. Even with high rates of CCS, fossil hydrogen production produces substantial emissions.³¹

²⁹ Swann (2018) *Gorgon-tuan Problem*, <https://www.tai.org.au/sites/default/files/P635%20Gorgon-tuan%20Problem%20%5BWeb%5D.pdf>

³⁰ Swann (2018) *Ibid.*

³¹ Beck, Jotzo, & Longden (2019) *For hydrogen to be truly “clean” it must be made with renewables, not coal* <http://theconversation.com/for-hydrogen-to-be-truly-clean-it-must-be-made-with-renewables-not-coal-128053>

Figure 4: Emissions intensity of different fuels



Source: Beck, Jotzo, & Longden (2019) *For hydrogen to be truly “clean” it must be made with renewables, not coal*

CONCLUSION

There is a growing tendency to release single reports and sometimes even just announcements without the broader context and strategy.

The Electric Vehicle Strategy, which has major ramifications for Australia’s transport and electricity emissions, was due right now, mid-2020. Instead, after a little over a year of waiting, the public were provided with a Ministerial announcement for a small independent investment by the Clean Energy Finance Corporation on EVs noting the strategy was delayed.³² Another example is the liquid fuel security review which has been completed yet remains hidden. Instead the public is drip feed announcements or requests without context.³³

The Technology Roadmap is a useful tool and discussion point. It is the Australia Institute’s hope that this discussion feeds into a more crucial conversation around Australia’s long-term direction and diplomacy. Without this overall guidance and support, led by the federal government, the Roadmap will sit idle along with previous reports.

³² Minister for Energy and Emissions Reduction Angus Taylor (2020) *Supporting new technology to drive uptake of electric vehicles*

³³ Australian Government (2020) Help increase Australia’s domestic fuel storage: request for information <https://www.industry.gov.au/news-media/help-increase-australias-domestic-fuel-storage-request-for-information>