From: [redacted]
To: [redacted]
Cc: Tim Roy; [redacted]
Subject: LABOR'S ECONOMY WRECKING TARGETS
Date: Wednesday, 20 February 2019 11:21:33 PM
Attachments: 190221 - Brian Fisher - Climate Op Ed.pdf
190221 - Taylor - Background - Economic Impacts of Emissions Targets.pdf
^N^N Draft for webpage - 15 Feb 19.pdf

Hi team

Apologies for the late update – as you may have already seen their is an emissions splash in The Australian.

Find below our TPs and draft MR which will go out tomorrow morning.

I have also attached Dr Brian Fisher from BA Economics' opinion piece, the most recent brief on the modelling (I understand an updated version will go online first thing tomorrow morning), and a background doc.

Background:
This modelling is independent modelling by respected economic consultancy BA Economics. Dr Brian Fisher is one of Australia's most respected advisers on climate change and the economic impact of current and future climate and energy policies.

The modelling shows the comparison of 26-28% emissions reduction target to 45% emissions reduction target. Impact per policy below:

Coalition (27% target):
Reduction in real GDP, 2030: $19bn (-0.1% on growth rate)
Cumulative GDP losses: $69bn
Reduction in real wages: ~$2,000
Reduction in FTE, 2030: 78,000 jobs
Wholesale electricity prices: Increase 14%

Labor (45% target):
Reduction in real GDP, 2030: $144bn (-0.6% on growth rate)
Cumulative GDP losses: $472bn
Reduction in real wages: ~$9,000
Reduction in FTE, 2030: 336,000 jobs
Wholesale electricity prices: Increase 58%

TALKING POINTS: LABOR'S ECONOMY WRECKING TARGETS

- This just confirms Labor's reckless emissions reductions targets will be a wrecking-ball through the Australian economy.
- Labor's targets will
  - Cost the economy $472 billion,
  - Slash more than 336,000 jobs,
  - Cut the average wage by over $9,000, and

    - Increase wholesale electricity prices by more than 58%.
- This is further proof that under a Bill Shorten Labor government Australians will be worse off.
- Bill Shorten has never come clean with Australians about the true cost of Labor's targets on the economy. Now we know why.
- Now Bill Shorten needs to come clean. Which industries will he close first? Will it be agriculture or aluminium, mining or manufacturing? Which jobs will he export overseas first?
- Labor's reckless targets will punish Australian families already struggling with cost of living pressures, destroy our international competitiveness, while doing nothing for global emissions.
- We have a sensible and balanced plan for meeting our emission reduction commitments.
- Only the Coalition can be trusted to keep our economy strong, our power prices down, and the lights on.

[redacted]
- [redacted]
- [redacted]

[redacted]
- [redacted]

[redacted]
- [redacted]
- [redacted]
- [redacted]
- [redacted]

[redacted]
- [redacted].

I'll upload TPs to the google doc (feel free to amend) – but if you have a Minister who is out early and has a question, don't hesitate to get them to give me a call.

Cheers, [redacted]

THE HON ANGUS TAYLOR MP

MINISTER FOR ENERGY

MEDIA RELEASE

Thursday, 21 February 2019

THE DEVASTATING COST OF LABOR'S RECKLESS TARGETS

Modelling released today has confirmed that Labor's reckless emissions reductions targets will be a wrecking-ball through the Australian economy.

The work, released by BAEconomics's Managing Director Brian Fischer, shows that under Labor's 45% Emissions Reduction Target and 50% Renewable Energy Target, it will:

- cost the economy $472 billion,
- slash more than 336,000 jobs,
- cut the average wage by over $9,000, and
- increase wholesale electricity prices by more than 58%.

This is further proof that under a Bill Shorten Labor government, Australians will be poorer. Bill Shorten says Australians deserve a pay rise. Instead, he is promising them a massive pay cut.

Under Labor, Australians will pay more. We will pay more for basic necessities like food, housing, energy and transport.

And Australians **will find it harder to find a job under a Shorten Labor Government** to pay for the essentials.

Under Labor, global emissions will go up. Labor's targets will send energy-intensive industries offshore, where they will face less stringent environmental and safety regulations.

Bill Shorten has never come clean with Australians about the true damage of Labor's targets on household budgets, small businesses, wages, industries and local economies. Now we know why.

Bill Shorten needs to come clean.

Which industries will he close first? Will it be agriculture or aluminium, mining or manufacturing? Which jobs will he export overseas first?

Labor's reckless targets will punish Australian families already struggling with cost of living pressures, destroy our international competitiveness, while doing nothing for global emissions.

Only the Morrison Government has a sensible and balanced plan for meeting our emission reduction commitments. Only the Coalition can be trusted to keep our economy strong, our power prices down, and the lights on.

ENDS

Energy Minister's office: [redacted]

There is a real cost to reducing our emissions

Brian Fisher

As both a farmer and an economist I pay close attention to both the weather and how much things cost.

Like thousands of other farmers in Australia's south-east, I'm having to handfeed livestock because of the continuing drought and to this day I still wonder about what is happening with our climate.

I perhaps give it more thought than many having also been involved in climate policy research since 1992 and I still get frustrated about how deficient and even outright dishonest the climate debate continues to be.

For example, at the headline level there are two common propositions – the first being that Australia alone can positively influence the climate and second there is little to no economic cost for us in achieving significant greenhouse gas emissions reductions.

Both are simply untrue.

In 2012, the most recent year that a full inventory of all greenhouse gases is available, Australia's share of global emissions was just 1.15 per cent, so there is nothing we can do alone that will have a material impact on the global climate let alone save icons such as the Great Barrier Reef from climate change.

What of course is required is meaningful global cooperation under the Paris Agreement but even then, we are reliant on all countries doing their bit and to date, as with many other UN treaties, there is a wide gulf between laudable aims and what is delivered.

As for the second proposition, regardless of the approach Australia adopts to reduce emissions there is an inevitable cost to our economy as more emissions intensive activities make way for less intensive industries. In many cases adjustments are technically difficult and therefore expensive.

For example, at present it is simply not practical to control methane emissions from livestock grazed on native pasture, the source of a significant share of agricultural emissions. As a result, the marginal cost of abatement is very high with the implied impost on industry significant.

In other cases making emissions reductions is cheaper. Incentivised activities such as those supported under the government's $2.5 billion Emissions Reduction Fund (ERF), show that up to a limited point, emissions reductions can be achieved for around $A13-14/tCO2 abated in the example of returning carbon to the soil.

However, to reduce our emissions by say 35 per cent by 2030 – compared to benchmark 2005 levels – would far and away exceed anything achieved under the ERF to date and we could expect the cost of abatement to climb steeply as the economy adjusts.

To provide an insight into the economic impact of emissions abatement out to 2030 in light of the Paris Agreement, BAEconomics has modelled two possible policy positions of the federal government and opposition respectively.

The first being the Paris target of a 26-28 per cent reduction with the second being a more ambitious reduction target of 45 per cent with a renewables target of 50 per cent.

The modelling chooses the least cost way of meeting the specified abatement targets.

Inescapable, is that both policy scenarios will result in economic cost in terms of reduced GDP growth as the economy is forced away from its current trajectory. This will in turn affect employment and real wages, with regional economies dependent on the production and export of fossil fuels exposed to more severe adjustment pressure compared to more diversified urban economies.

As you might expect, achieving the lesser target is not as disruptive but it still comes at a price. For instance, in terms of GDP the economy would be around $A19 billion smaller in 2030, with cumulative losses over the decade of around $A69 billion. This is equivalent to growth rate of 2.8 per cent a year compared to 2.9 per cent under the base case.

In 2030 the first scenario would also see around 78,000 less full-time equivalent jobs in the economy and a full-time wage of around $A104,600 per year compared to $A106,400 in the base case, a reduction of two per cent in real wages. Under this option, Australia's share of renewables would reach around 36 per cent and the wholesale electricity price would be $93/MWh compared to $81/MWh in 2030.

To achieve the more stringent 45 per cent target with 50 per cent renewables, would see the Australian economy $A144 billion smaller in 2030 with cumulative losses over the decade of $A471 billion with an average annual growth rate of 2.3 per cent compared to 2.9 per cent.

Under the base case, the Australian economy would support around 14 million full-time equivalent jobs in 2030 but there would be around 336,000 fewer jobs by meeting the 45 per cent emission reduction target. The full-time wage would also be around $A97,400 – a reduction of eight per cent. In meeting the combined 50 per cent renewables target and the emissions target the wholesale electricity price would be around $128/MWh.

At the end of the day, the political process will determine the emissions reduction road that Australia takes, but in the meantime, we need to inject some honesty into the debate about the true cost of achieving our targets.

Dr Brian Fisher is Managing Director of BAEconomics Pty Ltd. Dr Fisher has been involved in climate policy research since 1992 and has participated as a lead or convening lead author in three IPCC climate assessments. Details of his research papers on climate policy can be found at www.baeconomics.com.au.

So many targets – what do they mean?

- Under the 2015 Paris Agreement, the Liberal National Government has committed to reducing emissions by 26-28% on 2005 levels by 2030.
- The Government has also committed to a 23.5% Renewable Energy Target (RET) by 2020. According to the independent Clean Energy Regulator, this target will be met before 2020.
- In 2015, the Labor Opposition committed to a 45% reduction in emissions on 2005 levels by 2030, and a 50% RET by 2030. This remains the policy of the Federal Labor Party.

Australia's progress in reducing emissions

- Each year, the Department of Environment and Energy releases a report on Australia's emissions projections. The assumptions used in the report are conservative. The report tracks Australia's progress towards our Kyoto II (2020) emissions reduction target and our Paris (2030) target.
- The most recent report (December 2018) shows that:
  - Australia will overachieve on its 2020 target by 367 million tonnes of carbon dioxide equivalent (Mt CO2-e), including 'carryover' of 128 Mt CO2-e from the overachievement against our 2013 (Kyoto I) target.
  - The 2030 abatement task – the reduction in emissions required over the decade to meet our 2030 target – has reduced by over 90% since the 2008 projections.
  - The 2030 abatement task has fallen from 3,394 Mt CO2-e in 2008 to just 328 Mt CO2-e (including carryover).
- It is expected that the gap of 328 Mt CO2-e will be made up by continued renewable energy build, improvements in energy efficiency, and new policy measures to be announced by the Government before the 2019 Federal Election.

What about carryover?

The Government has committed to using Kyoto carryover (or overachievement) to help meet our 2030 target. Use of carryover reduces the burden on the economy required to reach the 2030 target. The Labor Opposition has not committed to whether it will use carryover to help reach its 45% target. The Greens strongly oppose the use of carryover, and it is thought that many of the independents hold a similar position.

Modelling announced 21 February 2019

Independent modelling by respected economic consultancy BAEconomics has compared the impact of a 27% emissions reduction target (the average of a 26-28% target) to a 45% emissions reduction target *together with* a 50% RET. Both scenarios *include* carryover. The modelling assumes Labor will ultimately use carryover, as the impacts of not doing so are disproportionately high. The reference scenario is based on *Australia's emissions projections 2018* and assumes no new policies.

Under either policy scenario, the economy must adapt as more emissions intensive activities make way for industries that are less emissions intensive. In some cases adjustment is technically difficult and therefore expensive – this in turn impacts employment and real wages. Initial results are:

	27% target	**45%/50% targets**
Reduction in real GDP, 2030	$19bn (-0.1% impact on growth rate)	$144bn (-0.6% impact on growth rate
Cumulative GDP losses	$69bn	$472bn
Reduction in real wages	~$2,000	~$9,000
Reduction in FTE, 2030	78,000 jobs	336,000 jobs
Wholesale electricity prices	Increase 14%	Increase 58%

Economic consequences of alternative Australian climate policy approaches

Australian climate policy is at a cross-roads. With a Federal election expected in May 2019, it is timely to assess the economic impacts of the alternative domestic policy approaches proposed by the two major political parties. While the Coalition government seeks to meet its Paris Agreement commitment of 26-28 per cent emissions reduction by 2030 (relative to 2005), the Labor opposition has announced a higher target of 45 per cent emissions reduction over the same time frame, with the aim of reaching net zero emissions by mid-century.

BAEconomics has examined the economic impacts of adopting different domestic climate policies using the BAEGEM Computable General Equilibrium (CGE) Model. BAEGEM is a recursively dynamic CGE model of the world economy. For each one-year time step, BAEGEM simulates the inter-relationships between production, consumption, economic growth, flows of international trade and investments, constraints on natural resources and production factors, and greenhouse gas emissions (Mi and Fisher 2014). The world regions and production sectors covered in the current model disaggregation are presented in Table 1 and some key model assumptions are set out in Table 2.

Table 1: Regions and sectors in BAEGEM

	Regions		Sectors
1	United States	1	Crops
2	Canada	2	Livestock
3	Mexico	3	Forestry
4	EU27	4	Fishing
5	Russia	5	Thermal Coal
6	Rest of Europe	6	Metallurgical Coal
7	China	7	Oil and Gas
8	India	8	Oil refinery
9	Japan	9	Iron ore
10	Korea	10	Other mining
11	Australia	11	Food processing
12	Rest of Asia	12	Chemicals, rubber and plastics
13	Brazil	13	Manufacture of non-metallic mining products
14	Rest of Latin America	14	Other manufacturing
15	Middle East	15	Iron and Steel
16	North Africa	16	Non-Ferrous Metal
17	South Africa	17	Electricity
18	Rest of Africa	18	Construction
		19	Land Transport
		20	Air and water Transport
		21	Services

Table 2: Overview of BAEGEM

Distinguishing Feature	BAEGEM
Solution Concept	Market equilibrium driven by supply and demand
Expectations/Foresight	Recursive dynamics
Representation of end-use sectors	There is one representative household and one government for each economy
Investment dynamics	Investment is driven by long-term GDP growth rates and investment return differentials between economies
Labour market flexibility	Not fully flexible, lower GDP growth rate will a trigger higher unemployment rate and a fall in real wages
Link between energy system and macro-economy	GDP sets the scale of economic activity in the model, which in turn drives the demand for each commodity in each segment of the world economy
Greenhouse gases covered	CO_2, CH_4, N_2O, HFCs, PFCs and SF_6
Emission sectors covered	Energy, Transport, Fugitives, Industry, Agriculture, Waste, LULUCF
Electricity production	Substitution allowed between Coal, Gas, Oil, Hydro, Nuclear, Wind, Solar, Biomass and Other Renewables
Technological Change/Learning	Learning-by-doing gradually reduces the average production costs of renewable technologies (except hydro), compared with conventional electricity technologies over the reference case
Integration costs	Increased investment in intermittent renewable electricity technologies incurs additional capital efficiency integration costs to firm generation from these sources. Firming costs are based on estimates in Lovegrove et al. (2018).
Thermal efficiency improvement for fossil fuel electricity generation	0.5 per cent per year over the reference case
Energy consumption	Substitution allowed between coal, gas, liquid fuel and electricity
Fuel consumption in transportation	Substitution allowed between coal, oil, gas, biofuel and electricity
Autonomous fuel efficiency improvement for transportation	2.5 per cent per year over the reference case
Autonomous energy efficiency in other sectors	0.5 per cent for developed economies, 1 per cent for developing economies over the reference case
Implementation of climate policy targets	Carbon prices, cap-and-trade, indirect taxes, regulatory targets, and combinations of the above

In our modelling we have analysed a range of policy scenarios using as a starting point the Australian Government's emissions projections released in December 2018 (Department of Environment and Energy 2018). One of the key features of the Department of Environment and Energy's most recent projections is their estimate of the extent to which Australia is likely to over-achieve on its Kyoto Protocol emissions reduction target. We have assumed that the Kyoto carryover will be utilised to help meet future targets under the Paris Agreement.

In the first instance we have modelled two alternative policy commitments. The first policy scenario is one in which a Paris target of a 26-28 per cent reduction in emissions is achieved by 2030 compared to the base year of 2005, allowing the Kyoto carryover to be utilised. In this scenario renewable energy generators contribute 36 per cent of Australia's electricity by 2030. In the second policy scenario Australia undertakes a 45 per cent reduction in greenhouse gas emissions compared to the 2005 base year, again allowing for the use of the Kyoto carryover and in addition a 50 per cent renewables target is imposed on the electricity sector.

Under either policy scenario the Australian economy must adjust as more emissions intensive activities make way for industries that are less greenhouse gas emissions intensive. In some cases such adjustments are technically difficult and therefore expensive. For example, at present it is not practical to control the methane emissions from livestock grazed on native pasture land and as a consequence the marginal cost of abatement is very high for that activity. In other activities the projects approved under the Coalition Government's Emissions Reduction Fund show that, up to a certain point, emission reductions can be achieved by, for example, terrestrial sequestration of carbon, for around \$A13-14/tCO_2e abated. The modelling chooses the least cost way of meeting the specified abatement targets subject to the constraints on renewable energy generation in the electricity sector. All policy options will result in some cost in terms of output foregone (GDP) because the economy is being forced to adjust away from the trajectory it is on. This adjustment will in turn affect employment and real wages.

Meeting a 26-28 per cent reduction target is projected to mean that by 2030 the Australian economy would be around \$A19b smaller in terms of GDP than it otherwise would have been.[1] This is equivalent to saying that the economy grew at a rate of 2.8 per cent per year over the decade to 2030 compared to a rate of 2.9 per cent a year.

To achieve a 45 per cent target is much more costly in terms of projected output change. Expressed in terms of the impact in 2030 of the more stringent target the economy is projected to be \$A144b smaller than it otherwise would have been in terms of loss in GDP. This is equivalent to the economy growing at around 2.3 per cent per year over the decade to 2030 compared to a rate of 2.9 per cent.

Cumulative GDP losses (discounted to net present value terms using an assumed social discount rate of 2.6 per cent) are estimated to be A\$69 billion and A\$472 billion over the decade to 2030 depending on whether less or more stringent abatement targets are adopted.

In BAEGEM the labour market is not fully flexible with some adjustment taken up by a change in employment but with the major share of adjustment accounted for by changes in the real wage rate. In other words, a negative shock to output will result both in some loss of jobs and a reduction in real wages. With a 26-28 per cent emissions reduction target average real yearly income for a full-time worker is projected to be around \$A2000 lower than it otherwise would have been in 2030. With a 45 per cent reduction target the projected fall in real annual wages is around \$9000

[1] Unless otherwise stated all results are presented in real \$A 2016.

per year by 2030, illustrating the extent of the economic adjustment required by the economy to reach the more stringent target.

This analysis is part of an ongoing research project being undertaken by BAEconomics. Further results from this work will be released as they become available.

References

Department of Environment and Energy (2018). *Australia's emissions projections 2018*, Commonwealth of Australia, http://www.environment.gov.au/system/files/resources/128ae060-ac07-4874-857e-dced2ca22347/files/australias-emissions-projections-2018.pdf.

Mi, R. and Fisher, B. S. (2014), *Model Documentation: BAEGEM the BAEconomics Computable General Equilibrium Model of the World Economy*, http://www.baeconomics.com.au/wp-content/uploads/2014/02/BAEGEM-229 documentation-21Feb14.pdf).

From: [redacted]
To: [redacted]
Subject: Climate Op Ed (final).pdf
Date: Wednesday, 20 February 2019 6:42:56 PM
Attachments: Climate Op Ed (final).pdf
ATT00001.txt

There is a real cost to reducing our emissions

Brian Fisher

As both a farmer and an economist I pay close attention to both the weather and how much things cost.

Like thousands of other farmers in Australia's south-east, I'm having to handfeed livestock because of the continuing drought and to this day I still wonder about what is happening with our climate.

I perhaps give it more thought than many having also been involved in climate policy research since 1992 and I still get frustrated about how deficient and even outright dishonest the climate debate continues to be.

For example, at the headline level there are two common propositions – the first being that Australia alone can positively influence the climate and second there is little to no economic cost for us in achieving significant greenhouse gas emissions reductions.

Both are simply untrue.

In 2012, the most recent year that a full inventory of all greenhouse gases is available, Australia's share of global emissions was just 1.15 per cent, so there is nothing we can do alone that will have a material impact on the global climate let alone save icons such as the Great Barrier Reef from climate change.

What of course is required is meaningful global cooperation under the Paris Agreement but even then, we are reliant on all countries doing their bit and to date, as with many other UN treaties, there is a wide gulf between laudable aims and what is delivered.

As for the second proposition, regardless of the approach Australia adopts to reduce emissions there is an inevitable cost to our economy as more emissions intensive activities make way for less intensive industries. In many cases adjustments are technically difficult and therefore expensive.

For example, at present it is simply not practical to control methane emissions from livestock grazed on native pasture, the source of a significant share of agricultural emissions. As a result, the marginal cost of abatement is very high with the implied impost on industry significant.

In other cases making emissions reductions is cheaper. Incentivised activities such as those supported under the government's $2.5 billion Emissions Reduction Fund (ERF), show that up to a limited point, emissions reductions can be achieved for around $A13-14/tCO2 abated in the example of returning carbon to the soil.

However, to reduce our emissions by say 35 per cent by 2030 – compared to benchmark 2005 levels – would far and away exceed anything achieved under the ERF to date and we could expect the cost of abatement to climb steeply as the economy adjusts.

To provide an insight into the economic impact of emissions abatement out to 2030 in light of the Paris Agreement, BAEconomics has modelled two possible policy positions of the federal government and opposition respectively.

The first being the Paris target of a 26-28 per cent reduction with the second being a more ambitious reduction target of 45 per cent with a renewables target of 50 per cent.

The modelling chooses the least cost way of meeting the specified abatement targets.

Inescapable, is that both policy scenarios will result in economic cost in terms of reduced GDP growth as the economy is forced away from its current trajectory. This will in turn affect employment and real wages, with regional economies dependent on the production and export of fossil fuels exposed to more severe adjustment pressure compared to more diversified urban economies.

As you might expect, achieving the lesser target is not as disruptive but it still comes at a price. For instance, in terms of GDP the economy would be around $A19 billion smaller in 2030, with cumulative losses over the decade of around $A69 billion. This is equivalent to growth rate of 2.8 per cent a year compared to 2.9 per cent under the base case.

In 2030 the first scenario would also see around 78,000 less full-time equivalent jobs in the economy and a full-time wage of around $A104,600 per year compared to $A106,400 in the base case, a reduction of two per cent in real wages. Under this option, Australia's share of renewables would reach around 36 per cent and the wholesale electricity price would be $93/MWh compared to $81/MWh in 2030.

To achieve the more stringent 45 per cent target with 50 per cent renewables, would see the Australian economy $A144 billion smaller in 2030 with cumulative losses over the decade of $A471 billion with an average annual growth rate of 2.3 per cent compared to 2.9 per cent.

Under the base case, the Australian economy would support around 14 million full-time equivalent jobs in 2030 but there would be around 336,000 fewer jobs by meeting the 45 per cent emission reduction target. The full-time wage would also be around $A97,400 – a reduction of eight per cent. In meeting the combined 50 per cent renewables target and the emissions target the wholesale electricity price would be around $128/MWh.

At the end of the day, the political process will determine the emissions reduction road that Australia takes, but in the meantime, we need to inject some honesty into the debate about the true cost of achieving our targets.

Dr Brian Fisher is Managing Director of BAEconomics Pty Ltd. Dr Fisher has been involved in climate policy research since 1992 and has participated as a lead or convening lead author in three IPCC climate assessments. Details of his research papers on climate policy can be found at www.baeconomics.com.au.

From: [redacted]
To: [redacted]
Cc: [redacted]; Tim Roy; [redacted]
Subject: RE: Draft MR and TPs [SEC=UNCLASSIFIED]
Date: Wednesday, 20 February 2019 3:26:00 PM

Thanks [redacted].

[redacted] – we should also mention regional communities in this – they will be disproportionality impacted.

If asked: BA Economics

- This modelling is independent modelling by respected economic consultancy BA Economics.
- Dr Brian Fisher is one of Australia's most respected advisers on climate change and the economic impact of current and future climate and energy policies.
- [more detail to come from Brian on why his model is superior]

From: [redacted]
Sent: Wednesday, 20 February 2019 12:50 PM
To: [redacted]
Cc: [redacted] Tim Roy
[redacted]
Subject: RE: Draft MR and TPs [SEC=UNCLASSIFIED]

Hi [redacted],

As discussed, some minor suggestions below in red.

I suggest we also have some TPs on the credibility of the modelling – I just don't know enough about BAE.

[redacted]

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Talking points

- Modelling released today confirms what we and others already know: that Labor's reckless targets will be a "wrecking-ball" through the economy.
- Modelling by BA Economics shows that by 2030 Labor's 45% Emissions Reduction Target and 50% Renewable Energy Target will:
  - Cost the economy over $500 billion [2016$ 502.16bn]
  - Cost over 336,000 full-time jobs [336,166]

- Cut the average wage by over $9,000 [$9,036]
  - Increase wholesale electricity prices by 58%
- Labor's reckless targets will require a new carbon tax many times (do we know how many?) greater than their first carbon tax.
- We all remember the impact Labor's first carbon tax had on the economy.
- Bill Shorten needs to come clean on the true cost of his big, new Carbon Tax 2.0.
- What this modelling shows is that if Labor proceeds with its 45% target, Bill Shorten needs to choose which jobs and which communities he will destroy.
- Which local Australian industries will Bill Shorten choose to shut?
- Which Australian workers will Bill Shorten choose to be laid-off?
- Which jobs will Bill Shorten send offshore?
- Which local communities will Bill Shorten pick to fold?

[redacted]

- [redacted]
- [redacted]
- [redacted]

[redacted]

- [redacted]
- [redacted]
- [redacted]

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From: [redacted]
Sent: Wednesday, 20 February 2019 12:47 PM
To: [redacted]
Cc: [redacted] Tim Roy
[redacted]
Subject: RE: Draft MR and TPs [SEC=UNCLASSIFIED]

Thanks – what does the modelling in layman's say about the 26 per cent target?

If asked: given your target will also have an impact, why don't you just walk away from the

Paris Treaty?

- As the PM said: "We agreed on 26 per cent. It was an achievable target…we're going to meet the commitment we said we'd meet and that's what I think Australians expect us to do – to live up to our commitments." Alan Jones, 28 November 2018

From: [redacted]
Sent: Wednesday, 20 February 2019 12:36 PM
To: [redacted]
Cc: [redacted] Tim Roy
[redacted]
Subject: Draft MR and TPs [SEC=UNCLASSIFIED]

[redacted] et al

Rough first cut of TPs below.

[redacted]

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Talking points

- Modelling released today confirms what we and others already know: that Labor's reckless targets will be a "wrecking-ball" through the economy.
- Modelling by BA Economics shows that by 2030 Labor's 45% Emissions Reduction Target and 50% Renewable Energy Target will:
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    - Cut the average wage by over $9,000 [$9,036]
    - Increase wholesale electricity prices by 58%
- Labor's reckless targets will require a new carbon tax many times greater than their first carbon tax.
- We all remember the impact Labor's first carbon tax had on the economy.
- Bill Shorten needs to come clean on the true cost of his big, new Carbon Tax 2.0. Which industries will he shut? Which jobs will he send offshore?

[redacted]

- [redacted]
- [redacted]
- [redacted]

[redacted]?

[redacted] [redacted]

[redacted] [redacted]

[redacted] [redacted]

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From: [redacted]
To: [redacted]
Subject: Aust climate policy 4Feb19.docx
Date: Wednesday, 20 February 2019 11:00:32 AM
Attachments: ATT00001.txt
Aust climate policy 4Feb19.docx

Economic consequences of alternative Australian climate policy approaches

Author: Brian S. Fisher

Corresponding author: Brian Fisher, bfisher@baeconomics.com.au, GPO Box 5447, Kingston, ACT, 2604, Australia.

Abstract

Australian climate policy is at a cross-roads. With a Federal election expected in May 2019, it is timely to assess the economic impacts of the alternative domestic policy approaches proposed by the two major political parties. While the Coalition government seeks to meet its Paris Agreement commitment of 26-28 per cent emissions reduction by 2030 (relative to 2005), the Labor opposition has announced a higher target of 45 per cent emissions reduction over the same time frame, with the aim of reaching net zero emissions by mid-century.

This paper examines the economic impacts of adopting different domestic climate policies using the BAEGEM Computable General Equilibrium (CGE) Model. Cumulative GNP losses are estimated at between A$80 billion and A$1.2 trillion by 2030 depending on whether less or more stringent abatement targets are adopted and whether policy flexibility is allowed in meeting the targets. Associated reductions in sectoral output, employment and real wages are estimated, and the disproportionate burden of the electricity sector in meeting most targets is demonstrated. Jobs growth is projected to be lower under all policy scenarios with the most serious curtailment in jobs growth under a 45 per cent reduction target. Under the reference scenario real wages are projected to grow at 1.95 per cent over the decade to 2030. Under the policy scenarios growth in real wages falls to around 1.8 per cent in the case of a 27 per cent reduction target and utilising full policy flexibility. Given a 45 per cent reduction target and no policy flexibility in meeting that target real wages are projected to fall over the decade to 2030.

Policy flexibility in meeting emissions abatement targets, such as through partial international permit trading and the possibility of utilising the carryover from Australia's Kyoto 2 commitments are important options in substantially ameliorating the adverse economic effects of emissions abatement policy.

Keywords: Australian climate policy, economic consequences, policy flexibility, permit trading

1. Introduction

Australia outperformed its Kyoto Protocol first commitment target (2008-2012) and is over-achieving toward meeting its 2020 target of reducing greenhouse gas emissions by 5 per cent below 2000 levels, or 13 per cent below 2005 levels. Australia has further committed to reduce emissions by 26-28 per cent below 2005 by 2030 under the Paris Agreement. According to the Department of Environment (2016) this represents a 50-52 per cent reduction in emissions per person and a 64-65 per cent reduction in emissions intensity of the Australian economy between 2005 and 2030. Australia's Intended Nationally Determined Contribution (INDC) target set out in the Paris Agreement is similar in percentage terms to INDC targets announced by the EU, Canada and Japan.

There is considerable public disagreement about the appropriateness of the Paris target for Australia, and this is reflected in the disparate views on climate policy held by the two major political parties.

The Coalition government constructed and negotiated the pledge and therefore believes that Australia's commitment is appropriate and fair in the international context. It has adopted a suite of measures to achieve the Paris target, including a 23 per cent renewable energy target by 2020, and Direct Action which utilises taxpayer funds to reduce greenhouse gas emissions. Direct Action is underpinned by the Emissions Reduction Fund, a $2.55 billion fund used to purchase lowest cost emissions reductions via an auction among project proponents. The Fund is also supported by a safeguard mechanism to ensure businesses keep their emissions below historically determined baselines. Emissions exceeding a baseline must be paid for using emissions credits, which are regulated to ensure compliance.

The Australian Labor Party, currently in Opposition, views the current emissions target as an insufficient contribution by Australia to the global effort to avert dangerous climate change, and has announced that it will implement more stringent climate policy if successful at the next election. Labor has proposed a 45 per cent reduction in emissions by 2030 relative to 2005, and net zero emissions by 2050. It has also announced that it will increase the target for the contribution of renewables to electricity generation to 50 per cent by 2030.

With an Australian Federal election due in the first half of 2019, it is timely to re-examine the economic consequences of the dichotomous domestic climate policy approaches advocated by the country's major political parties. This paper does not attempt to estimate the possible economic consequences linked to climate change itself.

In this article, we describe the implications of six different climate policies in Australia, including impacts on emissions, gross domestic product and gross national product (GDP and GNP respectively), labour market outcomes, electricity sector outcomes and industrial output. We compare the results of these scenarios with a reference case in which only currently announced policies are represented and no new measures are adopted beyond 2020.

2. Literature Review

There is an extensive literature built over several decades examining the potential costs of alternative climate policies. A wide variety of methodologies are utilised in these studies, and a considerable array of alternative policy measures are analysed. Given that baseline projections and technology costs change, and underlying economic conditions shift year on year, it is important to recognise that specific results from older studies become outdated relatively quickly. It is also important to recognise that differing assumptions about emissions reduction goals, timeframes, baseline projections and other non-climate policies have considerable bearing on results. However, basic findings tend to persist, including the high correlation between abatement ambition and economic cost, and the benefits of allowing policy flexibility in meeting emission reduction goals.

As was the case historically, the more recent literature on climate policy effects in Australia continues to report a wide range of views on the economic consequences - and thus to some extent the ease or difficulty - of achieving emissions reductions.

Liu et al. (2019) studied the economic and environmental consequences in 2030 of participating countries meeting their Nationally Determined Contributions (NDCs) under the Paris Agreement.

They find that if all regions achieve their NDCs, the Paris Agreement reduces CO_2 emissions relative to baseline by 13 billion metric tons by 2030. However, the Paris scenario suggests that global CO2 emissions would not decline in absolute terms relative to 2015 levels, let alone follow a path consistent with a 2°C stabilisation scenario. CO2 tax rates in 2030 required to achieve the Paris reductions vary significantly by country, ranging from US$5/t CO_2 for Australia and Russia, to US$44 for India. GDP outcomes also vary by country but do not correlate with the magnitude of the domestic tax rates. For example, India's tax rate is the highest, but its GDP reduction falls in the middle of the group. After including domestic co-benefits resulting from climate change mitigation, India is projected to achieve one of the best net outcomes. Meanwhile, Australia experiences a net loss, as co-benefits do not outweigh the negative impacts of the tax.

Other global CGE modelling studies focussed on achievement of the Paris Agreement include Vandyck et al. (2016), who use a global CGE model coupled with a partial equilibrium energy system model to examine the impacts of both the Paris Agreement and a more ambitious 2 degree Celsius scenario. They find that global GDP losses under both scenarios are small (-0.42 per cent and -0.72 per cent respectively), but the gap between required emissions reductions under the two scenarios is significant. Targets are primarily met through energy demand reduction and decarbonisation of the power sector in the period to 2050, and employment undergoes a significant transition from energy intensive to low carbon service sectors.

Kompas et al. (2018) use an intertemporal global CGE model incorporating forward-looking investment to assess the economic effects of global warming scenarios in the range 1-4 degrees Celsius. The temperature goals are translated into emissions targets consistent with the temperature outcomes, and the model incorporates climate change damages into the results. The variance in results between the 4 degree scenario (baseline with no policy) and 2 degrees (Paris Agreement scenario) is used to calculate the assumed benefits of compliance with Paris at around US$17,489 billion per year in the long run (year 2100).

Fujimori et al. (2016a) examined the global economic effects of meeting a 2 degree climate change goal, assuming participants deliver their Paris Agreement 2030 NDCs. A dynamic CGE model of the world economy, drawing on climate, land-use and environmental information provided by other specialised models, was used to determine that drastic emissions reductions are required between 2030 and 2050 if the 2 degree goal is to be achieved. Fujimori et al. (2016b) take this conclusion and examine the effects of emissions trading under both the Paris Agreement and a more ambitious 2 degree warming goal. Global welfare loss, which is estimated using household consumption outcomes in 2030, was found to be two-thirds smaller where emissions trading was used to achieve NDCs. Likewise, achieving the 2 degree goal without emissions trading resulted in substantially higher global welfare loss than where emissions trading was implemented, and alternative burden-sharing schemes also mitigated outcomes significantly.

The impacts on the Australian economy of policies to reduce greenhouse gas emissions have been studied extensively in the past but there are few studies that have been completed to date that attempt to quantify the potential impacts of the Paris Agreement. Fisher (2016) together with McKibbin (2016) and Winchester (2016) provide a review of previous Australian studies of carbon abatement and energy policies but those reviews refer to analyses completed before the entry into force of the Paris Agreement.

3. Methodology

3.1 BAEGEM CGE model description

BAEGEM is a recursively dynamic CGE model of the world economy. For each one-year time step, BAEGEM simulates the inter-relationships between production, consumption, economic growth, flows of international trade and investments, constraints on natural resources and production factors, and greenhouse gas emissions (Mi and Fisher 2014). The core of BAEGEM is built around the concepts of the GTAP model (Hertel 1997), with government consumption, household consumption and industry production governed by microeconomic theory.

Government consumption of each commodity is derived from a Cobb-Douglas function nested with Armington composites of commodities supplied by domestic and foreign sources. Household demand is modelled through the stylised consumption behaviour of a representative household adjusted by population growth. At the first level, the representative household chooses quantities of non-energy commodities and an energy composite (that is, coal, gas, refined petroleum product, electricity and heat) to maximise a utility function, given a budget constraint. At the next level, the representative household chooses quantities of energy commodities to minimise the cost of consuming the energy composite in the previous level. The purpose of this two-level demand system is to better reflect the substitutability between energy commodities.

Demands for energy commodities in each production sector are derived from a nesting of Leontief, Constant Elasticity of Substitution (CES) and Constant Ratios of Elasticity of Substitution and Homothetic (CRESH) functions (Hanoch 1971).[1] At the first level, a Leontief technology links the input of factor-energy composites to industry output. At the second level, CES cost minimisation results in an optimal combination of energy and factor composites, where energy commodities and primary factors (that is, capital, labour, land and natural resources) are substitutable, but not perfectly. For land and natural resource-intensive industries (that is, crops, livestock, coal, oil, and gas), a CES structure with imperfect substitutability ensures that constraints on land and natural resources or more intensive use of capital and labour under finite natural resources can be modelled properly in BAEGEM. At the third level, another cost minimisation problem is specified to provide an optimal combination of energy commodities for inputs.

Electricity generation by technologies is modelled through a bottom-up technology bundle approach. The 'technology bundle' approach ensures that electricity output can be produced from a bundle of individually identified generation technologies and that each technology uses a different mix of inputs. The purpose of integrating a bottom-up modelling approach for the electricity sector into BAEGEM is to better represent the technology specific detail of the sector while retaining the benefits of the top-down interactions modelled in BAEGEM. In this application, the electricity output is the sum of nine technologies: coal; oil; gas; nuclear; hydro; wind; solar; biomass; and others.

The substitution possibilities between electricity technologies in BAEGEM are governed by a CRESH aggregation function. The CRESH function is a generalisation of the CES function and allows

[1] The functions in models which describe production in various sectors may be specified to be more or less flexible. For example in a Leontief specification inputs, such as labour and capital, will be combined in fixed proportions with no possibility of substitution between the two whereas flexible functional forms, such as that represented by the CRESH function, allow for substitution between inputs which is more reflective of what happens in the real world. The combination of functional forms as is done in BAEGEM makes it possible to allow substitution between inputs say within subsector of an industry but to prevent substitutions that cannot occur in the real world. For example, in BAEGEM electricity generated from a coal-fired power station is an imperfect substitute for electricity generated from renewables because a thermal coal plant cannot be converted into a wind generator. For a further discussion of production functions and their use in CGE models see for example Woodland (1976).

different elasticities of substitution between its elements. In other words, certain technologies identified in the framework can be more substitutable with other technologies. The use of the family of CRESH aggregation functions accounts for the fact that electricity, which is a homogenous output, can be generated in an economy simultaneously from different technologies with different production costs. This approach prevents the model generating a result where the lowest cost technology takes the whole market.

BAEGEM has a greenhouse gas emissions module built specifically for modelling domestic or international climate change policies. The module covers a set of policy instruments (i.e. carbon tax, emission trading, regulatory targets and indirect taxes) and their linkages with consumption, prices, production and greenhouse gas emissions. The introduction of an emission target or carbon price will result in a series of economic consequences in BAEGEM. Under a domestic emissions trading scheme, each production sector is modelled as a separate agent who makes a least-cost decision about abatement or selling or buying emissions credits. Under international emissions trading, emissions credits are traded between each central agency until the differentials in marginal abatement cost diminish subject to any constraints on international permit transfer. A schematic representation of the key features of BAEGEM is provided in Figure 1 and the key characteristics of BAEGEM are summarised in Table 1.

Figure 1: A schematic diagram of BAEGEM

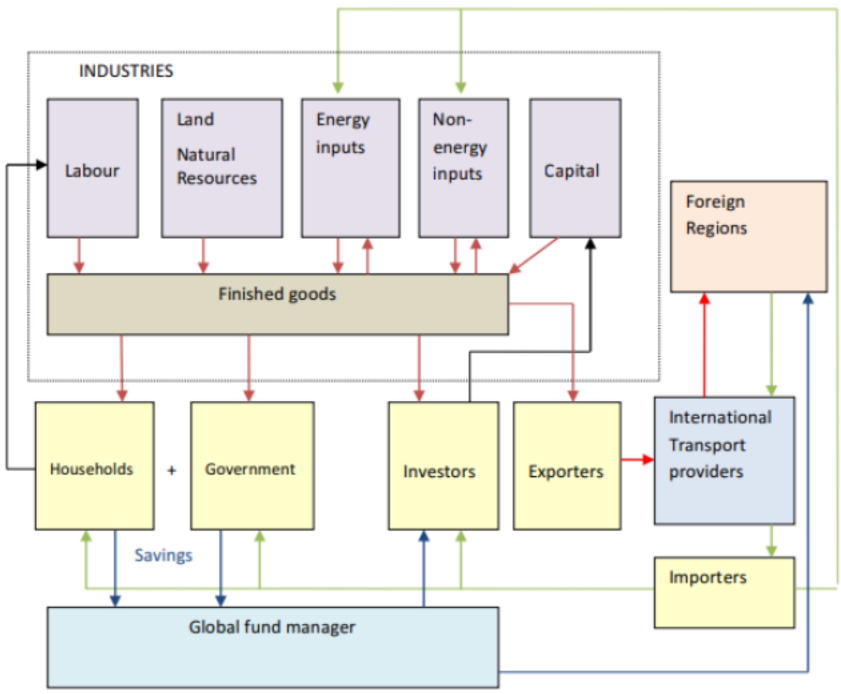


Table 1: Overview of BAEGEM

Distinguishing Feature	BAEGEM
Solution Concept	Market equilibrium driven by supply and demand
Expectations/Foresight	Recursive dynamics
Representation of the world economy	For the purposes of the present paper the world is divided into 18 economies as shown in Table 2

Representation of end-use sectors	There is one representative household and one government for each economy.
Investment dynamics	Investment is driven by long-term GDP growth rates and investment return differentials between economies.
Labour market flexibility	Not fully flexible, lower GDP growth rate will a trigger higher unemployment rate and a fall in real wages
Link between energy system and macro-economy	GDP sets the scale of economic activity in the model, which in turn drives the demand for each commodity in each segment of the world economy.
Greenhouse gases covered	CO_2, CH_4, N_2O, HFCs, PFCs and SF_6
Emission sectors covered	Energy, Transport, Fugitives, Industry, Agriculture, Waste, LULUCF
Electricity production	Substitution allowed between Coal, Gas, Oil, Hydro, Nuclear, Wind, Solar, Biomass and Other Renewables
Technological Change/Learning	Learning-by-doing gradually reduces the average production costs of renewable technologies (except hydro), compared with conventional electricity technologies.
Integration costs	Increased intermittent investment incurs additional capital efficiency integration costs to firm intermittent renewable electricity technologies. Firming costs are based on estimates in Lovegrove et al. (2018).
Thermal efficiency improvement for fossil fuel electricity generation	0.5 per cent per year
Energy consumption	Substitution allowed between coal, gas, liquid fuel and electricity
Fuel consumption in transportation	Substitution allowed between coal, oil, gas, biofuel and electricity
Autonomous fuel efficiency improvement for transportation	2.5 per cent per year
Autonomous energy efficiency in other sectors	0.5 per cent for developed economies, 1 per cent for developing economies
Implementation of climate policy targets	Carbon prices, cap-and-trade, indirect taxes, regulatory targets, and combinations of the above.

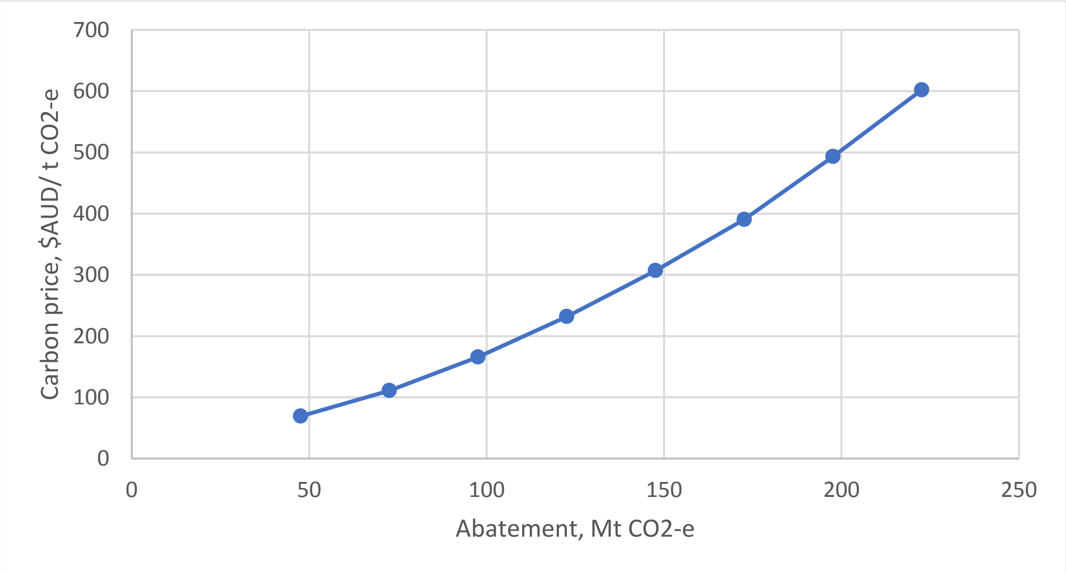
3.1.1 Modelling greenhouse gas emissions

A greenhouse gas module tracks the emissions of Kyoto gases (that is, CO_2, CH_4, N_2O, HFCs, PFCs and SF_6) over the course of production, transformation, consumption and combustion. For each time step, emissions of these gases are derived from the change in the quantity of related economic activities and changes in emission factors, subject to technological progress. BAEGEM assumes constant proportionality of emissions with respect to the quantity of fossil fuel combusted over time. The disaggregated CO_2 emissions for the base year are derived from the GTAP 9.0 database (Aguiar et al. 2016) adjusted to the 2013 base year using the latest combustion emissions data reported by the IEA (2015) and EDGAR v4.3 (2015) emissions database.

Non-combustion emissions, such as fugitive emissions from fossil fuel mining, enteric fermentation in livestock production and chemical transformation in manufacturing processes, are assumed to move proportionally with their production levels adjusted by EMF21 marginal abatement curves (Weyant et al. 2006). The use of marginal abatement curves in the module allows a gradual reduction of non-combustion emissions per unit of output under technological progress or a carbon price signal. The disaggregated non-CO_2 emissions for the base year are derived from the United States EPA database (US EPA 2012) and the GTAP 9.0 database (Aguiar et al. 2016) adjusted by the latest aggregate combustion emissions data reported by the IEA (2015) and EDGAR v4.3 (2015) emission database.

The shape of the domestic marginal abatement cost function in BAEGEM can be observed by shocking the model with increasingly higher abatement targets and observing the carbon prices that are required to reach these targets. Such a function is illustrated in Figure 2. This response function has been generated assuming that the renewable generation penetration level in the domestic economy is the same as that in the reference case.

Figure 2: Australian domestic marginal abatement cost function in BAEGEM



4. Database

The BAEGEM2013 database is derived from several sources. At its core, the database is a global Social Accounting Matrix (SAM), which captures the flow of economic transactions of households, governments, producers and international transport operators. Key economic transactions such as private consumption, government consumption, investment, total exports and total imports are benchmarked with the latest 2013 data from the United Nations (UN 2015) and the International Monetary Fund (IMF 2016). The industry structure for each economy is derived from the GTAP v9 database. For Australia, the SAM is supplemented by the use of industry gross-value data and industry import and export data from the Australian Bureau of Statistics.

In addition to the SAM, BAEGEM2013 incorporates energy data and electricity generation data from IEA publications (IEA 2015). Australian emissions for 2013 are based on Australian Department of Environment and Energy (2018). International emissions in BAEGEM2013 are derived from the GTAP 9 database (Aguiar et al 2016), the IEA CO_2 emission database (2014) and the EDGAR v4.3 (2015) database.

The full BAEGEM2013 database divides the world into 28 regions, and the database covers 54 commodity groups with a strong focus on energy and mineral commodities. It includes black thermal coal, brown coal, coking coal, oil, gas, iron ore, bauxite, copper, gold, uranium, titanium, zirconium and other minerals. Each production sector is assumed to produce a single, homogenous commodity within their regions. The full list of regions and production sectors is shown in Appendix Table A1. For this study, the database was aggregated to 18 regions (Table 2) and 21 sectors (Table 3).

5. Reference case and Policy Scenarios

The key objective in this paper is to evaluate the economic impacts of the domestic climate change policies proposed by the two main political parties in Australia. From this purpose, one reference case and six policy scenarios were developed in BAEGEM.

5.1 Reference case

The reference case is a baseline scenario representing the world in which current climate change mitigation policies continue to 2030 but where there is no international agreement on mitigation targets from 2020. As such, before 2020, developed countries including Australia implement measures to reach their pledged 2020 emission targets. Developing countries continue their existing mitigation policies but do not aim to meet any quantitative emission reduction targets.

Population growth, economic growth, energy efficiency improvements and non-combustion emissions improvements are some of the most important determinants of reference case emissions projections. Under the current reference case, the population in Australia is assumed reach 28.5 million by 2030. Assumptions on population growth to 2030 in other key countries and regions are provided in Table 2. These growth rates are consistent with the medium variant projections in the United Nations' World Population Prospects (UN 2015).

Australia’s real GDP is assumed to grow on average at 2.9 per cent over the projection period to 2030, slightly below its twenty-year long-term trend rate. Economic growth rate assumptions for the other key countries and regions in BAEGEM are also documented in Table 2. These growth rates are based around forecasts by the International Monetary Fund (IMF 2016).

The reference case assumes that thermal efficiency for fossil fuel electricity generation will improve by 0.5 per cent a year until 2030. Hence, for every gigawatt-hour of electricity generated from fossil fuel plant, 0.5 per cent less fossil fuel is consumed each year across the average of existing and new plant.

Autonomous fuel efficiency in transportation improves by 2.5 per cent a year until 2030. For land transportation, this improvement applies to each vehicle type. Fleet-wide fuel efficiency improvements resulting from substitution between different types of vehicles are modelled separately in BAEGEM and any improvements from this effect are additive with autonomous fuel efficiency improvements.

Energy efficiency in other uses improves by 0.5 per cent a year in developed countries and 1.0 per cent a year in developing countries. That is, for every unit of output, less energy is required to produce the same level of output every year. However, energy efficiency improvement does not necessarily imply lower energy consumption or lower emissions. Energy efficiency improvements could stimulate consumption through cost reduction and thus increase energy consumption.

Non-combustion emissions per unit of output have been falling over time due to technological advancement and better management practices. BAEGEM assumes these trends will continue with non-combustion emissions improving by 1.5 per cent a year per unit of output under the reference case.

Table 2: Population and economic growth assumptions (% average per year), reference case

	Population growth, %		Real GDP growth, %	
	2016-2020	2021-2030	2016-2020	2021-2030
United States	0.71	0.68	2.24	1.95
Canada	0.90	0.77	2.00	2.00
Mexico	1.24	0.98	2.84	3.34
EU27	0.13	0.03	1.80	1.50
Russia	-0.01	-0.23	1.20	2.20
Rest of Europe	0.82	0.42	2.67	2.88
China	0.39	0.12	5.81	4.94
India	1.11	0.90	7.62	6.31
Japan	-0.23	-0.40	0.43	0.96
Korea	0.36	0.23	3.01	2.91
Australia	1.31	1.06	2.94	2.91
Rest of Asia	1.23	1.02	5.02	5.02
Brazil	0.76	0.53	1.25	2.90
Rest of Latin America	1.06	0.87	2.47	4.00
Middle East	1.71	1.50	3.02	3.64
North Africa	1.81	1.51	4.31	4.42
South Africa	1.21	0.94	2.02	3.32
Rest of Africa	2.77	2.60	4.77	5.30

Australian reference case emissions are calibrated to the Australian Government's most recent emissions projections to 2030 by emissions sector (Department of Environment and Energy 2018). For Australia, total emissions in the reference case are assumed to reach 540 million tonnes by 2020. Existing climate change mitigation policies including the Emission Reduction Fund (ERF), the Renewable Energy Target (RET) scheme, and the National Carbon Offset Standard (NCOS) are fully reflected in the reference case. In the case of the RET a target of 33 000GWh is set for the large scale scheme by 2020 with the legislation and target remaining in place until 2030. No new policy measures are introduced in the reference case after 2020. Australian emissions are calibrated to reach 563Mt CO_2e in 2030 consistent with the latest Australian Government projections.

Production sectors for this paper are aggregated into 21 sectors, as shown in Table 3.

Table 3: Aggregated Industrial Sectors

Sectors				
1. Crops	6. Metallurgical Coal	11. Food processing	16. Non-Ferrous Metal	21. Services
2. Livestock	7. Oil and Gas	12. Chemicals, rubber and plastics	17. Electricity	
3. Forestry	8. Oil refinery	13. Manufacture of non-metallic mining products	18. Construction	
4. Fishing	9. Iron ore	14. Other manufacturing	19. Land Transport	
5. Thermal Coal	10. Other mining	15. Iron and Steel	20. Water and Air Transport	

5.2 Policy scenarios

The scenarios were defined by varying assumptions on abatement targets, renewable energy generation shares, and access to international permits to meet part of the domestic mitigation task. The scenarios are summarised in Table 4.

Scenarios 1 - 3 impose an emission target representing a 27 per cent reduction off 2005 levels consistent with the current federal government's announced Paris contribution of a reduction in emissions to 26 to 28 per cent by 2030. Scenarios 4 - 6 impose a more stringent emissions target representing a reduction of 45 per cent compared to 2005 levels. These different targets were chosen to reflect the publicly announced emissions targets of the Coalition and Labor parties respectively.

To reflect a further ambition of the Labor party, a renewable energy generation target of 50 per cent by 2030 applies to scenarios 4 - 6. For Scenarios 1 – 3 the renewable target remains close to the reference case at around 36 per cent by 2030. This level is consistent with the renewable electricity generation share implied by the projections presented in Department of Environment and Energy (2018).

It is assumed that emissions reductions are applied linearly from 2020 to ensure that the specified target is met in 2030 and that all Australian domestic sectors contribute to the emissions reductions task. In scenarios 2,3,5 and 6, where the Kyoto carryover is available to meet the Paris target, the carryover projection is taken from Department of Environment and Energy (2018).

International permit trading is allowed in scenarios 3 and 6, where it is assumed that up to 25 per cent of the target can be met by the purchase of emissions permits from overseas at the world permit price. To calculate the world permit price, it is assumed that all countries with NDCs under the Paris Agreement fully meet those commitments by the years specified in their individual NDCs. Further it is assumed that the United States reaches its NDC whether it remains as a member of the Paris Agreement or not. These scenarios have been included to provide context to the potential implications of international trade in permits for contributing to escalating emissions targets versus attempts to meet targets solely within Australia's borders.

Table 4: Policy scenarios; Assumption summary

Scenario	Emissions assumptions
Reference case	Without new policy beyond 2020 and Australian emissions calibrated to 2018 DEE projections
Scenario 1:	-27% from 2005 by 2030
Scenario 2:	-27% from 2005 by 2030 with use of Kyoto carryover
Scenario 3:	-27% from 2005 by 2030 with use of carryover and permit trading
Scenario 4:	-45% from 2005 by 2030 and 50% renewables
Scenario 5:	-45% from 2005 by 2030 and 50% renewables with use of carryover
Scenario 6:	-45% from 2005 by 2030 and 50% renewables with carryover and trading

Emissions trading allows industries with higher marginal abatement costs to purchase emissions permits from industries with lower marginal abatement costs. As such, the overall abatement cost for the economy is reduced as industries search for least cost alternatives to meet the regulatory target. The price paid by one industry to another industry for compensating their effort to reduce one extra tonne of CO_2 equivalent is the market price for carbon. This market-based carbon price is explicitly modelled in BAEGEM with the expectation that the more stringent the emission target, the higher the carbon price (all else equal).

Emissions trading in BAEGEM is represented at the industry level. The marginal abatement cost curve of each industry reflects the aggregate effect of individual firms in the industry. For each time step, BAEGEM compares the marginal abatement cost of each industry with respect to the prevailing carbon price and gives an approximation of the least cost solution. The least cost solution is influenced by a number of factors in each industry including: (i) fuel uses; (ii) ease of fuel substitution; (iii) emissions sources; (iv) emissions intensity; (v) output level; (vi) ease of output substitution; and (vii) costs of alternative technologies.

The likely costs of green technologies over the next 15 years have a strong influence on intertemporal abatement costs. This is of particular significance in the electricity and transport sectors. BAEGEM assumes that that the intermittency of wind and solar energy does not put cost pressure on the power system until the share of electricity generation from wind and solar reaches 17 per cent. Beyond this threshold, the power system requires dispatchable power plants on standby, or sufficient installed battery or other storage to meet any sudden deficit in electricity supply.

BAEGEM assumes that intermittency costs gradually increase from zero to $45/MWh when the share of generation from wind and solar increases from 17 per cent to 35 per cent. The intermittency and integration costs are assumed to peak at $200/MWh when the share of generation from wind and solar exceeds 75 per cent.

Population growth rates in the policy scenarios are the same as those in the reference case but real GDP growth rates are determined by the model in the policy scenarios. The labour market is not fully flexible, so unemployment can vary in the short to medium term. Depending on the size of the policy shock it is assumed that between 15 and 30 per cent of the adjustment in the labour market is represented by a fall in employment and the remainder is represented by a fall in real wages.

6. Results

In this section we describe the results of modelling the scenarios described above in BAEGEM. The simulation results are discussed with a focus on the impacts on emissions, GDP, GNP, the electricity market, sectoral output, employment and real wages. The results reflect the economic impacts of the scenarios relative to what otherwise would have occurred if no policy interventions were implemented. They also describe the incremental effects of adding flexibility to the method by which emissions abatement targets are reached. All prices are expressed in real 2016$A unless otherwise stated.

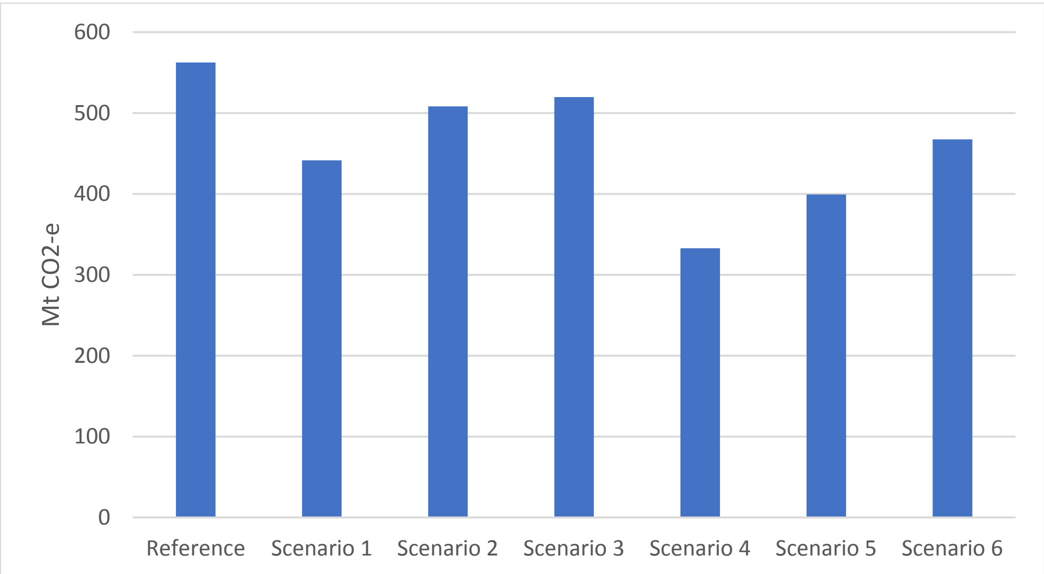
6.1 Emissions reductions and carbon penalties

Australian emissions are projected to reach 563Mt CO_2e by 2030 under the reference case. The greatest abatement under the scenarios is achieved by Labor's proposed 45 per cent reduction policy excluding permit trading or carry-over, which results in 333Mt CO_2e of emissions by 2030.

Emissions under all other scenarios fall within this range, with domestic emissions higher under scenarios that allow the greatest flexibility in meeting domestic targets. This reflects firstly that Kyoto carry-over represents an intertemporal transfer that lowers the emissions reduction effort required in the current period, while scenarios that allow permit trading imbed a lower domestic abatement task via a partial contribution from international emissions reductions. The emissions outcomes under each scenario are shown in Figure 3.

Emissions reductions are contributed by all sectors of the economy, however the electricity generation sector, transport, and combustion sectors do a disproportionate share of abatement given their relatively larger emissions bases. Waste and Land use, Land use change and Forestry contribute relatively little to the abatement task given their smaller baseline emissions profiles. Agricultural emissions remain relatively constant under all scenarios, demonstrating the relative difficulty and higher marginal cost of reducing emissions from this source.

Figure 3: Australia's domestic greenhouse gas emissions, reference case and policy scenarios



The economic impacts associated with emissions abatement result from the introduction of either an explicit or a shadow carbon price. The two main factors that influence the carbon price are the magnitude of the emissions abatement task, and the availability and cost of abatement options.

Where international trade in emissions permits occurs, this lowers the marginal abatement cost by opening up new opportunities for lower cost emissions reduction from other countries, thereby lowering the Australian carbon price and ameliorating the economic effects of the penalty.

This dynamic clearly plays out in the estimated shadow carbon penalties for Australia under the modelled scenarios (Table 5). The Coalition's emissions target of -27 per cent below 2005 levels by 2030 results in an estimated shadow carbon price of A$263/t **$CO_2$e**. Allowing for both Kyoto carry-over and international trade in emissions permits reduces the carbon penalty to $73/t **$CO_2$e.**

Labor's 45 per cent emissions target over the same time horizon imposes a shadow carbon penalty of A$696/tCO2e, which can again be substantially reduced to $96/t **$CO_2$e** by allowing for emissions reduction carry-over between commitment periods and international permit trading.

Table 5: Carbon price, A/tCO_2$e in 2030

Year	Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5	Scenario 6
Carbon price	263	92	73	696	326	97

6.2 Gross Domestic Product

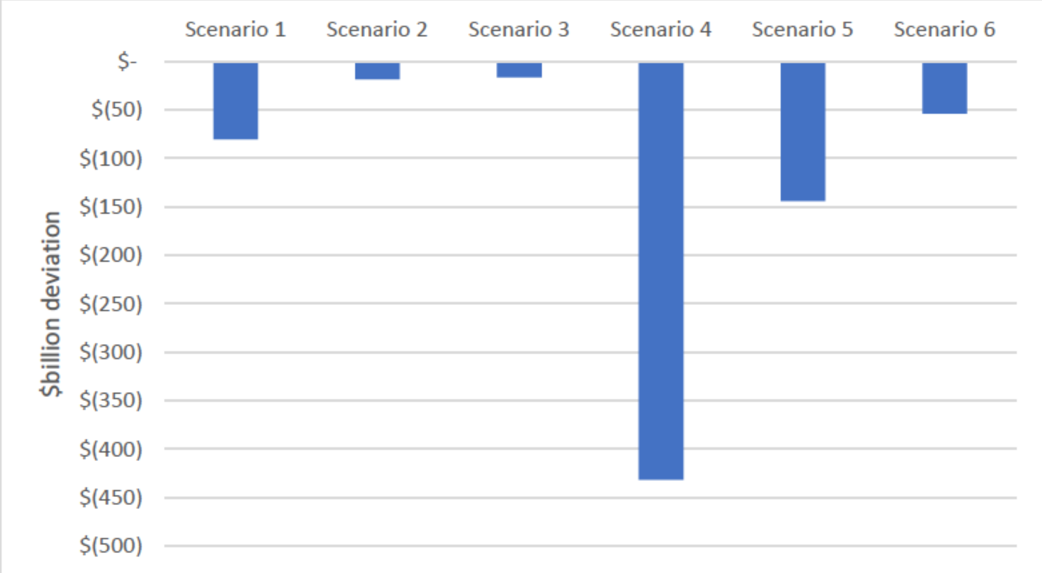
Real GDP is the most commonly used measure of the overall performance of an economy. Projected levels of real GDP in Australia under all policy scenarios are lower than reference case GDP. The more stringent the emissions target by 2030, the lower the average projected GDP growth rate.

The modelling indicates that any form of climate policy will have a negative impact on GDP relative to the reference case, with results demonstrating GDP losses ranging from A$17 billion to A$432 billion in 2030 (see Figure 4). GDP growth is affected least where there is flexibility in achieving emissions targets. This flexibility is modelled here via Kyoto carry-over of emissions reductions surplus to those required to meet Australia's Kyoto 2nd commitment period pledge, and international trade in permits up to the specified limit.

Under the Coalition emissions target of -27 per cent by 2030, if carry-over and permit trading are allowed, Australia's GDP growth rate over the period from 2021 to 2030 is projected to slow very moderately by around 0.1 percentage points per year from a reference case annual growth rate of 2.91 per cent.

Under Labor's modelled policy scenarios, a similar dynamic is at play where less flexibility in the approach to emissions reduction results in increasingly negative effects on GDP. However, when the emissions reduction ambition is set higher (to -45 per cent by 2030), the relative economic growth effects resulting from less flexible policy are magnified. The projected annual GDP growth rate over the period between 2021 and 2030 slows 2.65 per cent where flexible instruments are deployed and to 0.88 per cent where they are not. The cumulative impact of slower growth over the period to 2030 results in projected GDP losses of $228 billion when permit trading and use of the carry-over is allowed. The cumulative loss is projected to be $1.2 trillion without either carry-over or permit trading.[2]

Figure 4: Real GDP deviation from the reference case, 2030



6.3 Gross National Product

In BAEGEM, the sale and purchase of emissions permits between economies are considered as international transfers of capital income and as such are reflected in the calculation of Gross National Product (GNP). An economy that mainly purchases emissions permits from other economies would expect its GNP to fall relative to its GDP while an economy that mainly sells emissions permits would expect its GNP to rise relative to its GDP, all other factors held constant.

The projected net present value (NPV) of the loss of GNP over the decade from 2021-2030, relative to the reference case, ranges from $80 billion (scenario 3) to $1.2 trillion (scenario 4) under the modelled Coalition and Labor policy scenarios respectively (see Table 5). Consistent with the projected impacts on GDP the results suggest that the more policy flexibility that is allowed the less the negative impacts of the reductions in emissions on GNP.

Table 5: NPV* of cumulative real GNP loss from 2021-2030, relative to the reference case

Year	Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5	Scenario 6
Real GNP ($b)	-$293	-$89	-$80	-$1237	-$502	-$254

*Applied with a social discount rate of 2.6 per cent a year

6.4 Electricity market

Under the reference case, electricity generation in Australia is projected to reach around 300 TWh by 2030. This is equivalent to around a 1.4 per cent increase a year. The growth rate from 2021 to 2030 is slightly higher at around 1.6 per cent a year, accompanied by projected higher consumption by electric vehicles. The share of renewable energy, including hydro-electricity, is projected to increase from around 13 per cent in 2013 to around 36 per cent by 2030 in the reference case. Total

[2] The cumulative losses in GDP are expressed in $A 2016 calculated at an assumed social discount rate of 2.6 per cent.

electricity demand is lower under each of the policy scenarios modelled than under the reference case.

Turning to the specific effects of the scenarios on the electricity market, we find that the fuel mix is radically transformed under Labor's policy scenarios, with a more moderate transition attaching to the Coalition's emissions target. In all policy scenarios, a significant amount of coal is removed from the fuel mix relative to the reference case. Results for other fuel types vary substantially depending on the scenario under consideration. The projected electricity generation mix outcomes in 2030 under the modelled scenarios are reported in table 6.

Table 6: Electricity generation mix in 2030, Australia (%)

	Reference	Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5	Scenario 6
Coal	40	23	32	34	12	18	26
Gas	23	38	30	29	37	31	22
Renewables	36	38	36	36	50	50	50
Other	2	1	2	2	1	1	2
Total	100%	100%	100%	100%	100%	100%	100%

The Coalition's policy (Scenario 1) results in a near halving of coal generation, and rapid uptake of gas, with limited effects on renewables and other fuels.[3] If carry-over provisions and international permit trading are added to the Coalition policy toolkit, the fuel mix retains more coal fired generation and less uptake of gas occurs relative to scenario 1. This result reflects that less abatement is required in the electricity sector where flexibility options reduce the overall domestic abatement task either by carrying forward excess emissions reductions from the prior commitment period, or permit trading lowers the sectoral requirement for electricity. In fact, in scenario 3 which incorporates both trading and carry-over alongside the Coalition's -27 per cent target, the uptake of renewable generation technology does not vary from the reference case, less coal is required to transition out of the system, and there is a more moderate transition to gas than under scenario 1.

At the higher emissions abatement task of -45 per cent proposed by Labor, the fuel mix must radically transform. Around three-quarters of reference case coal fired generation must retire by 2030, and renewables penetration must rise around 40 per cent relative to reference case uptake (which itself incorporates an additional 33,000 GWh of generation capacity). Gas penetration increases 14 per cent beyond reference case levels in similar proportion to the contribution of gas under the Coalition policy scenario, noting however that overall electricity demand is lower under scenarios 4-6 compared with scenarios 1-3. Again, carry-over allowances and permit trading reduce the size of the task, thereby mitigating the extent of electricity sector transformation. However, given Labor's fixed policy objective of a 50 per cent renewables target, we still observe much greater transition away from coal than under the equivalent Coalition policy combinations. The transition to gas remains significant under the Labor policies modelled, making up a major share of the fuel mix in combination with renewables.

As expected, the effects on wholesale electricity prices are significant, with the largest single determinant being abatement ambition, followed by the level of policy flexibility. The wholesale

[3] In the policy scenarios reported here it is assumed that adequate domestic Australian gas supplies are available at $A10-12/GJ to meet the needs for fuel switching in the electricity industry.

price reflects the LCOE of the existing generation capacity, the intermittency and integration costs of wind and solar technologies, and the supply and demand for electricity. Any policy instruments targeting greenhouse gas emissions in the electricity generation sector will have a direct impact on the wholesale price. On the other hand, the direct effect on the price paid for transmission, distribution and retail services will be small because emissions from these activities are small.

Under the reference case the wholesale electricity price in Australia is projected to increase from $69/MWh in 2016 to around $81/MWh by 2030 in today's dollars. This represents an increase of about 1.5 per cent a year in real terms. For comparison, the GSP weighted average wholesale price in the National Electricity Market (NEM) from 2005-2016 rose about 3.2 per cent a year in nominal terms. The low growth in the wholesale electricity price throughout the projection period reflects the low LCOE of the existing generation capacity with limited further depreciation value and the rising competition from renewable energy.

The wholesale electricity price is projected to rise much faster under the policy scenarios. A rise in the shadow carbon price, increases in average LCOE after switching to new-build renewables and gas and increases in intermittency costs are the key factors driving the wholesale electricity price higher in the policy scenarios. By 2030, Australian electricity prices increase around 38 per cent under the Coalition policy and by 94 per cent under Labor's proposed policy, relative to the reference case electricity price projection. These effects can be mitigated by more than two-thirds by allowing carry-over of emissions and permit trading.

Given Australia's electricity prices are already high relative to international standards, these price effects translate into significant consequences for industrial activity, and hence real wages and employment. The modelled wholesale electricity price projections at 2030 are presented in Table 7.

Table 7: Impacts on wholesale electricity price in Australia, $/MWh

	Reference	Scenario 1 -27%	Scenario 2 -27% w c/o	Scenario 3 -27% w c/o & trade	Scenario 4 -45%	Scenario 5 -45% w c/o	Scenario 6 -45% w c/o & trade
Wholesale electricity price ($/MWh)	81	112	93	91	157	128	111

6.5 Sectoral output

The details of impacts on industry output by sector are presented in Table 8 in terms of the projected impacts on industry output in 2030 compared to projected output under the reference case.

Under the reference case, BAEGEM projects that Australia's mining sector will continue to grow to 2030. Thermal coal production is projected to increase by around 0.6 per cent a year from 2021 to 2030 which represents a lower growth rate than that experienced in the past decade. Gas is projected to grow after 2020 but the growth rate will slow. Oil production is projected to remain flat while iron ore, Australia's largest export commodity, is projected to increase by around 3.1 per cent a year from 2021 to 2030.

Table 8: Industry output projections, percentage deviation from reference case, 2030

	Scenario 1 -27%	Scenario 2 -27% w c/o	Scenario 3 -27% w c/o & trade	Scenario 4 -45%	Scenario 5 -45% w c/o	Scenario 6 -45% w c/o & trade
Crops	-1.7	-0.6	-0.5	-6.8	-2.7	-1.1
Livestock	-2.0	-1.3	-1.2	-0.7	-2.6	-2.2
Forestry	-1.1	-1.3	-1.3	2.0	-1.6	-2.2
Fishing	-6.6	-2.7	-2.2	-15.5	-8.6	-3.6
Thermal Coal	-37.3	-21.2	-19.0	-63.8	-44.0	-26.4
Metallurgical Coal	-10.9	-4.8	-4.1	-26.7	-13.2	-5.1
Oil and Gas	1.4	1.7	1.4	-14.5	-1.6	1.1
Oil refinery	-13.1	-4.3	-3.4	-36.7	-17.0	-5.2
Iron Ore	2.2	-0.4	-0.7	11.3	3.8	0.3
Other mining	-8.1	0.1	1.2	-22.3	-13.0	-5.9
Food processing	-1.8	-0.7	-0.5	-3.7	-3.0	-2.1
Chemicals, rubber and plastic	-9.8	0.8	1.8	-38.9	-15.8	-2.1
Manufactures non-metallic mining products	-5.9	-0.5	0.0	-20.9	-9.3	-2.8
Other manufactures	-1.3	0.8	0.7	-19.3	-4.6	-1.3
Iron and Steel	-5.0	3.4	4.2	-31.4	-11.0	-1.2
Non-ferrous metal	-21.8	4.1	7.4	-67.1	-37.0	-14.8
Electricity	-11.3	-3.9	-3.0	-23.8	-14.0	-7.7
Construction	-3.4	-0.9	-0.8	-16.2	-5.8	-2.2
Land Transport	-6.2	-1.4	-1.0	-20.5	-9.1	-2.8
Water and Air Transport	-4.9	-1.7	-1.4	-12.3	-6.5	-2.4
Services	-1.7	-0.4	-0.5	-10.5	-3.7	-1.8

*Other mining includes mining services

As may be expected, the imposition of any carbon constraint results in the curtailment of output in sectors involved in producing fossil fuels such as coal, gas and oil. It also has an impact on sectors that are intensive users of fossil energy and/or electricity.

Looking first at the fossil energy sectors, thermal coal, with its high emission factor per unit of energy, is projected to be hit the hardest of any sector as carbon capture and storage technology is assumed not to be commercially viable until after 2030. The impact of climate policy on gas is far less severe than for thermal coal. This is because the substitution effect between coal and gas offsets the negative impacts brought about by greenhouse gas reductions except under very stringent emissions abatement scenarios. Oil refining also declines under all policy scenarios, however policy flexibility significantly reduces the negative effects of imposing emissions constraints.

Under Labor's proposed policy (scenario 4), coal production falls more than 60 per cent, and oil and gas by 15 per cent in 2030 relative to the reference case. These reductions in sectoral output are ameliorated by a lower effective abatement level if carry-over is permitted and by the introduction of policy flexibility via permit trading. However, the impacts remain significant under a 45 per cent reduction scenario even allowing for policy instrument flexibility. For instance, the impacts on thermal coal output are reduced by half where international permit trading is allowed in conjunction with carry-over (scenario 6), but the sector's output is still 26 per cent lower than it otherwise would have been under the reference case. Directly affected by fossil fuel pricing, electricity output is expected to be 24 per cent lower than reference case by 2030 under Labor's proposed policy (scenario 4).

The sectoral output effects under the Coalition policy of -27 per cent by 2030 (scenario 1) are less severe than under Labor's policy scenarios. Even so, coal production nevertheless falls by over 37 per cent relative to the 2030 reference case level, and the sector's output remains curbed by about 20 per cent even with both policy flexibility measures in place (scenario 3). The oil and gas sector is positively affected under the Coalition's modelled scenarios, with the substitution toward lower emissions-intensity gas a key factor in the outcome. Electricity output under scenario 1 declines 11 per cent by 2030 relative to the reference case, reducing to a 3 per cent curtailment by 2030 when policy flexibility is introduced in scenario 3.

Since fossil fuels underpin a substantive proportion of energy consumption in Australia both via electricity, direct and indirect use, the impacts of the climate policies modelled in this paper have broad ramifications beyond energy commodities and electricity. Cropping and fishing, manufacturing, construction, transport and services are all meaningfully affected.

Of note is the substantial transformation required in land-based transport to achieve these modelled climate policies. While the share of rail remains relatively constant between the reference case and policy scenarios, major shifts are observed out of internal combustion (ICE) and into hybrid and electric vehicles. This effect is most marked under the Labor policy scenario, where the ICE share falls from 73 per cent in 2030 under the reference case to 43 per cent, while hybrid and electric vehicle uptake rises from 4 per cent under the reference case to 32 per cent in scenario 4.

The energy intensive non-ferrous metals sector is heavily affected by the substantial curtailment of emissions, and can be observed under most policy scenarios to be doing much of the heavy lifting alongside the coal and electricity sectors in reaching emissions targets. Under scenarios 2 and 3, non ferrous metals output increases relative to the reference case because the sector benefits from policy flexibility and lower real wages.

Outputs of the manufacturing, transport and services sectors are also lower than reference case in response to increasingly stringent emissions abatement targets, reflecting energy cost pressures due to escalation of the implicit carbon price.

The iron ore industry is one of the few industries projected to experience a positive outcome under the scenarios. This is largely because the iron ore industry is not particularly emission-intensive relative to other sectors, is highly internationally competitive and would benefit from the projected reduction in real wages.

As shown in Table 8, other mining production is more negatively affected than iron ore, particularly under the Labor policy scenarios. This is because the industry is more emissions intensive than iron ore production, and electricity use in other mining is significantly higher.

6.6 Employment and wages

BAEGEM assumes that the labour market is neither fully flexible nor fully sticky under the policy scenarios. That is, real wages fall following the implementation of emission targets but do not fall to a level that would hold the unemployment rate at the non-accelerating inflation rate of unemployment (NAIRU). Here, BAEGEM assumes that the adjustment in real wages and employment are bounded by the adjustment in real GDP in percentage terms. The actual outcomes in the labour market will ultimately depend not only on the government's emission reduction policies but also on its labour market policies.

Under the reference case, real wages in Australia are projected to increase by 1.95 per cent a year during the next decade. In the policy scenarios, reflective of significant reductions in output across most sectors of the Australian economy, employment and real wages are projected to fall compared to what they would otherwise have been (Figure 5). The larger the emissions reduction by 2030, and therefore the higher the implicit carbon price, the lower the real wage rate.

Australia's average yearly full-time real wage relative to the reference case in 2030 declines under all policy scenarios, as represented in Figure 5.

Job losses relative to reference case employment in 2030 are significant – ranging from -227,000 under the Coalition target and rising to -586,000 under the proposed Labor policy. Allowing Kyoto carry-over and permit trading to contribute 25 per cent of the target mitigates these projected job losses significantly (Figure 6).

Figure 5: Australia's real wage relative to the reference case, 2030

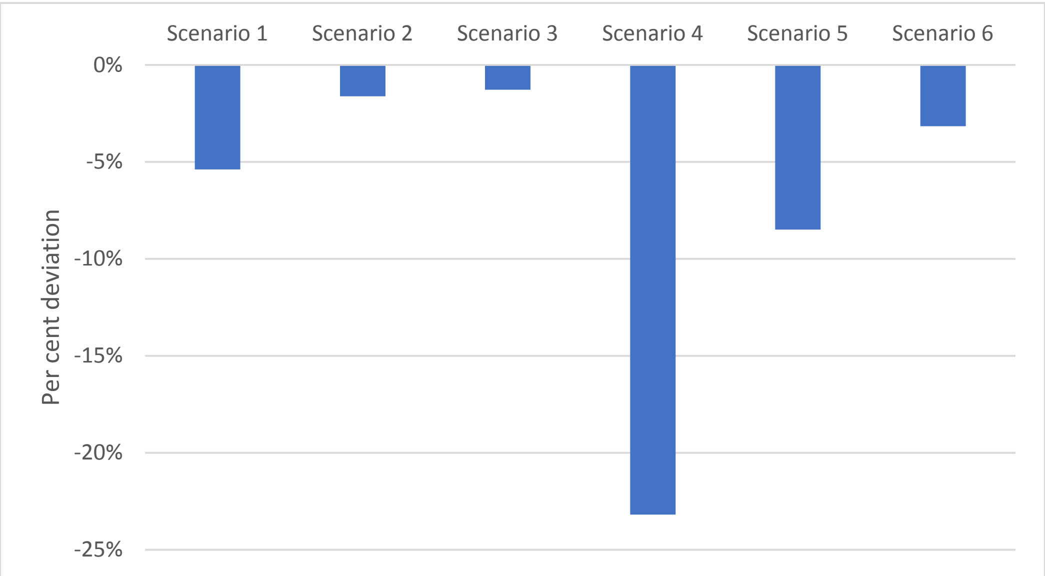
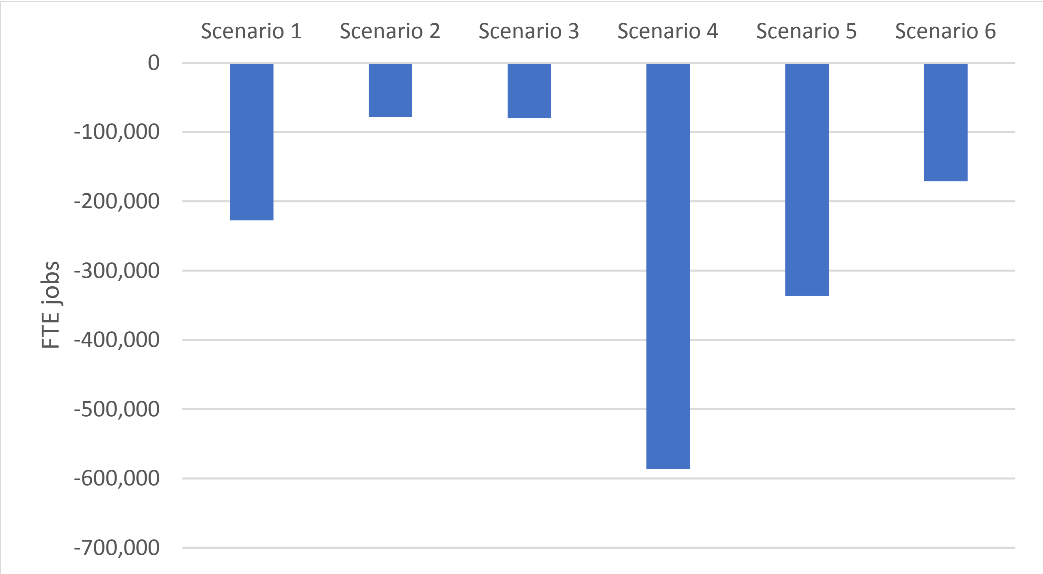


Figure 6: Full time equivalent jobs relative to the reference case, 2030



7. Conclusions and Policy Implications

Climate and energy policy will almost certainly be a key differentiator between the two major political parties at the upcoming Australian Federal election. The Coalition government has proposed meeting Australia's Paris Agreement commitments through a 26-28 per cent emissions reduction by 2030 relative to base-year emissions in 2005. The opposition Labor party has announced a higher emissions target of 45 per cent over the same time period, with an objective of 50 per cent renewable electricity generation and an aim to reach net zero emissions by mid-century.

This paper examines the economic impacts of adopting these different domestic emissions targets using the BAEGEM Computable General Equilibrium (CGE) Model. Six separate scenarios are modelled alongside a reference case scenario, which assumes no new policy beyond that already in place from 2020. Differentiating the scenarios are assumptions on emissions reductions, availability of mitigation through Kyoto carry-over, renewable energy targets and recognition of international emissions permits to meet part of the domestic mitigation task.

Cumulative GNP losses are estimated at A$293 billion by 2030 for the Coalition emissions reduction target of -27 per cent, and A$1.2 trillion under Labor's higher 45 per cent emissions abatement goal. These GDP losses are brought about by the implicit carbon price and transition requirements for the economy to meet the emissions targets specified. The Coalition policy leads to a shadow carbon price of A$263/t$CO_2$e, while Labor's proposed policy target incurs a projected carbon price of A$696/t$CO_2$e.

Associated negative consequences for sectoral output, employment and wages are estimated. The sectors hardest hit by the policies of both parties are electricity, thermal coal, non-ferrous mining and chemicals, rubber and plastic.

Policy flexibility in meeting emissions abatement targets is modelled via two options: i) by lowering the abatement task in the projection period by allowing carry-over of excess abatement from the Kyoto commitment period; and ii) by allowing part of the domestic abatement task to be met by international emissions permit trading. Both options are demonstrated to be important options in greatly ameliorating the adverse economic effects of climate policy. Results indicate that when these additional policy options are introduced, negative GNP effects are around one quarter of what they otherwise would be without policy flexibility. Of the two flexibility options examined in this paper, allowing Kyoto carry-over had a larger impact than enabling 25 per cent of the abatement task to be contributed by international permit trading.

The paper highlights the significant economic consequences, and thereby the inherent political difficulties, associated with adoption of ambitious emissions reduction targets. It also demonstrates the sizeable benefits attached to building in adjunct policy measures that allow targets to be met flexibly, and at lowest marginal cost.

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Appendix

Table A1: Full list of economies and production sectors in BAEGEM

No.	Economies	No.	Production sectors
1	US	1	Agriculture, Hunting, Forestry and Fishing
2	Canada	2	Iron Ore
3	Mexico	3	Copper Concentrates
4	Germany	4	Gold
5	UK	5	Bauxite
6	France	6	Uranium
7	Italy	7	Titanium
8	Rest of EU28	8	Zirconium
9	Russia	9	Other minerals and quarrying
10	Rest of Europe	10	Brown Coal
11	Rest of CIS	11	Black thermal coal
12	Japan	12	Coking coal
13	Korea	13	Oil
14	Taiwan	14	Gas
15	Mongolia	15	Food, Beverages and Tobacco
16	China	16	Textiles and Textile Products
17	India	17	Leather, Leather and Footwear
18	Indonesia	18	Wood Products
19	Australia	19	Pulp, Paper, Paper , Printing and Publishing
20	Rest of Asia	20	Coke
21	Brazil	21	Refined Petroleum
22	Rest of South America	22	Nuclear Fuel
23	Middle East		
24	North Africa	23	Chemicals and Chemical Products
25	Mozambique	24	Rubber and Plastics
26	Guinea	25	Other Non-Metallic Mineral
27	Rest of Sub-Saharan Africa	26	Alumina
28	South Africa	27	Aluminium
		28	Other Non-Ferrous Metal
		29	Iron and Steel
		30	Other metal products
		31	Machinery, Nec
		32	Electrical and Optical Equipment
		33	Transport Equipment
		34	Manufacturing, Nec; Recycling
		35	Electricity
		36	Gas and Water Supply
		37	Construction
		38	Sale, Maintenance and Repair of Motor Vehicles
		39	Wholesale Trade
		40	Retail Trade
		41	Hotels and Restaurants
		42	Land Transport
		43	Water Transport
		44	Air Transport
		45	Travel agency

	46 Post and Telecommunications 47 Financial Intermediation 48 Real Estate Activities 49 Other Business Activities 50 Public Admin and Defence 51 Education 52 Health and Social Work 53 Other Community, Social and Personal Services 54 Private Households with Employed Persons

From: [redacted]
To: Tim Roy
Subject: FW: Analysis and op Ed's [SEC=UNCLASSIFIED]
Date: Tuesday, 15 January 2019 3:23:29 PM
Attachments: image001.png

Just FYI – think he hit reply rather than reply all.

From: Taylor, Angus (MP) [mailto:Angus.Taylor.MP@aph.gov.au]
Sent: Tuesday, 15 January 2019 3:01 PM
To: [redacted]
Subject: Re: Analysis and op Ed's [SEC=UNCLASSIFIED]

Brilliant. Thanks [redacted]

Sent from my iPhone

On 14 Jan 2019, at 5:11 pm, [redacted] wrote:

[redacted]

[redacted]

[redacted] [redacted]

[redacted]

[redacted]

[redacted]

[redacted] [redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

From: Taylor, Angus (MP) [mailto:Angus.Taylor.MP@aph.gov.au]
Sent: Saturday, 5 January 2019 3:23 PM
To: Tim Roy [redacted]; Tim Neal [redacted]; [redacted]
Subject: Analysis and op Ed's

Team

While I'm away it would be good if we could work on two 'parcels' of work, which (as a forcing device) I have captured in a draft op ed and supporting analysis.

1. Comparing electricity prices - Labor v Coalition

This piece is an analysis that needs to be done state by state (and nationally) for households and small businesses.

I have had a first crack at the analysis, using various sources, for NSW households. It builds heavily on the recently released AEMC forecasts, with extra overlays from the ACCC report, as well Brian Fisher's carbon price work (I have used draft numbers, these will need to the updated when we get the final ones)

[redacted]

[redacted]

[redacted] it would be great if you could do this state by state (it's a pretty straightforward cut and paste) and also do a small business version (which means charging less for distribution and transmission, so wholesale prices are a much bigger party of the charges)

[redacted]

[redacted]

We won't be able to do this until we have Fisher's modelling, and we need to think how it fits with the shortlist of underwriting projects

2. Labor's emission targets - the implications

This is a piece laying out the full implications from past modeling of Labor emission policies:

[redacted]

We need to think about the timing of this with respect to Fisher's modelling work.

[redacted] - we need to get the exact numbers behind the 2020-2030 abatement task as it was forecast in 2008. The PM has talked about 3.2 billion tonnes (now down to around 320 million) but I can't find any original source for this. The one document often attributed with this was Labor's 2008 "Australia's low pollution future". This might be a question for the department.

[redacted]

[redacted]

Hope that's clear. I'll be on WhatsApp and email while I'm away. It would be good to keep this work moving

Cheers

Angus

Sent from my iPad

From:	Taylor, Angus (MP)
To:	[redacted]
Subject:	Re: Analysis and op Ed's [SEC=UNCLASSIFIED]
Date:	Tuesday, 15 January 2019 3:01:26 PM
Attachments:	image001.png
Importance:	High

Brilliant. Thanks [redacted]

Sent from my iPhone

On 14 Jan 2019, at 5:11 pm, [redacted] wrote:

[redacted]

[redacted]

[redacted] [redacted]

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[redacted]

[redacted]

[redacted]

[redacted] | Adviser

Office of the Hon Angus Taylor MP
Minister for Energy | Member for Hume
Parliament House CANBERRA ACT 2600

T. +61 2 6277 7210 | M. [redacted]

From: Taylor, Angus (MP) [redacted]
Sent: Saturday, 5 January 2019 3:23 PM
To: Tim Roy [redacted] Tim Neal [redacted]
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[redacted]

[redacted]

We won't be able to do this until we have Fisher's modelling, and we need to think how it fits with the shortlist of underwriting projects

[redacted]

[redacted]

[redacted]

We need to think about the timing of this with respect to Fisher's modelling work.

[redacted] - we need to get the exact numbers behind the 2020-2030 abatement task as it was forecast in 2008. The PM has talked about 3.2 billion tonnes (now down to around 320 million) but I can't find any original source for this. The one document often attributed with this was Labor's 2008 "Australia's low pollution future". This might be a question for the department.

[redacted]

[redacted]

Hope that's clear. I'll be on WhatsApp and email while I'm away. It would be good to keep this work moving

Cheers

Angus

Sent from my iPad

[redacted] [redacted]
To: "Taylor, Angus (MP)"
Cc: Tim Roy; [redacted]
Subject: RE: Analysis and op Ed's [SEC=UNCLASSIFIED]
Date: Tuesday, 15 January 2019 12:11:13 PM
Attachments: image001.png

[redacted]

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[redacted] [redacted]

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[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted] Adviser

Office of the Hon Angus Taylor MP
Minister for Energy | Member for Hume
Parliament House CANBERRA ACT 2600

T. +61 2 6277 7210 | M. [redacted]

From: Taylor, Angus (MP) [mailto:Angus.Taylor.MP@aph.gov.au]
Sent: Saturday, 5 January 2019 3:23 PM
To: Tim Roy [redacted]
Subject: Analysis and op Ed's

Team

While I'm away it would be good if we could work on two 'parcels' of work, which (as a forcing device) I have captured in a draft op ed and supporting analysis.

1. Comparing electricity prices - Labor v Coalition

This piece is an analysis that needs to be done state by state (and nationally) for households and small businesses.

I have had a first crack at the analysis, using various sources, for NSW households. It builds heavily on the recently released AEMC forecasts, with extra overlays from the ACCC report, as well Brian Fisher's carbon price work (I have used draft numbers, these will need to the updated when we get the final ones)

[redacted]

[redacted] it would be great if you could do this state by state (it's a pretty straightforward cut and paste) and also do a small business version (which means charging less for distribution and transmission, so wholesale prices are a much bigger party of the charges)

[redacted]

We won't be able to do this until we have Fisher's modelling, and we need to think how it fits with the shortlist of underwriting projects

2. Labor's emission targets - the implications

This is a piece laying out the full implications from past modeling of Labor emission policies:

[redacted]

We need to think about the timing of this with respect to Fisher's modelling work.

[redacted] we need to get the exact numbers behind the 2020-2030 abatement task as it was forecast in 2008. The PM has talked about 3.2 billion tonnes (now down to around 320 million) but I can't find any original source for this. The one document often attributed with this was Labor's 2008 "Australia's low pollution future". This might be a question for the department.

[redacted]

Hope that's clear. I'll be on WhatsApp and email while I'm away. It would be good to keep this work moving

Cheers

Angus

Sent from my iPad

From:	Taylor, Angus (MP)
To:	Tim Roy; Tim Neal; [redacted]
Subject:	Analysis and op Ed's
Date:	Saturday, 5 January 2019 3:22:57 PM
Importance:	High

Team

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[redacted]

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Cheers

Angus

Sent from my iPad

From: [redacted]
To: Tim Roy
Cc: John Hirjee; Tim Neal; [redacted]
Subject: FW: Follow up from Minster Taylor meeting [SEC=UNCLASSIFIED]
Date: Thursday, 20 September 2018 11:37:53 AM
Attachments: [redacted]

Hi [redacted]

The attached report was a comeback from the Minister's meeting with AEMO last Friday.

[redacted]

From: [redacted]
Sent: Thursday, 20 September 2018 10:39 AM
To: [redacted]
Subject: Follow up from Minster Taylor meeting

Hi [redacted],

Please find attached the [redacted] report discussed last week. Please note this is confidential and for your information only. We are in the process of being updated. Happy to discuss any of the content with you.

Best Regards

Peter Geers
Executive General Manager Markets
Australian Energy Market Operator
T [redacted]
M [redacted]
E [redacted]@aemo.com.au

From: [redacted]
To: [redacted]
Subject: Follow up from Minster Taylor meeting
Date: Thursday, 20 September 2018 10:39:53 AM
Attachments: [redacted]

Hi [redacted]

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Best Regards

[redacted]
Executive General Manager Markets
Australian Energy Market Operator
[redacted]

Economic consequences of alternative Australian climate policy approaches

Australian climate policy is at a cross-roads. With a Federal election expected in May 2019, it is timely to assess the economic impacts of the alternative domestic policy approaches proposed by the two major political parties. While the Coalition government seeks to meet its Paris Agreement commitment of 26-28 per cent emissions reduction by 2030 (relative to 2005), the Labor opposition has announced a higher target of 45 per cent emissions reduction over the same time frame, with the aim of reaching net zero emissions by mid-century.

BAEconomics has examined the economic impacts of adopting different domestic climate policies using the BAEGEM Computable General Equilibrium (CGE) Model. BAEGEM is a recursively dynamic CGE model of the world economy. For each one-year time step, BAEGEM simulates the inter-relationships between production, consumption, economic growth, flows of international trade and investments, constraints on natural resources and production factors, and greenhouse gas emissions (Mi and Fisher 2014). The world regions and production sectors covered in the current model disaggregation are presented in Table 1 and some key model assumptions are set out in Table 2.

Table 1: Regions and sectors in BAEGEM

	Regions		Sectors
1	United States	1	Crops
2	Canada	2	Livestock
3	Mexico	3	Forestry
4	EU27	4	Fishing
5	Russia	5	Thermal Coal
6	Rest of Europe	6	Metallurgical Coal
7	China	7	Oil and Gas
8	India	8	Oil refinery
9	Japan	9	Iron ore
10	Korea	10	Other mining
11	Australia	11	Food processing
12	Rest of Asia	12	Chemicals, rubber and plastics
13	Brazil	13	Manufacture of non-metallic mining products
14	Rest of Latin America	14	Other manufacturing
15	Middle East	15	Iron and Steel
16	North Africa	16	Non-Ferrous Metal
17	South Africa	17	Electricity
18	Rest of Africa	18	Construction
		19	Land Transport
		20	Air and water Transport
		21	Services

Table 2: Overview of BAEGEM

Distinguishing Feature	BAEGEM
Solution Concept	Market equilibrium driven by supply and demand
Expectations/Foresight	Recursive dynamics
Representation of end-use sectors	There is one representative household and one government for each economy
Investment dynamics	Investment is driven by long-term GDP growth rates and investment return differentials between economies
Labour market flexibility	Not fully flexible, lower GDP growth rate will a trigger higher unemployment rate and a fall in real wages
Link between energy system and macro-economy	GDP sets the scale of economic activity in the model, which in turn drives the demand for each commodity in each segment of the world economy
Greenhouse gases covered	CO_2, CH_4, N_2O, HFCs, PFCs and SF_6
Emission sectors covered	Energy, Transport, Fugitives, Industry, Agriculture, Waste, LULUCF
Electricity production	Substitution allowed between Coal, Gas, Oil, Hydro, Nuclear, Wind, Solar, Biomass and Other Renewables
Technological Change/Learning	Learning-by-doing gradually reduces the average production costs of renewable technologies (except hydro), compared with conventional electricity technologies over the reference case
Integration costs	Increased investment in intermittent renewable electricity technologies incurs additional capital efficiency integration costs to firm generation from these sources. Firming costs are based on estimates in Lovegrove et al. (2018).
Thermal efficiency improvement for fossil fuel electricity generation	0.5 per cent per year over the reference case
Energy consumption	Substitution allowed between coal, gas, liquid fuel and electricity
Fuel consumption in transportation	Substitution allowed between coal, oil, gas, biofuel and electricity
Autonomous fuel efficiency improvement for transportation	2.5 per cent per year over the reference case
Autonomous energy efficiency in other sectors	0.5 per cent for developed economies, 1 per cent for developing economies over the reference case
Implementation of climate policy targets	Carbon prices, cap-and-trade, indirect taxes, regulatory targets, and combinations of the above

In our modelling we have analysed a range of policy scenarios using as a starting point the Australian Government's emissions projections released in December 2018 (Department of Environment and Energy 2018). One of the key features of the Department of Environment and Energy's most recent projections is their estimate of the extent to which Australia is likely to over-achieve on its Kyoto Protocol emissions reduction target. We have assumed that the Kyoto carryover will be utilised to help meet future targets under the Paris Agreement.

In the first instance we have modelled two alternative policy commitments. The first policy scenario is one in which a Paris target of a 26-28 per cent reduction in emissions is achieved by 2030 compared to the base year of 2005, allowing the Kyoto carryover to be utilised. In this scenario renewable energy generators contribute 36 per cent of Australia's electricity by 2030. In the second policy scenario Australia undertakes a 45 per cent reduction in greenhouse gas emissions compared to the 2005 base year, again allowing for the use of the Kyoto carryover and in addition a 50 per cent renewables target is imposed on the electricity sector.

Under either policy scenario the Australian economy must adjust as more emissions intensive activities make way for industries that are less greenhouse gas emissions intensive. In some cases such adjustments are technically difficult and therefore expensive. For example, at present it is not practical to control the methane emissions from livestock grazed on native pasture land and as a consequence the marginal cost of abatement is very high for that activity. In other activities the projects approved under the Coalition Government's Emissions Reduction Fund show that, up to a certain point, emission reductions can be achieved by, for example, terrestrial sequestration of carbon, for around $A13-14/t$CO_2$e abated. The modelling chooses the least cost way of meeting the specified abatement targets subject to the constraints on renewable energy generation in the electricity sector. All policy options will result in some cost in terms of output foregone (GDP) because the economy is being forced to adjust away from the trajectory it is on. This adjustment will in turn affect employment and real wages.

Meeting a 26-28 per cent reduction target is projected to mean that by 2030 the Australian economy would be around $A19b smaller in terms of GDP than it otherwise would have been.[1] This is equivalent to saying that the economy grew at a rate of 2.8 per cent per year over the decade to 2030 compared to a rate of 2.9 per cent a year.

To achieve a 45 per cent target is much more costly in terms of projected output change. Expressed in terms of the impact in 2030 of the more stringent target the economy is projected to be $A144b smaller than it otherwise would have been in terms of loss in GDP. This is equivalent to the economy growing at around 2.3 per cent per year over the decade to 2030 compared to a rate of 2.9 per cent.

Cumulative GDP losses (discounted to net present value terms using an assumed social discount rate of 2.6 per cent) are estimated to be A$69 billion and A$472 billion over the decade to 2030 depending on whether less or more stringent abatement targets are adopted.

In BAEGEM the labour market is not fully flexible with some adjustment taken up by a change in employment but with the major share of adjustment accounted for by changes in the real wage rate. In other words, a negative shock to output will result both in some loss of jobs and a reduction in real wages. With a 26-28 per cent emissions reduction target average real yearly income for a full-time worker is projected to be around $A2000 lower than it otherwise would have been in 2030. With a 45 per cent reduction target the projected fall in real annual wages is around $9000

Unless otherwise stated all results are presented in real $A 2016.

per year by 2030, illustrating the extent of the economic adjustment required by the economy to reach the more stringent target.

This analysis is part of an ongoing research project being undertaken by BAEconomics. Further results from this work will be released as they become available.

References

Department of Environment and Energy (2018). *Australia's emissions projections 2018*, Commonwealth of Australia, http://www.environment.gov.au/system/files/resources/128ae060-ac07-4874-857e-dced2ca22347/files/australias-emissions-projections-2018.pdf.

Mi, R. and Fisher, B. S. (2014), *Model Documentation: BAEGEM the BAEconomics Computable General Equilibrium Model of the World Economy*, http://www.baeconomics.com.au/wp-content/uploads/2014/02/BAEGEM-229 documentation-21Feb14.pdf).