

A Model Line-up

Comparing economic models of high ambition emission reduction targets

This paper analyses 22 recent modelling reports of the economic impacts of higher ambition targets. Extensive literature shows Australia can achieve higher ambition targets with very small economic impacts. Claims that higher ambition would be 'economy wrecking' or 'apocalyptic' are not credible.

Discussion paper

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Summary

Debate about the *cost of climate action* is a recurring feature of Australian politics and has been central to the political turmoil of the last decade. Advocates for delaying or limiting climate action often point to modelling that claims to show the costs of action are very high.

Australia's current climate targets, of 26% below 2005 levels by 2030, are inadequate and leave Australians exposed to large costs from increasing climate change. In the Paris Agreement, Australia agreed current targets were too low and must be increased. According to the Climate Change Authority, Australia's targets should be at least 45% by 2030 to be in line with the Paris Agreement.

The Government says that ambitious targets (greater than 26%) would be "economy wrecking", adopting this rhetoric from the Business Council of Australia (BCA). The Government has also seized on new modelling from economist Brian Fisher, who claims lower emissions would have a very high cost for Australia. Media commentators called the impacts "apocalyptic".

These claims are outliers and not credible. The extensive literature on the cost of action contradicts claims from the BCA, Brian Fisher and the government. Higher ambition is possible with low to negligible economic impact.

This report examines 22 reports modelling higher ambition emission reductions by 2030.

19 reports are from the last five years alone, in peer reviewed journals, and from academics, government agencies and consultants. This report also considers the three major Treasury reports from 2008 to 2013.

10 of the reports consider economy wide impacts. 12 reports look exclusively at electricity, including 5 modelling 100% renewable energy.

None of these reports show action on climate change is 'economy wrecking'. All of them show the cost is very small compared to ongoing economic growth. Some reports show positive benefits from action, even without considering avoided climate change.

All of the economy-wide modelling shows high ambition targets lead to strong ongoing growth from 2020 to 2030. Higher ambition targets have at most a *very small* impact on GDP growth compared to no action. This includes the three older report

from Treasury. The impact in every scenario is no more than 0.14% points of GDP growth per annum or 1.7% points from 2020 to 2030. The impact is even smaller when compared with the government's current target. Increasing ambition from current targets has a very small impact on growth. In one model GDP growth *increases* with higher action.

The wide variation between reference cases from different modellers shows how other economic forces will have a far greater impact on the Australia economy than reducing domestic emissions. There is far less difference between the 'no action' and 'high ambition' scenarios within each model, than the far greater difference between 'no action' reference cases of each of the different models, for the same period of time.

Compared with results from this literature, Brian Fisher's modelling is a clear outlier. The 'apocalyptic' impacts of Fisher's worst case scenario, with no international unit trade, are far outside of all other scenarios with no international unit trade (with an impact more than 10 times greater than six other comparable reports). Fisher's less apocalyptic scenario, with half of the abatement from international unit trade, still produces lost GDP growth bigger than any other report.

All of the reports focusing on the electricity sector show either that higher ambition can reduce power costs, or that the increases are modest and manageable, including to 100% renewables.

There are many opportunities for lower cost abatement in electricity which mean electricity should decarbonise earlier. CSIRO finds new wind and solar, backed up with storage, is now the cheapest new generation. Falling renewables costs mean estimated costs of decarbonisation continues to fall.

4 reports find increased electricity emission reductions or increased renewables lead to lower prices or lower energy system costs. This includes reports from Frontier Economics, Reputex, CSIRO and Energy Networks Association, and UNSW. Modelling for the Abbott government's Review of the 2020 Renewable Energy Target (RET) came to the same result; Brian Fisher was on the panel for the RET Review.

A further report from Jacobs finds cut between 60% and 75% in electricity by 2030 would increase costs by 0.3% of disposable household income. One report finds more renewables increases jobs in the electricity sector.

5 reports consider 100% renewable energy systems, including from UTS, ANU and UNSW. One report finds 100% renewable energy would reduce system costs to 2050. 3 find the cost is modest and achievable with current technology. Of greater impact to

the electricity sector is policy certainty and effective regulation; the absence of both have led to retail prices increasing 56% over the last decade.

Brian Fisher's models are again a clear outlier. Renewables in his models reach around 50%, yet wholesale power prices in his are outside the range found nearly all other reports. The one exception is a conservative analysis of 100% renewables.

Claims from Fisher and the BCA are out of line with the extensive literature, and with the reports they themselves cite or commissioned. A 2018 ARENA-funded ITP report, that Fisher claims to draw on, finds 100% dispatchable renewable energy would cost less than Fisher's wholesale prices for 50% renewables. In direct contradiction of Fisher's modelling, the ITP report concludes that "a range of proven and affordable options is available to more than adequately cater for significantly increased levels of renewable energy in the Australian energy mix, and for an eventual net zero emission technology mix by 2050".

It is unclear why the government has chosen to rest its policy argument on Fisher's reports, rather than the advice of the hundreds of economists at its disposal in the public service, or the extensive existing literature, including major reports from Treasury.

In formulating climate targets and policy, the next government should use the expertise of the public service, including the Climate Change Authority and Treasury, as well as the extensive existing literature. It should not rely on unreliable claims from the big business lobby and consultants with discredited modelling. It should focus on avoiding the costs of climate change by increasing ambition on reducing Australia's emissions.

Introduction

For more than a decade Australian politics has been wracked by turmoil about climate change. Climate change policy has played a key role in the many changes of Prime Minister and of governments, characterising this period of political and policy uncertainty.

The controversy focuses on the *cost of action*. Decarbonising Australia's economy will require substantial changes over many years, in particular phasing out fossil fuels and replacing them with zero carbon energy sources.

Controversy about the cost of action often focuses on economic modelling. Economic modelling is just an attempt to simplify and simulate the real world. In the real world from 2012 to 2014, just five years ago, Australia experienced emissions reduction combined with solid economic growth.¹ Yet controversy about the costs of action often ignores Australia's lived experience and focuses more economic modelling.

Those seeking to delay or limit action often focus on economic modelling of the cost of higher ambition. Models are established with questionable assumptions and results are presented in ways that make these costs seem large, rather than in the context of the size of the economy. Warnings regarding the economic cost of action, backed with 'scary numbers' from modelling, have been a recurring feature of Australia's decade of political turmoil, which has only intensified in recent years.

In 2018, the Business Council of Australia (BCA) argued that stronger action on climate change would be "economy wrecking". Then in 2019, economist Brian Fisher produced economic modelling of higher ambition targets that media commentators described as "apocalyptic". The economy-wrecking claim has been cited repeatedly by the government and commentators when criticising higher ambition targets.

This debate has largely ignored the extensive literature of economic modelling and analysis showing Australia can have much lower emissions with much lower costs.

¹ Swann et al (2019) *Cold shower on economics of global warming*
[www.tai.org.au/sites/default/files/P729 Cost of climate inaction %255bWEB%255d.pdf](http://www.tai.org.au/sites/default/files/P729%20Cost%20of%20climate%20inaction%20WEB.pdf)

OUTLINE

This report begins by outlining why Australia's current targets are inadequate, and how claims by BCA and Fisher have been used to try to delay or limit action, while ignoring the far bigger *cost of inaction*.

The report then outlines and analyses 22 reports including 19 from the last five years, and 3 major reports from Treasury from 2008 to 2013. It finds that all of these reports contradict the claims by the BCA and Brian Fisher, finding low emissions and high renewables is possible at very low cost, with many benefits.²

² The authors would like to thank Nicky Ison for assistance with reports modelling 100% renewables.

Inadequate emissions targets

The Australian Government's current greenhouse gas emission reduction target is 26-28% below 2005 levels by 2030.

The Government says it will pursue the higher target if "circumstances allow, taking into account opportunities to reduce emissions and factors such as the costs of technology".³ Yet the Government appears to aim for just 26% economy-wide, despite rapidly falling renewable energy and storage costs.

The Coalition Government said it will not increase its 2030 targets. Refusal to consider increased targets is not in line with the Paris Agreement. The targets recorded in 2015 in Paris were supposed to be 'down-payments' on increased future action. In the Paris Agreement Australia agreed that "much greater emission reduction efforts will be required" to 2030 and agreed to make updated pledges that represent "a progression over time".⁴

In addition, the government will cut its 26% target in half through the dubious use of 'carry-over' carbon credits accrued from the previous Kyoto Protocol climate agreement.⁵

If all countries were to follow Australia's approach, warming would reach over 3 degrees and up to 4 degrees.⁶

Even a 26% reduction without carry-over is inadequate. In 2015, Australia's Climate Change Authority (CCA), a statutory body set up to give independent advice to government on climate policy, looked at what targets Australia would need to reduce emissions in line with the goals of the Paris Agreement. The CCA urged cuts equivalent

³ Australian Government (2015) *Australia's intended Nationally Determined Contribution to a new Climate Change Agreement*

<https://www4.unfccc.int/sites/submissions/INDC/Published%20Documents/Australia/1/Australias%20intended%20Nationally%20Determined%20Contribution%20to%20a%20new%20Climate%20Change%20Agreement%20-%20August%202015.pdf>

⁴ UNFCCC (2015) *Paris Agreement – Article 3*

https://unfccc.int/sites/default/files/english_paris_agreement.pdf

⁵ Hannam (2019) *Scott Morrison's Pea & Thimble Trick*

<https://www.smh.com.au/environment/climate-change/scott-morrison-s-pea-and-thimble-trick-20190226-p51090.html>

⁶ Climate Action Tracker (2017) *Australia – Fair Share*

<https://climateactiontracker.org/countries/australia/fair-share/>

to 45%-65% below 2030 levels by 2005.⁷ Regardless of how 'fair share' is calculated, emissions cuts must be far greater than the current 26% target.⁸

The Opposition proposes a 45% target by 2030 on 2005 levels. This is at the bottom of the range the CCA says is consistent with the 2-degree global goal under the Paris Agreement. The Opposition also targets 50% renewables by 2030.⁹

Other parties, such as the Greens, and some independent MPs and candidates, have proposed even stronger targets, including 100% renewable by 2030.

Early in 2019, the Prime Minister announced the Government plans to continue existing policies, with less funding. These 'direct action' policies have resulted in Australia's emissions increasing for the last five years, to levels not seen since 2011.

The Prime Minister claimed the policies would meet the 26% target "without wrecking the economy".¹⁰ The Prime Minister has continued to argue that higher ambition targets would have a very large negative impact on Australia.

⁷ Climate Change Authority (2015) *Final report on Australia's future emissions reduction targets* <http://climatechangeauthority.gov.au/special-review/final-report-australias-future-emissions-reduction-targets>

⁸ Merzian & Campbell (2018) *Advance Australia's Fair Share* <http://www.tai.org.au/content/advance-australias-fair-share>

⁹ Climate Change Authority (2015) *Final report on Australia's future emissions reduction targets*

¹⁰ Prime Minister Morrison (2019) *Meeting Our Climate Commitments Without Wrecking The Economy* <https://www.pm.gov.au/media/meeting-our-climate-commitments-without-wrecking-economy>

‘Economy wrecking’?

While the Paris Agreement is now ‘supported’ by most voices in public debate, many powerful voices still argue that action consistent with the Paris Agreement would be prohibitively costly.

Two voices have been particularly influential in recent years: the Business Council of Australia (BCA) and Brian Fisher.

BUSINESS COUNCIL OF AUSTRALIA

Throughout 2018, the Business Council of Australia (BCA), the lobby group for big business CEOs, argued that stronger action on climate change would be “economy wrecking”. Specifically, they said it would be “economy wrecking” to set an electricity emissions reduction target of 45% (on 2005 levels by 2030). Instead, they call for the current 26% target to be maintained.¹¹

The BCA reportedly promised the Coalition Party room it would run a political campaign on this basis through to the election.¹² The Prime Minister and many other Ministers have since repeated the BCA’s claims, even citing the BCA’s authority as evidence, when criticising the Opposition’s higher ambition targets.

Asked to justify its claim a 45% target would wreck Australia’s economy, the BCA has given the justification that there is “little analysis” of a 45% target.¹³

The justification is bizarre. If there is little analysis, how can the BCA make the claim? Worryingly, the few studies they cite or have commissioned do not support the BCA claims and in key respects even contradict it.

Most importantly, the BCA ignores the considerable analysis over many years of higher ambition targets, how to achieve them and the costs and benefits of doing so.

¹¹ BCA (2018) *Tweet - 6:03 PM - 25 Jun 2018*

<https://twitter.com/BCAcomau/status/1011414577702031361>

¹² Murphy (2018) *Turnbull quashes Abbott’s bid to give party room a say on energy guarantee*, The Guardian <https://www.theguardian.com/australia-news/2018/jun/26/turnbull-quashes-abbotts-bid-to-give-party-room-a-say-on-energy-guarantee>

¹³ Westacott (2018) *Why The Australia Institute is a climate wrecker with false claims*

<https://www.afr.com/news/economy/why-the-australia-institute-is-a-climate-wrecker-with-false-claims-20180828-h14mrw>

The BCA has not rescinded the ‘economy wrecking’ claim. It is now facing dissenting voices from member companies,¹⁴ many of which are themselves taking strong action with emission reduction and renewables targets.¹⁵

BRIAN FISHER

In 2019, BAEconomics released a series of reports presenting modelling of different climate change scenarios and policies. These reports show a very large economic cost from increased action on climate change.

BAEconomics is a consultancy that appears to consist of a single economist, Brian Fisher. Since leaving a public service career, Fisher has consulted extensively to the Minerals Council of Australia and coal companies. He has a long history of producing economic modelling to show the cost of action on climate change is very large and therefore prohibitive.

Fisher’s latest modelling is deeply flawed. It is based on a wide range of strange and unjustified assumptions. It has been widely criticised.¹⁶

Again, the Government has seized on this modelling to criticise the Opposition’s higher emissions targets.

It is unclear why the Government, with the resources of the entire public service at its disposal, has instead chosen to base its policy position and indeed much of its election campaign on the voluntary work of a consultant to the coal industry.

¹⁴ Williams (2018) *Lobby groups in spotlight as shareholder campaign targets Westpac*
<https://www.smh.com.au/business/companies/lobby-groups-in-spotlight-as-shareholder-campaign-targets-westpac-20181011-p5096n.html>

¹⁵ Swann (2019) *Business Council of Australia at Odds With Own Members on Climate Action*
<http://www.tai.org.au/content/business-council-australia-odds-own-members-climate-action>

¹⁶ The Australia Institute (2019) *Let us assume* <http://www.tai.org.au/content/let-us-assume>

Inaction is ‘economy wrecking’

The claims of both the BCA and Fisher both ignore the significant costs of inaction.

While studies of the cost of action alone can be valid and valuable, they must not be used to distract the public from the cost of inaction.

As Sir Nicholas Stern found in his landmark 2006 report:

the benefits of strong and early action far outweigh the economic costs of not acting. ... Climate change will affect the basic elements of life for people around the world.¹⁷

The Intergovernmental Panel on Climate Change (IPCC) confirmed in its recent Special Report, requested as part of the Paris Agreement, that weak climate action will only cost far more in the future.¹⁸

Recent conservative estimates for Australia show inaction on climate change could cost Australia \$131 billion per year, excluding increasing costs of natural disasters that already cost Australia over \$18 billion per year.¹⁹

Another major cost of inaction is financial risk from climate impacts and stranded assets. A 2018 study found “Climate-induced financial instability reinforces the growth-reducing effects of climate change”.²⁰ Allowing further excess investment in further fossil fuel and other high carbon assets increases systemic financial risks.

By taking action on climate change, Australia reduces climate damages directly and indirectly by promoting global action. By failing to lift ambition, Australia exposes itself to economic disruption, including through stranded assets and carbon trade tariffs. Australia also has an even larger impact via exports.

¹⁷ Stern (2006) *Stern Review on the Economics of Climate Change—Executive Summary* http://www.hm-treasury.gov.uk/d/CLOSED_SHORT_executive_summary.pdf

¹⁸ Intergovernmental Panel on Climate Change (2018) *Special Report into the impacts of global warming at 1.5 degrees above pre-industrial levels* https://www.ipcc.ch/site/assets/uploads/sites/2/2018/07/SR15_SPM_version_stand_alone_LR.pdf

¹⁹ Swann et al (2019) *Cold shower on economics of global warming* [www.tai.org.au/sites/default/files/P729 Cost of climate inaction %255bWEB%255d.pdf](http://www.tai.org.au/sites/default/files/P729%20Cost%20of%20climate%20inaction%20WEB.pdf)

²⁰ Dafermos et al (2018) *Climate Change, Financial Stability and Monetary Policy* in *Ecological Economics* <https://www.sciencedirect.com/science/article/pii/S0921800917315161>

While global action is needed, national self-interest alone justifies significant unilateral action. In particular, the health costs from burning fossil fuels are enormous. A 2019 Brookings Institute study found avoidable health and other direct costs mean it is in Australia and every other country's national self-interest to meet their current Paris targets.²¹

²¹ Liu, McKibbin, Morris, Wilcoxon, (2019) *Global Economic and Environmental Outcomes of the Paris Agreement* <https://www.brookings.edu/research/global-economic-and-environmental-outcomes-of-the-paris-agreement/>

Modelling on climate action

The BCA and Fisher's claims do not merely ignore the cost of inaction. They are contradicted by an extensive literature of economic modelling and analysis showing Australia can have much lower emissions with very small economic cost, and many benefits.

SUMMARY

The Australia Institute consulted the recent literature on the economic impact of higher emissions reductions in Australia.

Reports were included where they contained primary economic analysis, or detailed secondary analysis, of Australia from higher ambition policies to cut emissions than adopted currently, either economy-wide or in the electricity sector.

19 relevant reports were found from the last five years alone. These include peer-reviewed journals papers, academic papers, CSIRO and government commissioned reports, and consultancy reports.

3 earlier reports were also collected from Treasury, containing major macro-economic analysis of emission reduction targets.

None of these reports conclude that action on climate change would wreck the economy.

In all studies considering economy-wide impacts, deep emissions reductions were consistent with strong growth across the economy. Impacts on growth ranged from small, to negligible, to positive.

In all studies considering increased electricity abatement, impacts were either positive, with lower power prices, or modest increases.

Many recent studies found increasing renewable energy would reduce power prices, including one study looking at 100% renewable energy. Other studies looking at 100% renewable energy found only a modest cost impact even using current technology prices.

This literature directly contradicts both the claims of the BCA and the modelling from Brian Fisher.

LIST OF REPORTS

Reports considered here are listed below, and discussed in more detail in an appendix.

1. **ITP (2018)** *Comparison of dispatchable renewable electricity options*
2. **Reputex (2018)** *The impact of the NEG on emissions and electricity prices by 2030*
3. **Frontier Economics (2018)** *Tackling climate change and energy affordability for low-income households*
4. **Energy Networks Australia and CSIRO (2017)** *Electricity Network Transformation Roadmap: Final Report*
5. **ANU: Blakers, Lu, Stocks (2017)** *100% renewable electricity in Australia*
6. **ClimateWorks (2017)** *Power Up*
7. **Vandyck et al. (2016)** *A global stocktake of the Paris pledges: Implications for energy systems and economy*
8. **UTS: Institute for Sustainable Futures (2016)** *100% Renewable Energy For Australia: Decarbonising Australia's Energy Sector Within One Generation*
9. **EY and KGM and Associates (2016)** *Renewable Energy Jobs: Future Jobs and Growth*
10. **National Institute of Economic and Industry Research (NIEIR) (2016)** *Jobs in a clean energy future*
11. **Jacobs (2017)** *Modelling illustrative electricity sector policies*
12. **Victoria University Centre of Policy Studies (VU COPS) (2016)** *Simulations of the effects of greenhouse gas mitigation policies for the Australian electricity sector*
13. **UNSW: Centre for Energy and Environmental Markets (2016)** *100% Renewables in Australia: A Research Summary*
14. **Lenzen et al. (2016)** *Simulating low-carbon electricity supply for Australia*
15. **McKibbin (2015)** *Report 2: 2015 economic modelling of Australian action under a new global climate change agreement*
16. **ANU: Jotzo and Kemp at ANU (2015)** *Australia can cut emissions deeply and the cost is low*
17. **Vithayasrichareon et al (2015)** *Using renewables to hedge against future electricity industry uncertainties—An Australian case study*
18. **Climate Works, ANU and CSIRO (2014)** *Pathways To Deep Decarbonisation In 2050: How Australia can prosper in a low carbon world*
19. **Climate Change Authority (2014)** *Targets and Progress Review*
20. **Treasury and DIICSTRE (2013)** *Climate Change Mitigation Scenario*
21. **Treasury (2011)** *Strong growth low pollution: modelling a carbon price*
22. **Treasury (2008)** *Australia's Low Pollution Future: The Economics of Climate Change Mitigation*

There are many other reports that consider only the economic implications of Australia meeting its current emissions reduction targets. Some of these were cited or commissioned by the Business Council of Australia, or cited by Brian Fisher. These reports are also considered below. They contradict key claims from the BCA and Fisher.

CAVEATS

The studies considered here use different methods to test different emission reduction targets over different time periods, focus on different parts of the economy and use different policies and forms of abatement. Some use international units while others do not. Technology costs vary. The outcomes of models depend on the assumptions. While the reports have been reviewed, this analysis does not claim to scrutinise all of the relevant assumptions. Nonetheless, the report authors and report methods are considered credible.

None of these reports consider the cost of climate impacts and the benefits of avoiding them. Some of the reports consider some of the benefits of acting. However none include quantified analysis of climate and health benefits from setting lower emission targets.

Considering the cost of action in isolation is valid and can be useful, but it must always be viewed in the context of benefits of action.,

Economy-Wide Emission Reductions

Of the 22 reports considered, 10 reports consider economy-wide impacts, with 7 reporting results from original macro-economic modelling; and 3 synthesising and extend results from the above models and others.²²

All of these reports include scenarios that involve stronger action on climate change than adopted by the Australian government (of 26% by 2030). Most high ambition scenarios in these reports include emissions reduction targets close to or greater than 45% by 2030 on 2005 levels.

Some model the economy-wide impacts of abatement in specific sectors, for example just in electricity or energy more broadly. These studies are nonetheless based on high ambition targets.

The Treasury scenarios include use of international carbon permits. For the Treasury studies, this report analysed the scenario with the lowest share of abatement from international permits.

RESULTS

In *every* scenario considered in the 10 economy-wide reports, strong growth Australia's economy continues to grow to 2030 and beyond.

²² ClimateWorks (2017) *Power Up*

https://www.climateworksaustralia.org/sites/default/files/documents/publications/cwa_power_up_report_final_12_jul.pdf

Jotzo and Kemp at ANU (2015) *Australia can cut emissions deeply and the cost is low*

https://ccep.crawford.anu.edu.au/files/uploads/ccep_crawford_anu_edu_au/2015-05/australia_can_cut_emissions_and_the_cost_is_low-_jotzo_and_kemp_april_2015_-_submission_to_dpmmc.pdf

CCA (2014) *Targets and Progress Review* http://www.climatechangeauthority.gov.au/files/files/Target-Progress-Review/Targets%20and%20Progress%20Review%20Final%20Report_Chapter%2010.pdf

This does not mean that Australia will never again experience recession or a period of low growth. Rather it means climate action as modelled has minimal impact on growth.²³

In every high ambition scenario in these reports, the impact on annual GDP growth is a reduction of less than 0.15 percentage points, compared with no action. This includes each of the three Treasury modelling exercises.

The impact relative to current targets is even less than this. The cost of increasing emissions reduction targets is very small.

Figure 1 presents results from macro-economic modelling in economy-wide models. It presents growth in both the reference or 'no action' case, and the highest ambition case in each report. Results are shown for growth over the decade from 2020 to 2030 (around when the Paris Agreement target applies). This is based on annual GDP growth for each scenario. Annual growth rates, where possible, are from 2020 to 2030, otherwise taking the average over the whole scenario period (some starting earlier and many starting later).

Results were also included from Brian Fisher's modelling of 45% emission reduction by 2030 on 2005 levels, using three scenarios:

1. All domestic abatement, no shielding for emissions-intensive trade-exposed (EITE) industries;²⁴
2. 25% abatement from international trade, EITE shielding;²⁵
3. 50% abatement from international trade, EITE shielding.²⁶

²³ A more detailed way of explaining this is that in every scenario considered, the impact of climate policy is not large enough to compromise Australia's economic growth. Many of the modelling exercises examined assume a positive rate of growth into the future, usually based on long term averages. The models then estimate the impact of climate policy on this growth rate. In the real world, Australia could of course experience a recession – perhaps sparked by downturn in major trading partners or by climate-related impacts such as major drought and coastal inundation.

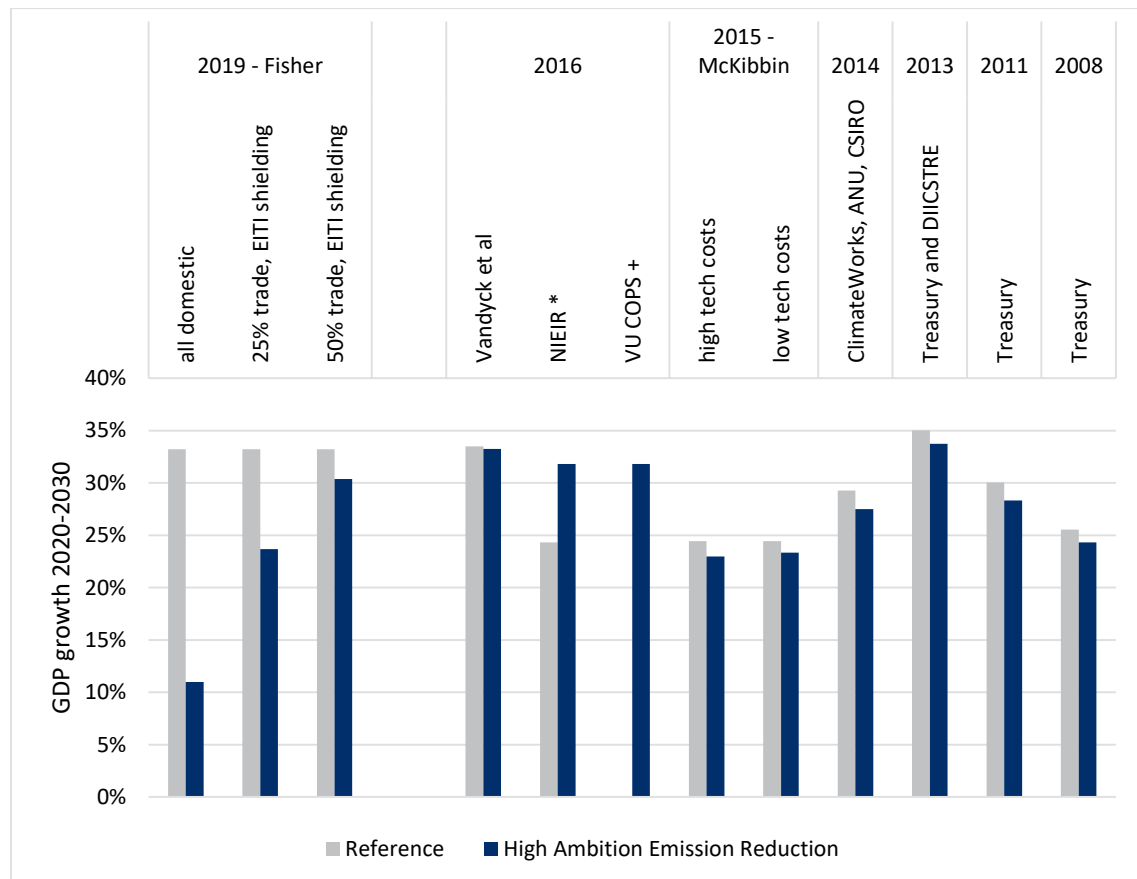
²⁴ Fisher (2019a) *Economic consequences of alternative Australian climate policy approaches*, Scenario 4 <http://www.baeconomics.com.au/wp-content/uploads/2019/03/Climate-Policy-Report-14March19.pdf>

²⁵ Fisher (2019b) *Economic consequences of Labor's Climate Change Action Plan* – Scenario 1 <http://www.baeconomics.com.au/wp-content/uploads/2019/05/Economic-Consequences-of-Labors-Climate-Change-Action-Plan-1May19.pdf>

²⁶ Fisher (2019b) *Economic consequences of Labor's Climate Change Action Plan* – Scenario 2

These scenarios were chosen as they provide a large range and have been the focus of media attention.

Figure 1: GDP growth 2020-30, economy-wide models of high ambition vs reference



Source: Derived from reports, as listed and described in text.

Note: * higher growth in high ambition scenario. + no reference scenario

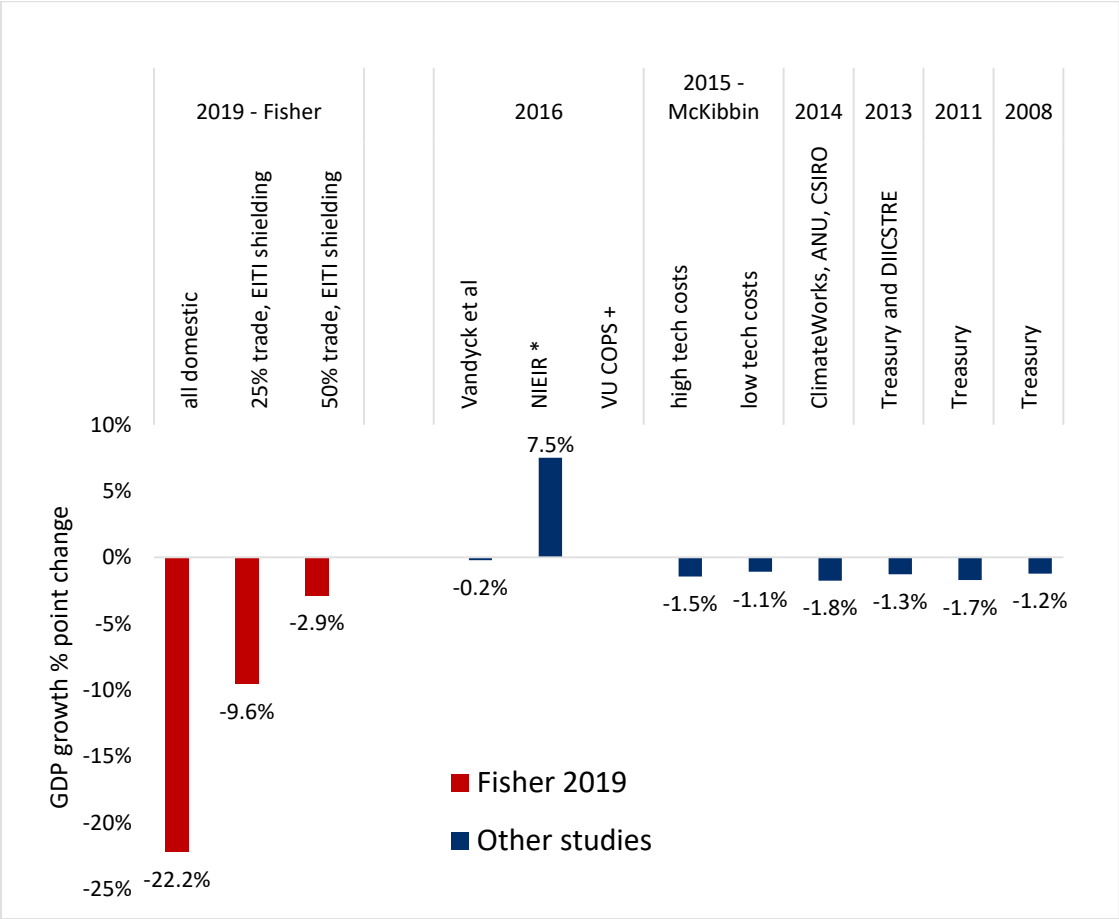
This Figure shows there is economic growth in *every* scenario in these models. In most scenarios, the economy grows between 23% and 33% over the decade.

The exception is Brian Fisher’s ‘all domestic’ mitigation scenario, which reduces GDP growth over the decade to just 9%. This is far below the comparable scenarios presented in the six studies that focused on all domestic emission reductions.

Figure 1 shows how each study varied in terms of setting their reference case. There is a far bigger variation between reference cases of different models, than there is between the reference case and the actual high ambition reductions within each scenario. This underlines how small the impact is compared to the impact of other matters that modellers must make assumptions about when constructing scenarios.

Most importantly, Figure 1 shows in most scenarios there is very little difference between the reference case and the high ambition case. The percentage point reductions in GDP growth are shown by themselves, in Figure 2.

Figure 2: GDP growth 2020-30 in high ambition vs reference, % points



Source: Derived from reports, as listed and described in text

In most scenarios, over the entire decade the difference in GDP growth is less than 1.7 percentage points. The only models with bigger impacts than this are from Brian Fisher. His 'all domestic' scenario projects an impact that is 10 times greater than all other studies of climate action.

Treasury 2008-2013

The earliest reports considered here are from Treasury.

The highest ambition scenarios in the three Treasury models from 2008 to 2013 showed deep decarbonisation to 2030 of between -40% to -60% on 2000 levels (two of the models show further abatement to 2050.)

The share of abatement (relative to BAU) from international units is between 20% and 29%.

Over these scenarios, impact on GDP is between 1.2 and 1.7 percentage points between 2020 and 2030.

All of the other scenarios chosen did not model use of international permits.

ClimateWorks, ANU and CSIRO 2014

In 2014, ClimateWorks, ANU and CSIRO modelled a *Deep Decarbonisation Pathway* for Australia of 53% reduction by 2030, and net zero emissions by 2050.

In this study, all abatement is domestic, through a 143% increase in electricity use, all growth from renewables. Transport and industry are electrified where possible. The scenario also uses biofuels and biocoke.

The economy grew 28% to 2030, 1.8 points lower than the reference.

ClimateWorks in 2017 extended this work further to assess opportunities for abatement under this pathway compared with abatement realised under current and proposed policies. It found lowest cost abatement required far greater electricity abatement, alongside many other opportunities.

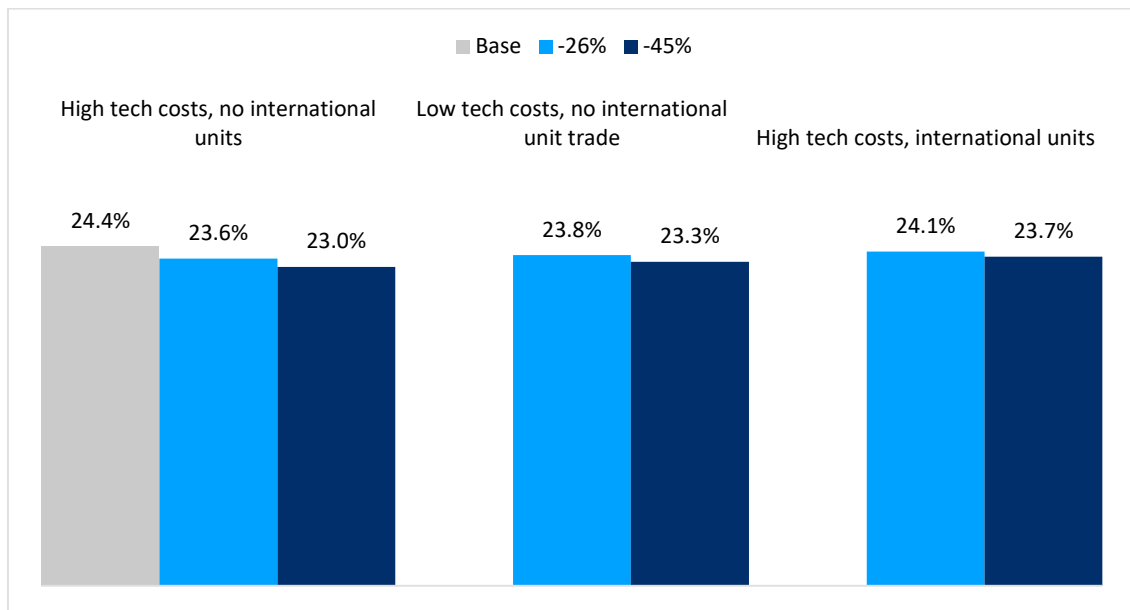
McKibbin 2015

McKibbin's 2015 modelling is of particular interest, as it was commissioned by the Abbott government and has been cited in recent debate.

McKibbin looked at impacts of 45% by 2030 on 2005. This target was assessed with "relatively high technology costs", adjusted upwards by 50%.²⁷ The 'core' scenario uses high costs. McKibbin also assessed "lower" technology costs which, with hindsight, is more in line with recent technology trends. Impacts were decreased further by the use of international units. Figure 3 shows GDP growth in these scenarios from 2020 to 2030.

²⁷ McKibbin makes the adjustment upwards for the 'core' scenarios to account for the fact that the modelling does not account for non-energy abatement. This is an unusual way to make that adjustment and it ignores prospects for abatement in those sectors.

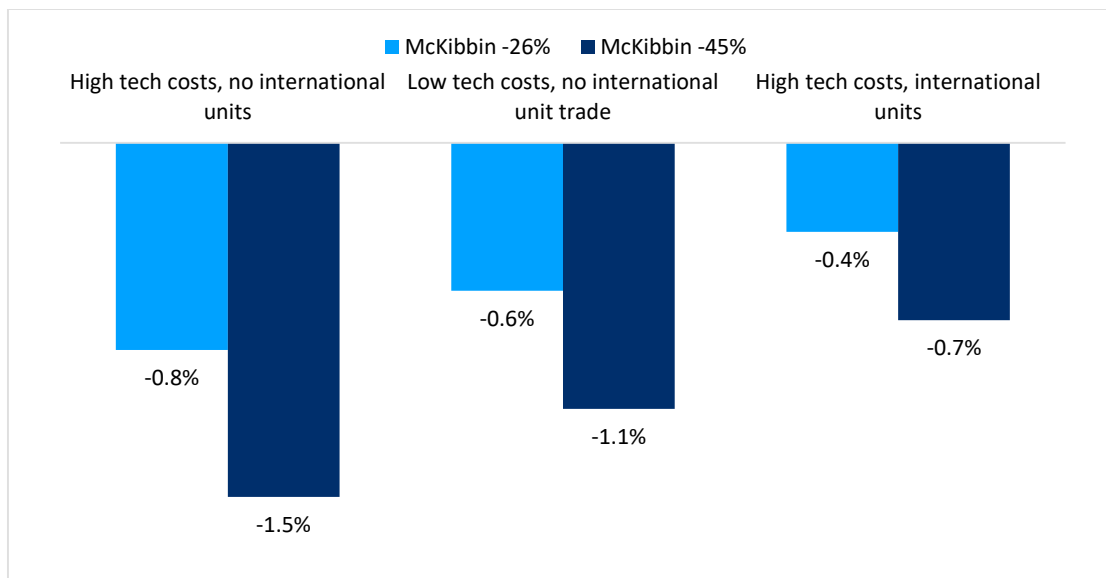
Figure 3: McKibbin 2015 - GDP growth 2020-30 in key scenarios



Source: McKibbin (2015), as listed and described in text

There is strong growth in every scenario. The gap between results is so small it is expanded in Figure 4, which shows the percentage point differences in each policy scenario vs the reference.

Figure 4: McKibbin 2015 – GDP growth 2020-30 vs reference



Source: McKibbin (2015), as listed and described in text

Using high technology costs, a 45% target reduces GDP growth to 2030 by 1.5 percentage points.

With low technology costs (similar to current technology prices), impact is reduced to just 1.1 percentage points.

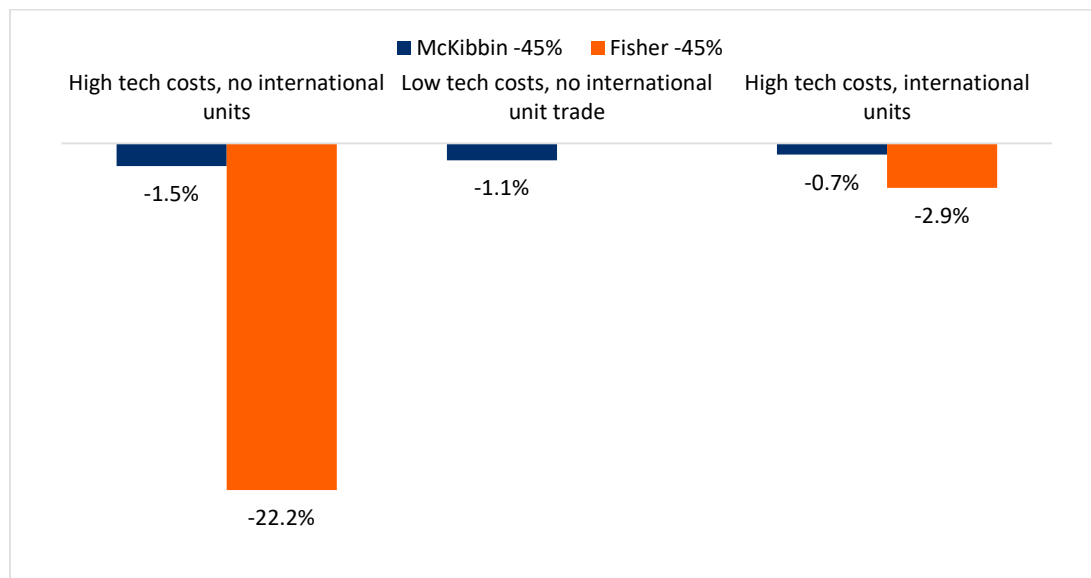
Using international permits further decreases the cost, to 0.7 percentage points.

The impact is even smaller when comparing with impacts of a 26% reduction within each McKibbin scenario. Increasing from 26% to 45% reduces GDP growth by 0.5 percentage points in the low technology costs with no international unit trade.

A 45% reduction with low technology costs results in just 0.3 percentage points GDP growth impact, when compared with 26% with high technology costs.

The small scale of these impacts even clearer when compared directly against results from Brian Fisher.

Figure 5: McKibbin 2015 vs Fisher 2019 – GDP growth impact with 45% reductions



Source: McKibbin (2015), Fisher (2019a, 2019b) as listed and described in text

Other reports 2016

The report by Vandyck et al included Australia as a region in a global modelling exercise looking at abatement beyond current targets. By applying a higher carbon price, Australia's economy increases abatement to 32% by 2030 on 2005. The economic impact is very small.

In 2016 Victoria University COPS (for the Climate Change Authority) modelled GDP impacts of different electricity sector policies, but did not compare against a reference case. Nonetheless, the report finds strong economic growth with low emissions,

stronger than under the reference case used in other models.²⁸ The central ‘carbon price’ scenario is used here; differences with other policies were very small.

A 2016 NIEIR report found lower emissions *increased* the rate of economic growth.²⁹ This report uses a different form of modelling to the other reports.³⁰ Consistent with this result, a 2015 ANU study also argues for ‘green dividend’ benefits from cutting emissions, including from enhanced energy productivity and health co-benefits.³¹

Fisher 2019

The only scenarios that find bigger negative impacts than 1.7 percentage points reduction over the decade are from Brian Fisher.

All of Fisher’s scenarios for high ambition show bigger impacts on GDP growth than in *any* other report: from 3 percentage points with 50% abatement from international units, up to 22.2 percentage points with no international units.

Even in the scenario with half of the abatement coming from international units, Fisher’s model finds bigger percentage point reductions in GDP growth than much earlier Treasury models where international units are only 20-29% of the abatement.

It is notable that Fisher’s models show far higher impacts than the earlier studies. The trend shown above and demonstrated in an ANU report is usually that later exercises find lower abatement costs.³² One reason for this trend is technology costs continue to fall faster than previously predicted.

²⁸ Victorian University’s Centre of Policy Studies (2016) *Simulations of the effects of greenhouse gas mitigation policies for the Australian electricity sector*, for CCA
<http://climatechangeauthority.gov.au/sites/prod.climatechangeauthority.gov.au/files/files/SR%20Modelling%20reports/Victoria%20University%20CGE%20modelling%20report.pdf> pii.

²⁹ National Institute of Economic and Industry Research (NIEIR) (2016) *Jobs in a clean energy future*, commissioned by ACF and ACTU
https://d3n8a8pro7vhmx.cloudfront.net/auscon/pages/1435/attachments/original/1477355385/ACF_Jobs_in_a_clean_energy_future.Web.pdf

³⁰ While all the other reports use CGE models, NIEIR gives a principled rejection of that approach, and instead argues for an alternative approach where policy to support new forms of capital stock can increase productivity.

³¹ Jotzo and Kemp at ANU (2015) *Australia can cut emissions deeply and the cost is low*
https://ccep.crawford.anu.edu.au/files/uploads/ccep_crawford_anu_edu_au/2015-05/australia_can_cut_emissions_and_the_cost_is_low-_jotzo_and_kemp_april_2015_-_submission_to_dpmmc.pdf

³² Ibid

THE INTERNATIONAL ENERGY AGENCY

Some reports take an economy wide perspective, but do not assess economic impacts. Rather, they show scenarios for how the energy system may develop given assumed economic trajectories.

A key example the International Energy Agency's *World Energy Outlook (WEO)*. This annual report gives perhaps the most widely cited assessment of energy system trajectories.

In the WEO, GDP growth is assumed in each region over coming decades. Within such constraints, the WEO provides detailed assessment of technical and economic feasibility world energy system trajectories.

The key IEA scenario is the *Sustainable Development Scenario*. This scenario shows how to achieve multiple goals together: economic growth equivalent to the no action scenario, success under the Paris Agreement on climate and universal modern energy access. It shows that for this to happen, coal use must go into immediate decline, including in Australia, and there must be no growth in gas use.

Despite these results, politicians and commentators often cite other scenarios in the WEO to justify increased fossil fuel use.

Such appeals fail to acknowledge the chosen scenario results in catastrophic climate change, and ignore the preferred *Sustainable Development Scenario*.

Electricity Sector Emission Reductions

Recent reports have focused more narrowly on the electricity sector. In such reports, electricity decarbonisation and 100% renewables are assessed for their impact on energy costs.

When considering these reports it is important to note each presents results in different metrics, including wholesale prices, retail prices, system costs. They generally do not consider potential abatement from energy efficiency, which is substantial.

It is also important to note any economy-wide target is most efficiently achieved with a higher target in electricity than across the economy, as there is broader scope for immediate low cost abatement in electricity cheaper than in other sectors. The government has opposed this, setting a 'pro-rata' target (applying the economy-wide target to the sector). While the opposition also has a pro-rata target for electricity, it says it will allow electricity to sell offsets to other sectors.

RESULTS

In total 12 reports were found that focus on electricity price or system cost impacts of bigger emissions reductions in electricity.

Increased electricity abatement

4 reports found policy to increase renewable energy and reduce electricity emissions would *decrease* power prices or costs, compared with no action or lower action scenarios. All of these reports are recent.

- In 2018, **Reputex** found a 'National Energy Guarantee' (NEG) with an electricity emissions target of 45% below 2030 on 2005 levels would result in wholesale prices of \$59/MWh. Business as usual prices were modelled at \$85/MWh.³³
- In 2018, **Frontier Economics** found a 45% electricity emissions target would result in retail savings from retail current prices (of 18.5%). This was around the

³³ Reputex (2018) *The impact of the NEG on emissions and electricity prices by 2030*, commissioned by Greenpeace https://www.reputex.com/wp-content/uploads/2018/07/REPUTEX_Modelling-of-the-National-Energy-Guarantee_0718_26-45.pdf

same as business as usual (of 18.3%). A stronger 65% target would result in only slightly smaller savings (of 15%).³⁴

- In 2017, **CSIRO and Energy Networks Australia** modelled policies for integration of renewables and flexible demand, including increased uptake of electric vehicles. They found such policies reduce both power bills and emissions to 2030, compared with no policy, and further cost savings in 2050, with emissions falling to zero.³⁵
- In 2015, **Vithayasrichareon et al from the UNSW Centre of Energy and Environmental Markets (CEEM)** examined optimal generation mix targets for 2030 given uncertain gas prices, carbon pricing policy and electricity demand. Through Monte Carlo analysis of different portfolios and scenarios, they found the lowest expected cost at 60% renewables by 2030, and further decreases to 'cost risk' (standard deviation of costs) with very small cost increases to 75% renewables by 2030.

In addition, 1 report found deep electricity emissions cuts in resulted in modest increases in electricity bills.

- **Jacobs**, for the Climate Change Authority, modelled an electricity emissions trajectory based on a carbon price that globally would limit warming to below 2 degrees. By 2030 electricity emissions fell by 60% to 75%, but retail bills increase by only 12% to 23%. Jacobs points out this is less than 0.3% of average household disposable income. Jacobs also did not consider energy efficiency or flexible demand, which would further decrease cost impacts and transition burdens.³⁶

1 further report focused only on employment.

- **EY and KGM and Associates** consider a 50% renewable energy target by 2030. They find an increase of renewable energy of this order increases net

³⁴ Frontier Economics (2018) *Tackling climate change and energy affordability for low-income households*, commissioned by ACOSS and BSL <https://www.acoss.org.au/wp-content/uploads/2018/09/ACOSS-BSL-Report-Tackling-climate-change-and-energy-affordability-for-low-income-households.pdf>

³⁵ Energy Networks Australia and CSIRO (2017) *Electricity Network Transformation Roadmap: Final Report* https://www.energynetworks.com.au/sites/default/files/entr_final_report_web.pdf

³⁶ Jacobs (2016) *Modelling illustrative electricity sector policies*, for <http://climatechangeauthority.gov.au/reviews/special-review/modelling-illustrative-electricity-sector-policies>

employment across the economy, with renewable energy associated jobs more than offsetting jobs lost in fossil energy.³⁷

It is also worth raising the modelling conducted for the Abbott Government's 2014 Review of the Renewable Energy Target (RET). Brian Fisher sat on the panel for this report.³⁸ The modelling, conducted by ACIL Allen, found increasing the RET would decrease power prices, consistent with existing literature at the time, but contrary to political expectations.³⁹ This report is not included in the total above as it considered increasing the RET to 2020. However, it is mentioned here as the results are contrary to Brian Fisher's own modelling.

100% renewable energy

Five reports consider the cost of a 100% renewable energy system.

One found a net reduction in system costs over time, due to fuel savings, while others found modest increases.

- In 2016 the **UTS Institute of Sustainable Futures (ISF)** modelled a 100% renewable energy system by 2030. It found the reduction in fuel costs lead to overall savings on system costs, with breakeven between 2025 and 2040, depending on fuel cost assumptions. In the *Advanced* scenario, renewable energy also decarbonised 41% of transport and 50% of industry by 2030. By 2050 fuel savings also resulted in lower total system costs.⁴⁰

Two reports find a significant increase in renewable energy was possible at costs lower than current wholesale prices, with 100% possible at modest costs, with current technology.

³⁷ EY and KGM and Associates (2016) *The Renewable Energy: Future Jobs and Growth*, commissioned by the Climate Council and EY Foundation
<https://www.climatecouncil.org.au/resources/renewablesreport/>

³⁸ Brewster (2014) *Renewable Energy Target review defends panel member Brian Fisher against conflict of interest claims* <https://www.abc.net.au/news/2014-06-05/renewable-energy-target-panel-defends-conflict-interest-claims/5501372>

³⁹ As discussed in Swann and Grudnoff (2015) *Take the Pressure Down*
<http://www.tai.org.au/sites/default/files/Take%20the%20pressure%20down%20-%20FINAL.pdf>

⁴⁰ UTS: Institute for Sustainable Futures (2016) *100% Renewable Energy For Australia: Decarbonising Australia's Energy Sector Within One Generation*, commissioned by GetUp! And Solar Citizens
https://www.uts.edu.au/sites/default/files/article/downloads/ISF_100%25_Australian_Renewable_Energy_Report.pdf

- A 2018 study from **ITP**, funded by ARENA, assessed available options for dispatchable renewable energy, including long and short term storage options. The cost for 100% dispatchable renewable energy averages around \$110/MWh, ranging between \$80-\$140/MWh.⁴¹ However, the report found the share of dispatchable energy needed to firm variable renewables is much lower than previously assumed. At 2017 technology prices, it found

“a combination of 30% dispatchable renewable energy and 70% variable renewable energy (i.e. wind or solar) would take the average LCOE from \$65/MWh to around \$80/MWh – comparable to today’s wholesale energy prices.”⁴²

- In 2017 **Blakers et al** from the ANU, in a peer reviewed journal, modelled a 100% renewable energy system, based mainly on known commercial technology of solar, wind, pumped hydro and high voltage transmission. At 2017 technology costs they find system costs per unit of energy \$93/MWh; at future technology costs, they find system costs of \$75/MWh. These costs are comparable to current wholesale prices (\$85/MWh average for 2018-19).⁴³

The other 100% renewable reports found costs were modest.

- In 2016 **The University of NSW Centre of Energy and Environmental Markets (CEEM)** reviewed previous models of 100% renewable energy systems for Australia, from 2010 to 2016. They find a range of costs in the preceding literature, with most studies finding wholesale and transmission costs of between \$100-\$140/MWh. The report also notes there are key ways to reduce costs further, especially providing certainty to reducing cost of capital, which is very important for renewables with nearly all of the cost upfront.
- In 2016 **Lenzen et al** from USYD and other universities, in a peer reviewed journal, found 100% renewables in Australia would cost 20c/kWh for generation, firming and transmission, and less than half as much if limits on wind are relaxed. If these components of the average national average bill cost 20c/kWh, retail bills would be around 20% higher than currently. As outlined by UNSW CEEM, this study is highly conservative in a number of ways. It limits wind capacity factors and generation shares to below current observations; arbitrarily limits spillage; ignores flexible demand; and assumes 2016 rather

⁴¹ Ibid, p 102

⁴² ARENA (2018) *Comparison of Dispatchable Renewable Electricity Options* <https://arena.gov.au/projects/dispatchable-renewable-electricity-options/>

⁴³ AER (2019) *Annual volume weighted average spot prices* <https://www.aer.gov.au/wholesale-markets/wholesale-statistics/annual-volume-weighted-average-spot-prices>

than plausible future costs. All of these assumptions result in an overestimate of costs. Solar and storage is now significantly cheaper than it was in 2016, and cheaper than most analysts then expected it would be by 2019.

It is important to compare these modelled costs to recent increases in retail prices. Retail prices increased by 56% in the decade to 2017-18.⁴⁴ Most of this was network cost increases, due largely to poor regulation, and wholesale price increases, due largely to policy uncertainty.

With solar and wind with storage is now the cheapest new power generation,⁴⁵ policy certainty would accelerate new generation and bring down wholesale prices. As noted above, more recent studies by Reputex and Frontier Economics have found additional investment in new generation reduces wholesale prices from current levels.

Fisher 2019

By contrast with the literature discussed, Brian Fisher's relies on models containing expensive emissions reductions from electricity.

Fisher imposes a 50% renewable energy floor on his scenarios, to match Opposition policy. Given low cost options in electricity, it is surprising that renewable energy increases only to 53% in one of the scenarios. However this occurs because his model assumes very high cost renewable energy firming and integration costs.

Fisher's scenario with full domestic abatement is most analogous to the above studies decarbonising electricity. That scenario finds wholesale power prices of \$157/MWh.⁴⁶ This is higher than nearly all of the studies considered above, including those considering 100% renewable energy.

The one exception, from Lenzen et al, considers 100% renewables, including both wholesale and transmission costs.⁴⁷ As mentioned above, the costs in that report are conservatively high, not least because it uses 2016 technology costs.

⁴⁴ ACCC (2018) *Restoring electricity affordability and Australia's competitive advantage Retail Electricity Pricing Inquiry—Final Report*
https://www.accc.gov.au/system/files/Retail%20Electricity%20Pricing%20Inquiry%E2%80%94Final%20Report%20June%202018_Exec%20summary.pdf

⁴⁵ CSIRO (2018) *NewGen* <https://www.csiro.au/en/News/News-releases/2018/Annual-update-finds-renewables-are-cheapest-new-build-power>

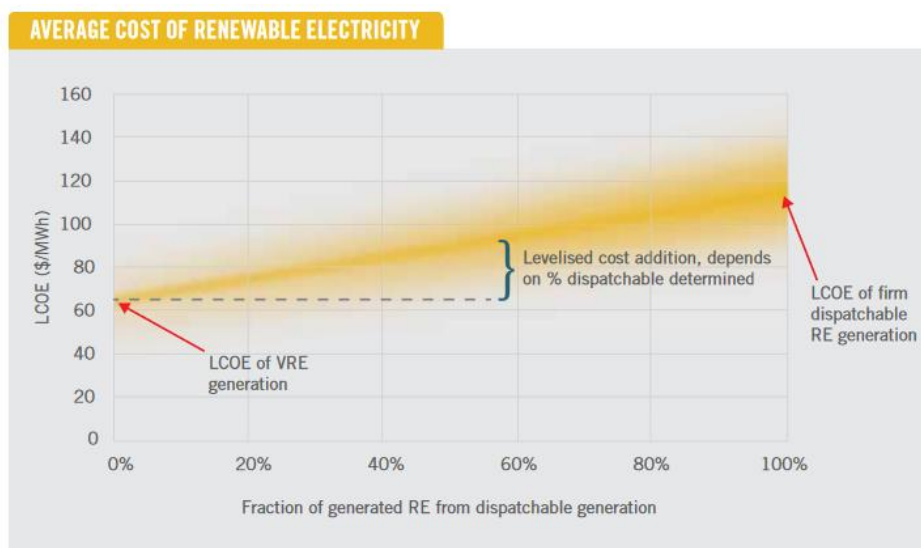
⁴⁶ Fisher (2019) *Economic consequences of alternative Australian climate policy approaches*, Scenario 4, page 15

⁴⁷ Lenzen et al (2016), described in text.

Fisher finds high wholesale energy prices because he makes very high cost assumptions for integrating variable renewables. He claims that integration costs rise from zero at 20% renewables to \$200/MWh at 75% renewables. He claims these costs come from the ITP report cited above.

Fisher's figures are not contained in the ITP report, which in fact contradicts Fisher's conclusion. As shown in Figure 7, from the ITP report, even at 100% dispatchable renewable energy, the *total* cost does not exceed \$140/MWh, or on average around \$110/MWh. Fisher assumes a cost for integration alone that is higher than the total cost for 100% dispatchable renewable power.

Figure 6: Incremental cost of increased dispatchable renewable energy – ITP



Source: ITP (2018), p 102

In direct contradiction of Fisher, the ITP report concludes:

“It is clear that a range of proven and affordable options is available to more than adequately cater for significantly increased levels of renewable energy in the Australian energy mix, and for an eventual net zero emission technology mix by 2050 as implicitly required by the longer-term goals of the Paris Accord.”⁴⁸

⁴⁸ ITP (2018) *Comparison of dispatchable renewable electricity options*
<https://arena.gov.au/assets/2018/10/Comparison-Of-Dispatchable-Renewable-Electricity-Options-ITP-et-al-for-ARENA-2018.pdf> p 107

The Australia Institute pointed out this contradiction on the day that Fisher released his first report. It is concerning that Fisher's modelling is not only out of step with an extensive literature, but also with the report on which it claims to be based.

Conclusion

Claims from Fisher and the BCA are out of line with the extensive literature, and with the reports they themselves cite or commissioned.

The Government has not explained why it has chosen to rest its policy argument on Fisher's reports, rather than the advice of the hundreds of economists at its disposal in the public service, or the extensive existing literature, including major reports from Treasury.

It has been reported that the Government did commission modelling of the economics of climate policy, into which Brian Fisher says he had input. It cannot be assessed as the Government has not released it.

In formulating climate targets and policy, the next government should use the expertise of the public service, including the Climate Change Authority and Treasury, as well as the extensive existing literature. It should not rely on unreliable claims from the big business lobby and consultants with discredited modelling. It should focus on avoiding the costs of climate change by increasing ambition on reducing Australia's emissions.

Appendix 1: Reports modelling climate policy

Author	Year	Title	Sector scope	Impact	Key Findings
ITP	2018	<i>Comparison of dispatchable renewable electricity options</i>	Electricity	System cost	less dispatchable needed than previously assumed. at 2017 prices, renewables 30% dispatchable and 70% variable renewable = \$80/MWh 100% dispatchable = \$80-140/MWh, average \$110/MWh.
Reputex	2018	<i>The impact of the NEG on emissions and electricity prices by 2030</i>	Electricity (NEM)	Prices, wholesale	-45% emissions by 2030 on 2005: wholesale prices \$59/MWh. BAU = -26% emissions by 2030: wholesale prices \$85/MWh.
Frontier Economics	2018	<i>Tackling climate change and energy affordability for low-income households</i>	Electricity (NEM)	Prices, retail	All emissions targets give retail savings from present. BAU: -18.5% prices. -26% emissions: -20.8% prices. -45% emissions: -18.3% prices. -65% emissions: -15% prices.
CSIRO and Energy Networks Australia	2017	<i>Electricity Network Transformation Roadmap: Final Report</i>	Electricity	Prices, retail	<i>Roadmap</i> to manage flexible demand and variable, decentralised renewables; reduces both emissions and prices. <i>No Roadmap</i> : -35% emissions by 2027 on 2017; -65% by 2050. <i>With Roadmap</i> : -40% emissions by 2027, small bill savings from <i>no Roadmap</i> ; zero emissions by 2050, -10% average bill; includes increased uptake of electric vehicles;

Author	Year	Title	Sector scope	Impact	Key Findings
ANU: Blakers, Lu, Stocks	2017	<i>100% renewable electricity in Australia</i>	Electricity	System costs	100% renewable energy, including pumped hydro and high voltage transmission. <i>Current technology costs: \$93/MWh;</i> <i>Future technology costs: \$73/MWh.</i>
ClimateWorks	2017	<i>Power Up</i>	Economy-wide	Lowest cost options	Many abatement options available consistent with (ClimateWorks ANU and CSIRO 2014). Decarbonised electrification is lowest cost way of reaching current and more ambitious emissions targets.
Jacobs	2017	<i>Modelling illustrative electricity sector policies</i>	Electricity	Prices, retail	Various policies for electricity emissions. -60% to -75% emissions by 2030: +12% to +23% retail prices, +0.08% to +0.34% of household disposable income.
Vandyck et al.	2016	<i>A global stocktake of the Paris pledges: Implications for energy systems and economy</i>	Economy-wide	GDP	<i>Global 2C Scenario</i> with higher carbon price: Australia's GDP in 2030 is -0.25% vs reference case. Equivalent to -0.02% per annum.
UTS Institute for Sustainable Futures	2016	<i>100% Renewable Energy For Australia: Decarbonising Australia's Energy Sector Within One Generation</i>	Economy-wide	System costs	<i>100% Renewable electricity by 2030</i> , -45% emissions on 2005: upfront investment cost lead to fuel cost savings starting from 2025 to 2040, depending on fuel cost sensitivities. <i>Advanced Renewables</i> : all sectors 100% renewable by 2050. Net savings from avoided fuel costs to 2050.
EY and KGM and Associates	2016	<i>Renewable Energy Jobs: Future Jobs and Growth</i>	Electricity	Jobs	<i>50%RE</i> : 50% renewables by 2030, electricity employment increases 24% vs BAU. Increased renewable jobs offset lost fossil jobs.

Author	Year	Title	Sector scope	Impact	Key Findings
National Institute of Economic and Industry Research	2016	<i>Jobs in a clean energy future</i>	Economy-wide	GDP, jobs	<i>Medium action:</i> 63% emissions reduction by 2040 on 2005; GDP increases 6% and jobs 8% vs BAU in 2040. <i>Strong action:</i> 80% emissions reduction by 2040 on 2005; GDP increases 9% and jobs 13%, vs BAU in 2040.
VU COPS	2016	<i>Simulations of the effects of greenhouse gas mitigation policies for the Australian electricity sector</i>	Economy-wide	GDP	<i>Carbon pricing scenario:</i> GDP growth 2.8% per year to 2050. No comparison with BAU, but growth rate higher than BAU in other modelling exercises.
Lenzen et al.	2016	<i>Simulating low-carbon electricity supply for Australia</i>	Electricity	System costs	<i>100% renewable energy:</i> 20c/kWh generation, firming and transmission cost. Component increase is 20% additional to 2018 retail prices. Assumes no technology cost reduction over time, no demand-response.
UNSW CEEM	2016	<i>100% Renewables in Australia: A Research Summary</i>	Electricity	Cost	<i>100% renewable energy:</i> review of existing literature finds feasible and affordable, range of system costs, retail bill impact 20-30%.
McKibbin	2015	<i>Report 2: 2015 economic modelling of Australian action under a new global climate change agreement</i>	Energy: electricity, transport, industry.	GDP	<i>High technology costs, no international carbon trade:</i> -26% emissions, -0.6% GDP in 2030, vs BAU; -45% emissions, -1% GDP in 2030 vs BAU; <i>Lower technology costs, no international carbon trade</i> -26% emissions, -0.4% of GDP in 2030 vs BAU; -45% emissions, -0.7% of GDP in 2030 vs BAU; (0.3% GDP difference between scenarios, 0.1% difference from -26% with high tech costs)

Author	Year	Title	Sector scope	Impact	Key Findings
ANU: Jotzo and Kemp at ANU	2015	<i>Australia can cut emissions deeply and the cost is low</i>	Economy wide	GDP	Synthesises literature on deep emissions reductions: GDP impact is small, consistent with strong GDP growth. Modelled costs fall over time in subsequent reports. Abatement could <i>increase</i> growth through energy productivity, health co-benefits.
UNSW CEEM: Vithayasrichar-eon et al,	2015	<i>Using renewables to hedge against future electricity industry uncertainties—An Australian case study</i>	Electricity (NEM)	Cost	Monte Carlo analysis of different portfolios to 2030, scenarios of carbon and gas prices, energy demand. Lowest expected cost at 60%RE by 2030, significant falls in 'cost risk' (standard deviation of costs) with \$0.2/MWh cost.
ClimateWorks ANU and CSIRO	2014	<i>Pathways To Deep Decarbonisation In 2050: How Australia can prosper in a low carbon world</i>	Economy wide	GDP	<i>BAU</i> : 2.6% annual GDP growth <i>Deep Decarbonisation Pathway</i> : -53% emissions by 2030 on 2005, 2.46% GDP per year, 2020 to 2030. 143% increase in clean electricity demand, biofuels and green hydrogen.
Climate Change Authority	2014	<i>Targets and Progress Review</i>	Economy wide	GNI per person	<i>Current policy</i> : -5% emissions by 2020 on 2000; <i>Recommended policy</i> : -15% emissions by 2020, annual growth in GNI per person falls by just 0.02% to 0.78%. (Based on Treasury and DIICSTRE, 2013)
Treasury and DIICSTRE	2013	<i>Climate Change Mitigation Scenario</i>	Economy wide	GDP	<i>Reference</i> : 3% annual GDP growth. <i>High carbon price</i> : -45% emissions by 2030 on 2000, 2.9% annual GDP growth. Uses 40% international units. Same annual GDP growth with lower emissions targets.

Author	Year	Title	Sector scope	Impact	Key Findings
Treasury	2011	<i>Strong growth low pollution: modelling a carbon price</i>	Economy wide	GDP	<p><i>Reference:</i> 1.4% annual growth in real GDP per person</p> <p><i>Carbon price:</i> -40% emissions by 2030 on 2000, 1.3% annual growth in real GDP per person.</p> <p>Same growth in scenario including half international units vs scenario with more domestic abatement.</p>
Treasury	2008	<i>Australia's Low Pollution Future: The Economics of Climate Change Mitigation</i>	Economy wide	GDP	<p><i>Reference:</i> 2.4% annual GDP growth.</p> <p><i>Moderate policies:</i> -5% to -15% emissions by 2020 on 2000, -60% to -80% by 2050, 2.3% annual GDP growth.</p> <p><i>Strong policies:</i> -25% emissions by 2020 and -90% by 2050, 2.2% annual GDP growth.</p>

Appendix - All reports

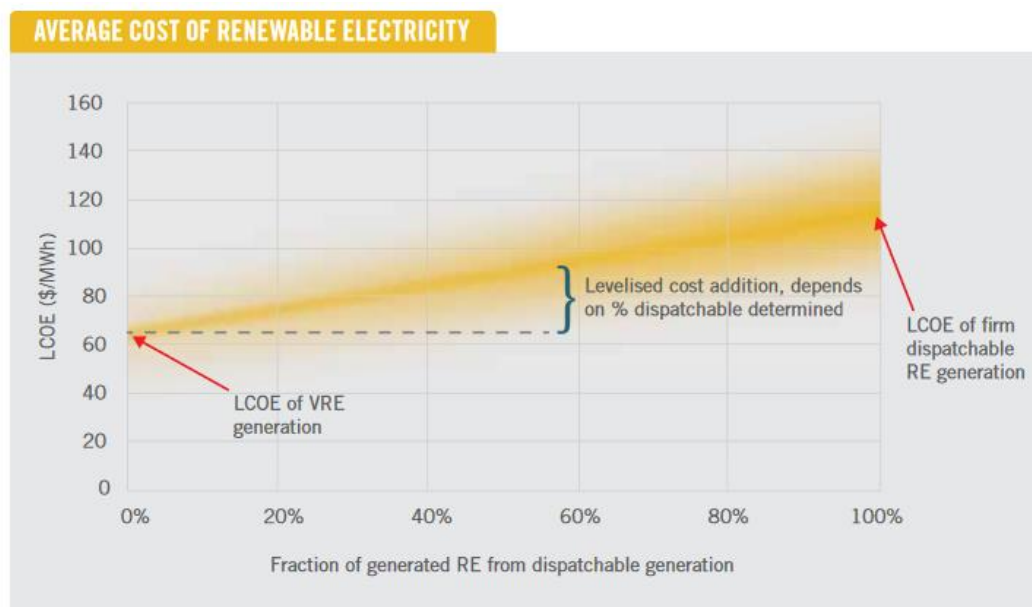
STUDIES OF HIGHER AMBITION - 2013-2019

ITP (2018) *Comparison of dispatchable renewable electricity options*

ARENA funded the energy consultancy ITP to assess requirements, costs and interactions of technologies available to provide dispatchable renewable energy, including long and short term storage options.

The report finds the amount of dispatchable renewable energy needed to firm variable renewables is much lower than previously assumed. Incremental costs for increased shares of dispatchable renewable energy are shown in Figure 7.

Figure 7: Incremental cost of increased dispatchable renewable energy – ITP



Source: ITP (2018), p 102

The cost for 100% dispatchable renewable energy is between \$80-\$140/MWh, averaging around \$110/MWh,⁴⁹ and

⁴⁹ Ibid, p 102

“at 2017 prices, a combination of 30% dispatchable renewable energy and 70% variable renewable energy (i.e. wind or solar) would take the average LCOE from \$65/MWh to around \$80/MWh – comparable to today’s wholesale energy prices.”⁵⁰

The final report concludes:

“It is clear that a range of proven and affordable options is available to more than adequately cater for significantly increased levels of renewable energy in the Australian energy mix, and for an eventual net zero emission technology mix by 2050 as implicitly required by the longer-term goals of the Paris Accord.”⁵¹

Reputex (2018) *Impact of NEG*

Reputex modelled wholesale electricity prices in the National Electricity Market (NEM) under different electricity sector emissions targets.⁵² It found power prices were lower under an emissions reduction policy of 45% by 2030 on 2005. The ‘business as usual’ scenario was found to meet the proposed National Energy Guarantee target of 26% by 2030 on 2005. In this scenario prices were at \$85/MWh. In the 45% scenario, prices were \$59/MWh.⁵³

Frontier Economics (2018) *Tackling Climate Change*

Frontier Economics modelled retail electricity prices in the NEM.⁵⁴ It found retail prices would be lower than present under all scenarios – business as usual, and emissions targets of 26%, 45% and 65% by 2030 on 2005. The 45% reduction target resulted retail savings effectively the same as business as usual (18.3% vs 18.5% savings). A

⁵⁰ ARENA (2018) *Comparison of Dispatchable Renewable Electricity Options*
<https://arena.gov.au/projects/dispatchable-renewable-electricity-options/>

⁵¹ ITP (2018) *Comparison of dispatchable renewable electricity options*
<https://arena.gov.au/assets/2018/10/Comparison-Of-Dispatchable-Renewable-Electricity-Options-ITP-et-al-for-ARENA-2018.pdf> p 107

⁵² Reputex (2018) *The impact of the NEG on emissions and electricity prices by 2030*, commissioned by Greenpeace https://www.reputex.com/wp-content/uploads/2018/07/REPUTEX_Modelling-of-the-National-Energy-Guarantee_0718_26-45.pdf

⁵³ Ibid, p 22

⁵⁴ Frontier Economics (2018) *Tackling climate change and energy affordability for low-income households*, commissioned by ACOSS and BSL <https://www.acoss.org.au/wp-content/uploads/2018/09/ACOSS-BSL-Report-Tackling-climate-change-and-energy-affordability-for-low-income-households.pdf>

target of 65% gave savings but a little less (15% savings) while a 26% reduction target gave only slightly bigger savings (20.8% savings).

ClimateWorks (2017) *Power Up*

ClimateWorks compares current abatement policy against opportunities for abatement available right now sufficient to get to 55% reductions by 2030 on 2005 levels.⁵⁵ The options focus on energy efficiency and clean electricity. This research draws on and updates options identified by Climate Works and ANU (2014), which as noted below research found deep decarbonisation was possible with modest economic impacts of just 0.14% points per year of GDP growth. The 2017 report does not repeat the economic modelling but updates the options used there and presents evidence that these options are the lowest cost way of reaching the both current and more ambitious targets.

CSIRO and ENA (2017) *Electricity Network Transformation Roadmap*

CSIRO and Energy Networks Australia (ENA) modelled policies to promote integration of variable, decentralised renewables and demand response, including increased uptake of electric vehicles.⁵⁶ The report found such policies would both increase emissions reductions and retail power costs, by increasing smart use of grid assets. In the base case emissions were 35% below 2017 levels by 2027 and the average bill was around \$1600. With the policy they outline, emissions fell by 40% and the average bill \$1566, even including increased demand from more electric vehicles. By 2050 these trends continue: in the base case emissions fell to 65% while bills reached \$2,000, while with policy emissions reached zero and bills were \$1,800.

ANU: Blakers et al. (2017) *100% Renewable*

Blakers et al. from ANU model a 100% renewable energy system for Australia.⁵⁷ The study focused on variable renewable balancing costs, including a new high voltage

⁵⁵ ClimateWorks (2017) *Power Up*

https://www.climateworksaustralia.org/sites/default/files/documents/publications/cwa_power_up_report_final_12_jul.pdf

⁵⁶ Energy Networks Australia and CSIRO (2017) *Electricity Network Transformation Roadmap: Final Report* https://www.energynetworks.com.au/sites/default/files/entr_final_report_web.pdf

⁵⁷ Blakers, Lu, Stocks (2017) *100% renewable electricity in Australia* <http://re100.eng.anu.edu.au/resources/assets/1708BlakersREAust.pdf>

transmission backbone and many new smaller scaled pumped hydro facilities. Using current wind and solar PV costs, it found system wholesale prices at \$93/MWh. Using future wind and solar PV costs, it found system wholesale prices at \$75/MWh. A gradual build out would see prices between these. Current prices, they note, average at about \$80/MWh.⁵⁸ This paper was published in a peer-reviewed academic journal.

Jacobs (2017) *Modelling illustrative electricity sector policies* - for CCA

As part of its 2016 Special Review, the Climate Change Authority (CCA) commissioned Jacobs to examine the economic impact of different ways of achieving an electricity emissions reduction target consistent with limiting warming to below 2 degrees.⁵⁹ The emissions constraint is imposed via a carbon price, in turn translated into an emissions budget for electricity to 2050, in turn imposed on all policies. Over the projection emissions fall around 60%-75% by 2030 and 75%-85% by 2050.⁶⁰ Jacobs found an impact on retail energy prices of 12% to 23% depending on the policy, with an impact of just 0.08% to 0.34% of household disposable income.⁶¹

Vandyck et al. (2016) *Stocktake of Paris pledges*

Vandyck et al. model impacts on the global economy of current climate policy and future carbon prices nominally consistent with a two-degree warming target. The model is disaggregated into country regions, including Australia. In the 2C scenario, Australia's GDP is only 0.25% smaller by 2030 than it is in the reference case, equivalent to a difference of 0.02% per annum over the 15 years modelled.⁶²

The reference case for Australia includes a carbon price of US\$20 per tCO₂e. In the INDC scenario this increased to \$32. There is only a small difference between reference and INDC. In the 2C scenario the price rises to \$53. This carbon price results in increased emissions reductions over Australia's current target for 2030, but less

⁵⁸ Ibid, p 480

⁵⁹ Jacobs (2016) *Modelling illustrative electricity sector policies*, <http://climatechangeauthority.gov.au/reviews/special-review/modelling-illustrative-electricity-sector-policies>

⁶⁰ Read off graph, from reference in 2020 to policy cases in 2030 and 2050, page 3.

⁶¹ Jacobs (2016) *Modelling illustrative electricity sector policies*, <http://climatechangeauthority.gov.au/reviews/special-review/modelling-illustrative-electricity-sector-policies>, p 6-7.

⁶² Vandyck et al. (2016) *A global stocktake of the Paris pledges: Implications for energy systems and economy*

emissions reduction than in other countries. This suggests Australia requires higher carbon prices. Notwithstanding, the model shows that higher carbon prices and bigger emissions cuts have little economic impact.

UTS ISF (2016) 100% Renewable Energy

The University of Technology Sydney (UTS) *Institute for Sustainable Futures* modelled an Australian energy system reaching 100% renewable energy by 2030.⁶³ This results in an emission reduction of 45% by 2030 on 2005 levels. GDP growth is fixed in the model. The model finds 100% renewables in the electricity sector results in cumulative savings on fuel costs over coming decades, starting between 2025 to 2040 (depending on fuel price sensitivities). The Advanced Renewables scenario goes further, reaching 41% renewables in transport and 50% in industry by 2030, and 100% renewables in all sectors by 2050, resulting in net savings from avoided fuel costs over the half century.

EY & KGM (2016) Renewable Energy Jobs

EY and KGM and Associates modelled the net increase in jobs economy wide from a 50% renewable energy target by 2030, including the loss of jobs in existing generation.⁶⁴ The report considers upstream demand from other sectors for operation and new installation of both existing fossil and new renewable energy. The BAU case has 34% renewables by 2030. In the 50% renewables case, jobs are 46% higher.⁶⁵

NIEIR (2016) Jobs in a clean energy future

The National Institute of Economic and Industry Research (NIEIR) modelled GDP and jobs under economy wide emissions constraints of around 54% and around 70% reduction by 2030 on 2005 (and further reductions in both scenarios to 2050).⁶⁶ The model found GDP increased six percent and jobs increased 8 per cent by 2030 under

⁶³ UTS: Institute for Sustainable Futures (2016) *100% Renewable Energy For Australia: Decarbonising Australia's Energy Sector Within One Generation*, commissioned by GetUp! And Solar Citizens https://www.uts.edu.au/sites/default/files/article/downloads/ISF_100%25_Australian_Renewable_Energy_Report.pdf

⁶⁴ EY and KGM and Associates (2016) *The Renewable Energy: Future Jobs and Growth*, commissioned by the Climate Council and EY Foundation <https://www.climatecouncil.org.au/resources/renewablesreport/>

⁶⁵ Ibid, p 16.

⁶⁶ National Institute of Economic and Industry Research (NIEIR) (2016) *Jobs in a clean energy future*, commissioned by ACF and ACTU https://d3n8a8pro7vhmx.cloudfront.net/auscon/pages/1435/attachments/original/1477355385/ACF_Jobs_in_a_clean_energy_future.Web.pdf

the medium scenario, compared with BAU. In the strong scenario GDP increased round 9 percent and jobs 13 percent, compared with BAU.⁶⁷

VU COPS (2016) Simulations of policies for the Australian electricity sector - for CCA

As part of its 2016 Special Review, the Climate Change Authority commissioned Victoria University's Centre of Policy Studies (VU COPS) to model the economy wide impacts of different climate policies for the electricity sector. The emissions scenarios involved substantial cuts, consistent with a 2C budget. The modelling did not compare the policy scenarios with a reference, but with each other. At any rate, in the central carbon pricing scenario the modelling found strong ongoing GDP growth of 2.8% per year to 2050.⁶⁸

UNSW CEEM (2016) 100% Renewables in Australia: A Research Summary

The UNSW Centre for Energy and Environmental Markets (CEEM) researchers examine existing literature on a 100% renewable energy system for Australia, drawing in particular on work at UNSW, USYD, AEMO and Beyond Zero Emissions.⁶⁹ Among these reports they find a range wholesale prices mostly between \$100-140/MWh for 100% renewable, totally firm energy systems. Based on AEMO projections they say retail customer bills would need to increase by 20-30%. This is comparable to price increases that have occurred since this report was published, in part due to lack of policy. The authors provide a range of policies that would help keep costs low, including reducing uncertainty to lower cost of capital for upfront renewables costs. They also recommend higher wind shares than widely considered at the time; subsequent cost falls for solar PV make this less important.

⁶⁷ Ibid, p 20.

⁶⁸ VU COPS (2016) *Simulations of the effects of greenhouse gas mitigation policies for the Australian electricity sector, for CCA*
<http://climatechangeauthority.gov.au/sites/prod.climatechangeauthority.gov.au/files/files/SR%20Modelling%20reports/Victoria%20University%20CGE%20modelling%20report.pdf> pii.

⁶⁹ Centre for Energy and Environmental Markets (2016) *100% Renewables in Australia: A Research Summary* <http://ceem.unsw.edu.au/sites/default/files/documents/100pc%20RE%20-%20Research%20Summary-2016-03-02a.pdf>

Lenzen et al. (2016) *Simulating low-carbon electricity supply for Australia*

USYD researchers use an optimisation model to examine the cost of a 100% renewable energy system, including requirements for transmission and firming energy (flexible and synchronous).⁷⁰ They find a 100% renewable energy system – both generation and transmission – would cost 20c/kWh or \$200/MWh. This is a 20% increase on 2018 residential costs, and less if net of green schemes.⁷¹ Crucially, the calculation assumes technology costs at the time, with no reduction in cost over time, and assumes no demand response to avoid expensive peaks or efficiency to reduce overall demand. These assumptions make the calculation highly conservative.

ANU: Jotzo and Kemp (2015) *Australia can cut emissions deeply and the cost is low*

In a detailed submission to the Commonwealth Government's post-2020 target review, ANU researchers synthesise a range of economic research, including models of high emissions reductions in Australia specifically.⁷² They analyse four economy-wide studies, including two from Treasury, showing deep emissions reductions are consistent with continued strong GDP growth, with very small impacts on growth rates resulting in all cases resulting in an economy around two and half times bigger in 2050.

The authors note that the projected cost of Australian emissions reductions continues to fall over subsequent studies. They also highlight evidence for net benefits from abatement typically excluded from models, including health benefits and GDP increases from enhanced energy productivity.

McKibbin (2015) *Economic Modelling of Australian Action - for DFAT*

ANU economist Warwick McKibbin was commissioned by DFAT to model the economic

⁷⁰ Lenzen et al (2016) *Simulating low-carbon electricity supply for Australia*
https://www.researchgate.net/publication/305830248_Simulating_low-carbon_electricity_supply_for_Australia

⁷¹ AEMC (2018) *National household electricity prices* <https://www.datocms-assets.com/6959/1545264238-2018-price-trends-combined-information-sheets.PDF> page 2

⁷² Jotzo and Kemp at ANU (2015) *Australia can cut emissions deeply and the cost is low*
https://ccep.crawford.anu.edu.au/files/uploads/ccep_crawford_anu_edu_au/2015-05/australia_can_cut_emissions_and_the_cost_is_low-_jotzo_and_kemp_april_2015_-_submission_to_dpmmc.pdf

cost of different emissions reduction targets. McKibbin first modelled impacts on Australia from action in other countries, then the cost of different Australian emissions reduction targets. He looked exclusively at energy, including power, transport and industry. The analysis “assumes relatively high abatement costs in the energy sector”.⁷³ With lower technology costs, 26% emissions reduction cost 0.4% of GDP in 2030, while 45% reduction cost 0.7% of GDP in 2030 – a difference of 0.3% points of GDP in 2030.

Climate Works and ANU (2014) *Pathways To Deep Decarbonisation*

As part of the global Deep Decarbonisation Pathways Project, Climate Works and ANU modelled rapid economy-wide emissions reductions in Australia. The decarbonisation scenario results emissions cuts of 53% by 2030 on 2005 levels, economy wide, and net zero emissions in 2050. The modelling found a BAU rate of GDP growth of 2.6% per year from 2020 to 2030. In the deep decarbonisation scenario, GDP grows by 2.46% per year from 2020 to 2030. The pathway involves a 143% increase in electricity demand as currently fossil based energy is transferred to renewable energy. It also involves biofuels, biocoke and green hydrogen.

CCA (2014) *Targets and Progress Review*

The Climate Change Authority (CCA) reviewed Australia’s 2020 and 2030 targets, including economic analysis of increased 2020 targets.⁷⁴ It found Australia’s economy (GNI per person) would grow on average by 0.8% per year under a 5% emissions reduction target (the current target). Under a 15% target this would fall by just 0.02% to 0.78% per year, reaching the same level just three months later.⁷⁵

⁷³ McKibbin (2015) *Report 2: 2015 economic modelling of Australian action under a new global climate change agreement* <https://dfat.gov.au/about-us/publications/Documents/economic-modelling-australian-action-under-new-global-cc-agreement.pdf> page 6

⁷⁴ CCA (2014) *Targets and Progress Review* http://www.climatechangeauthority.gov.au/files/files/Target-Progress-Review/Targets%20and%20Progress%20Review%20Final%20Report_Chapter%2010.pdf

⁷⁵ Ibid, p 127

TREASURY REPORTS 2008-2013

Treasury and DIICSTRE (2013) *Climate Change Mitigation Scenarios*

For the CCA Targets Review, Treasury and the Department responsible for climate change modelled the economic impact of different targets.⁷⁶ As well as presenting analysis of 2020 targets, later presented by CCA (2014), it also modelled scenarios with higher reduction by 2030 on 2000 levels. In all scenarios, annual GDP growth fell from 3% to 2.9%. Different price levels resulted in different levels of international abatement.⁷⁷ The high price scenario sees 45% reductions on 2000 levels by 2030, with about 40% coming from international permits.

Treasury (2011) *Strong growth low pollution*

Following the agreement of the Multi-Party Committee on Climate Change to implement a carbon price and other climate change policies, the Commonwealth Treasury conducted macro-economic modelling of emission reductions.⁷⁸ The modelling looked at Australia's economy given a range of action internationally, then looked at the impact of implementing a carbon price. It focused on a long-term target of 80% reductions by 2050 on 2000, reaching about 40% reduction by 2030. In the core scenario, around half of the abatement occurs through purchasing overseas credits. In the high price scenario more abatement is domestic.

In both scenarios, jobs and economic growth are strong out to 2050. In the base scenarios, without Australian policy, real GDP per person grows by 1.4% per person on average each year out to 2050. In both climate scenarios, real GDP per person grows

⁷⁶ Treasury and DIICSTRE (2013) *Climate Change Mitigation Scenarios*
http://www.climatechangeauthority.gov.au/files/files/Target-Progress-Review/Climate-Change-Mitigation-Scenarios-modelling-report-provided-to-the-Climate-Change-Authority-in-support-of-its-Caps-and-Target-review/Climate_Change_Mitigation_Scenarios.pdf

⁷⁷ Ibid, 76.

NB: While the indicators table says the reduction is 80% below 2000 levels, actual emissions in 2030 are 45% below 2000 levels.

⁷⁸ Treasury (2011) *Strong growth low pollution: modelling a carbon price*
<http://carbonpricemodelling.treasury.gov.au/content/report.asp>

by 1.3% per person on average each year out to 2050.⁷⁹ As Treasury says, “the economy continues to prosper while emissions are reduced.”⁸⁰

Treasury (2008) *Australia's Low Pollution Future*

As part of policy development for the Carbon Pollution Reduction Scheme, Treasury conducted macro-modelling of carbon prices and emissions reductions. It looked at different reductions to 2020 and to 2050. Moderate scenarios had 5%-15% reductions in 2020 by 2000 levels, with 60%-80% reductions by 2050. The ambitious scenario had reductions of 25% by 2020 and 90% by 2050. In the reference case, average annual GDP growth rate was 2.4% per year out to 2050. Moderate policy had average annual GDP growth of 2.3%. The strong policy had average annual GDP growth of 2.2%. The difference was so small that in all cases real GDP nearly tripled by 2050.⁸¹

OTHER REPORTS

Brookings Institute (2019) *Global economic and environmental outcomes of the Paris Agreement*

Researchers at the Brookings Institute, lead by Weifen Liu and Warwick McKibbin from the ANU, modelled the economic costs and benefits for different countries of implementing pledges under the Paris Agreement.⁸² The report notes that current pledges are not sufficient to meet the goal of the Paris Agreement, but does not model such a scenario. Rather it looks at the impacts on different countries from their own policies and from policies implemented in other countries. When considering the major health and climate benefits of reducing pollution, it finds it is in the self-interest of the Australia, the US, China and most major emitters to implement their Paris pledges. For Australia, the modelling finds the main impact on the Australian economy is from actions in other countries.

⁷⁹ Ibid, p 11

⁸⁰ Ibid, p iii

⁸¹ Treasury (2008) *Australia's Low Pollution Future: The Economics of Climate Change Mitigation* <http://lowpollutionfuture.treasury.gov.au>, p 145-7

⁸² Liu, McKibbin, Morris, Wilcoxon, (2019) *Global Economic and Environmental Outcomes of the Paris Agreement* <https://www.brookings.edu/research/global-economic-and-environmental-outcomes-of-the-paris-agreement/>

Parry et al (2018) *Mitigation Policies for the Paris Agreement* - for the IMF

For the IMF, Parry et al examine the costs and health benefits for G20 countries of implementing a low and rising carbon price, starting at US\$5 in 2017 and reaching US\$70 in 2030.⁸³ They find the impacts are modest and largely offset by the benefits. For Australia, there was trivial net impact on Australia, less than 0.2% in 2030. The benefits include a 20% reduction in air pollution deaths, below BAU. The report also finds a US\$70 per tonne carbon price would not fulfil Australia's emissions reduction target. This seems unlikely, given the range opportunities for low cost abatement, in particular in electricity. The report's conclusion is nonetheless instructive: such a price has negligible impact on Australia's economy.

Bain and Company (2016) *Australia's Options for Emissions Abatement*

Bain and Company were commissioned by the Business Council of Australia to assess abatement opportunities, as part of the BCA's submission to the ALP consultation into setting a new emissions reduction target. The report outlines abatement opportunities in different sectors towards 26% reductions on 2005 levels by 2030 towards 80% by 2050.

Contrary to the BCA's current position, Bain and Company urges a greater than pro-rata emissions reduction in electricity.⁸⁴ They find coal phased out by 2035 and replaced directly with renewables gives the most abatement at average wholesale cost of around \$67/MWh.⁸⁵ Note this is lower than recent spot prices. Moreover, the analysis assumes new coal is cheaper than new renewables, which the BCA itself acknowledged was no longer correct in the following year. Bain and Company also highlight economic benefits from vehicle fuel efficiency standards in line with the EU, with potential to save up \$7.7bn per year.

Bain and Company find the options they look at could nearly meet the 26% 2030 target. They also say "Australia can achieve the large majority of an ambitious target of

⁸³ Parry et al (2018) *Mitigation Policies for the Paris Agreement*,
<https://www.imf.org/en/Publications/WP/Issues/2018/08/30/Mitigation-Policies-for-the-Paris-Agreement-An-Assessment-for-G20-Countries-46179>

⁸⁴ Bain and Company (2016) *Australia's Options for Emissions Abatement*
<http://legacy.bca.com.au/publications/submission-on-the-australia-labor-party-consultation-on-an-emissions-reduction-target>

⁸⁵ Ibid, 9

10 Gt in cumulative reductions [ie. 80% reduction] domestically.”⁸⁶

⁸⁶ Ibid, 17