: vivideconomics

Review of international emissions trends and policy developments

Report prepared for WWF Australia

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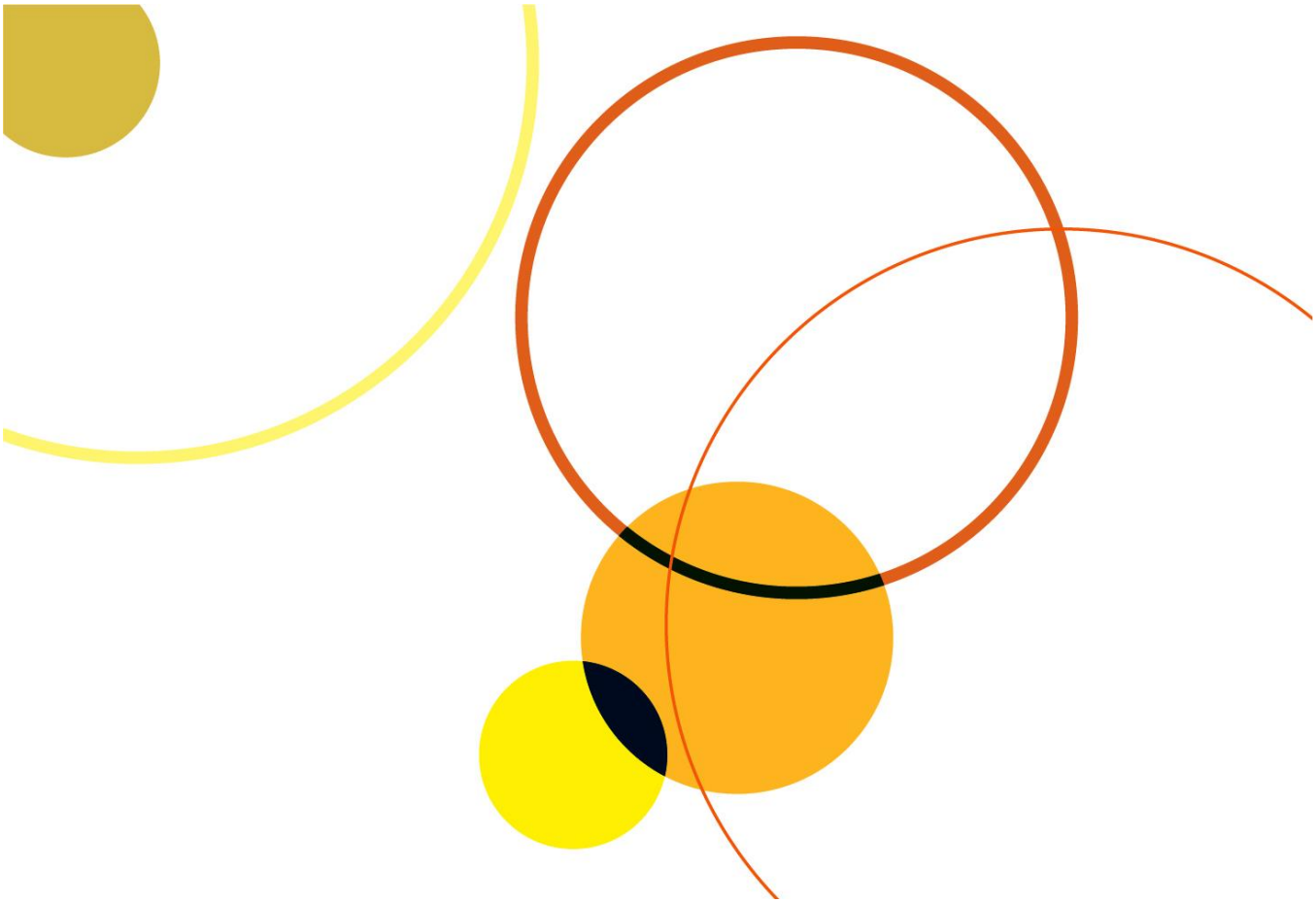


Executive summary

Over the past 50 years, increasing greenhouse gas concentrations have already had a direct effect on the Australian climate; effects which are anticipated to continue through the 21st Century. With a high degree of confidence, the IPCC (2014) has said that GHG emissions have contributed to rising average temperatures in Australia and decreasing rainfall in south-western Australia. Events such as the Black Saturday bushfires, which resulted in more than 170 deaths, have highlighted the vulnerability of some ecosystems and many human systems to climate variability. The frequency and/or intensity of such events is predicted to increase in many parts of Australia. In particular, with varying degrees of likelihood, the recent IPCC Fifth Assessment Report, released in March 2014, identifies the following key climate change related risks faced by Australia:

- increased frequency and intensity of flood damage to settlements and infrastructure;
- constraints on water resources, particularly in Southern Australia, driven by rising temperatures and reduced rainfall;
- increased risks to coastal infrastructure and low-lying ecosystems from continuing sea level rise;
- significant reduction in agricultural production in the Murray-Darling Basin and far south-eastern and south-western Australia if scenarios of severe drying are realised;
- increased damage to ecosystems and settlements, economic losses and risks to human life from wildfires in most of southern Australia, driven by rising temperatures and drying trends;
- increased morbidity, mortality and infrastructure damages during heat waves;
- significant change in community composition and structure of coral reef systems, driven by increasing sea-surface temperatures and ocean acidification; and
- the loss of ecosystems in mountainous regions and some native species.

Reducing these risks requires concerted international efforts. A key feature of the climate change problem is that each tonne of emissions has the same impact regardless of where it is emitted. This raises the risk that action to tackle climate change in one country (Australia) may be ineffective if the additional costs and regulation simply displace economic activity and emissions to locations which are less heavily regulated. This can result in a failure to reduce net emissions while at the same time harming Australia's economic interests. The risk of 'carbon leakage' is real and needs to be taken seriously; identifying which countries are taking action and the strength of that action is important to understand the significance of this risk.

At the same time, bilateral and multilateral cooperation is placing increased emphasis on what countries are doing to address climate change. The topic was a central theme in an EU-US summit in March 2014 where the two blocs agreed that sustainable economic growth is only possible if climate change is tackled (The White House 2014a). Leaders made an explicit link between trade liberalisation and efforts to address climate change. Similarly, in February 2014 a joint statement from the US and China reaffirmed their commitment to global efforts to meet the challenge. The countries agreed to achieve specific actions related to climate change in time for the Sixth US-China Strategic and Economic Dialogue to be held later in 2014. This suggests that international trade partners are increasingly placing attention on what countries are doing to address climate change, and that they are linking progress on the matter to a wider range of issues

affecting Australia's national interest. This further increases the importance of understanding the climate action that Australia's key international partners are taking.

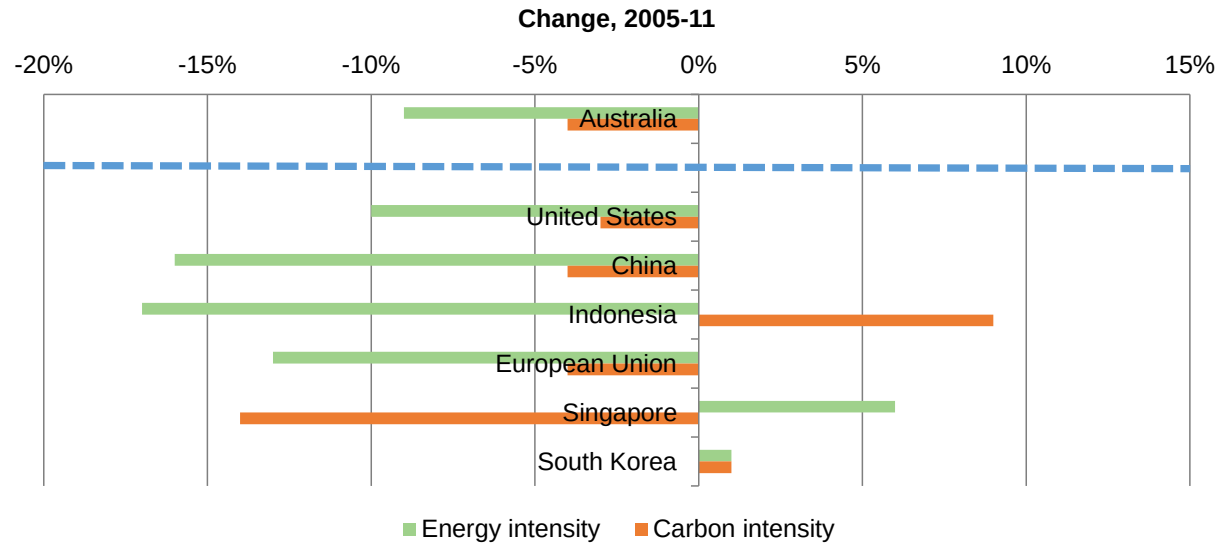
This report looks at both the historic performance and future trends in climate action in a series of Australia's key trading partners. It considers Australia's performance relative to six countries: the US, China, Indonesia, the EU, Singapore and South Korea. The report chose these countries on the basis of an objective assessment of either their contribution to global emissions or their significance as an Australian trading partner.

Historic performance of comparator countries

Four factors can explain trends in emissions from energy consumption: population growth, income growth, the energy intensity of the economy and the carbon intensity of energy consumption. Of these, the two most appropriate mechanisms for policy action are to reduce the energy intensity of the economy or the carbon intensity of energy consumption.

Figure 1. **Australia underperformed against four countries for reductions in energy intensity and against three for reductions in carbon intensity**

Source: *Vivid Economics*

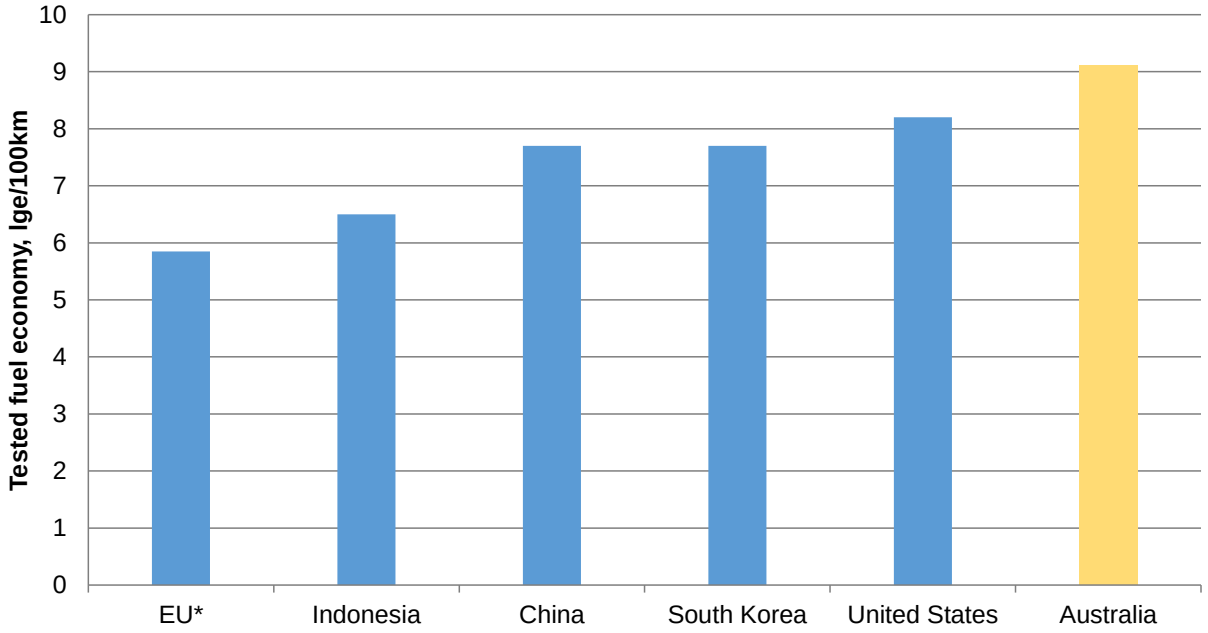


Four of the six comparators – EU, US, Indonesia and China – reduced the energy intensity of their economy more than Australia over the period 2005-2011. While the energy intensity of Australia's economy fell by nine per cent, other developed areas such as the US and EU achieved reductions in energy intensity of 10 and 13 per cent respectively as indicated in Figure 1. Reductions were higher again in China (16 per cent) and Indonesia (17 per cent).

One specific measure of energy intensity is provided by the energy efficiency of light duty vehicles; on this metric Australia is one of the worst performers in the world. IEA (2013) analysis of the fuel

economy of new registrations of light duty vehicles reveals that Australia's car fleet is the most energy intensive of the 37 countries reviewed, with each new vehicle consuming on average 9.1 litres of gasoline equivalent (lge) /100km. This is almost twice as high as the lead country, Denmark, which had a metric of 5.2 lge/100km and an EU average in the sample of 5.9 lge/100km (Figure 2). Australia also ranks behind the other comparator countries for which data is available including the US (8.2 lge/100km), South Korea (7.7 lge/100km), China (7.7 lge/100km) and Indonesia (6.5 lge/100km).

Figure 2. **Australia's light duty vehicle fleet is the least efficient of comparators for which data is available**



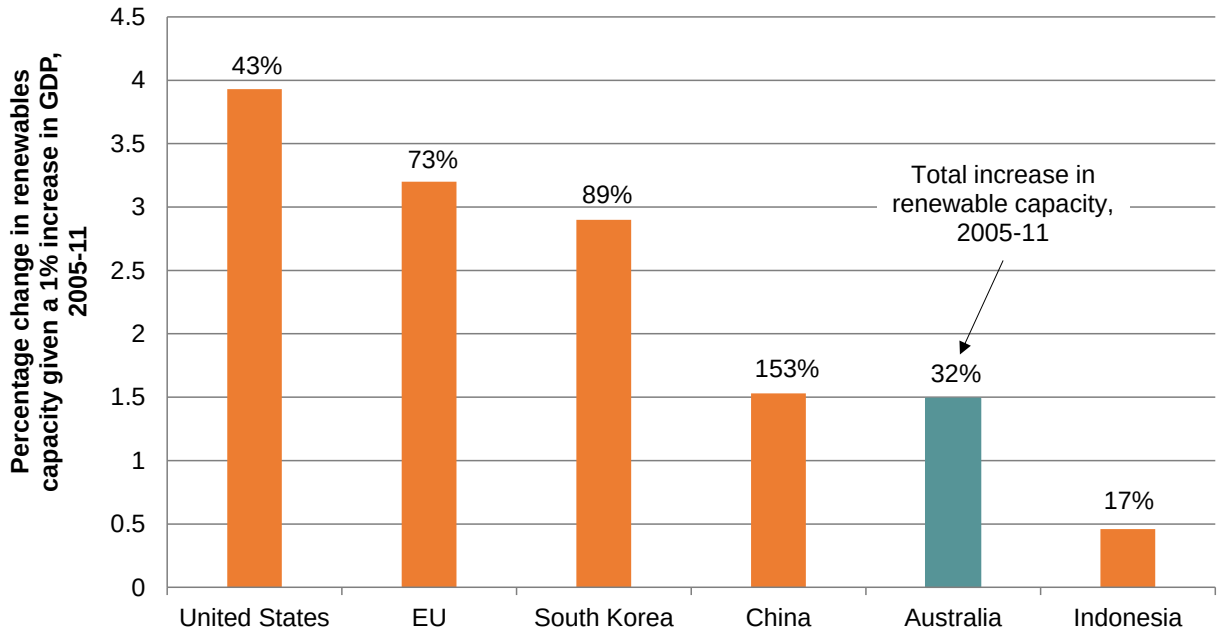
Note: *Tested fuel economy figures are 2010 averages based on country samples of new registrations of light duty vehicles; *EU is average across 21 tested member states; lge denotes litres of gasoline equivalent.*

Source: *Vivid Economics based on IEA*

For carbon intensity, three of the six countries – China, the EU and Singapore – achieved greater reductions in carbon intensity than Australia over the same time period. While Australia achieved a 3.6 per cent reduction in carbon intensity of energy consumption during 2005-11, China achieved a 4.2 per cent decline and the EU a 4.0 per cent decline. At 14 per cent, Singapore achieved the greatest reduction in carbon intensity.

A further metric which measures decarbonisation success is the extent of additional renewable energy capacity; Australia has added less capacity than most comparator countries. Figure 3 shows that Australia increased its renewable capacity by 32 per cent in the years 2005-11, adding 3,000 MW. In percentage terms this was the second lowest of all countries in the sample with China achieving a 153 per cent increase and the EU a 73 per cent increase. The figure also shows that in Australia, a 1 per cent increase in GDP over this period was associated with just a 1.5 per cent increase in renewables capacity; this was the fifth lowest out of the six countries analysed. In the EU and US, a 1 per cent increase in GDP was associated with a 3.2- 3.9 per cent increase in renewables capacity.

Figure 3. **Australia underperforms against four out of five comparator countries for the responsiveness of renewables capacity to changes in GDP**



Note: *Estimates on Singapore not available due to data limitations*

Source: *Vivid Economics based on EIA data*

Taken together, Australia compares unfavourably across many metrics of the country's recent emissions performance. Table 1 shows that against the six comparator countries, Australia:

- underperforms against four out of six countries for reductions in the energy intensity of the economy between 2005 and 2011;
- underperforms against all countries for which data is available on vehicle energy efficiency;
- underperforms against three countries in terms of reductions in the carbon intensity of its energy consumption; and
- underperforms against four out of five countries on a metric which captures the responsiveness of renewables capacity growth to GDP growth.

Future emissions trends

The CCA has assessed that Australia should increase its 2020 emission reduction target from five per cent to 15 per cent below 2000 levels. It finds that the 15 per cent target is the minimum required consistent with the latest science on climate change and a more equitable spread of effort over the decades ahead. The Authority also notes that the target can be achieved at manageable costs once appropriate policies are implemented.

Table 1. **Most comparator countries' recent performance was stronger than Australia's, especially for energy intensity and fuel economy**

Country		Carbon intensity		Energy intensity		Vehicle emissions standards		Renewables	
		Change, 2005-11	Performance vs Australia	Change, 2005-11	Performance vs Australia	Tested fuel economy, lge/100km	Performance vs Australia	Percentage increase in renewables capacity given a 1% increase in GDP	Performance vs Australia
	Australia	-4%	-	-9%	-	9.1	-	1.49	-
	United States	-3%	WEAKER	-10%	STRONGER	8.2	STRONGER	3.93	STRONGER
	China	-4%	STRONGER	-16%	STRONGER	7.7	STRONGER	1.53	STRONGER
	Indonesia	9%	WEAKER	-17%	STRONGER	6.5	STRONGER	0.46	WEAKER
	European Union	-4%	STRONGER	-13%	STRONGER	5.9*	STRONGER	3.20	STRONGER
	Singapore	-14%	STRONGER	6%	WEAKER	-	NA	-	NA
	South Korea	1%	WEAKER	1%	WEAKER	7.7	STRONGER	2.90	STRONGER

Notes: *Lge is litres of gasoline equivalent; *Average for 21 tested member states; Fuel economy tests are 2010 light duty vehicle averages for new registrations.*

Source: *Vivid Economics*

A five per cent target is weaker than many comparator countries' targets, particularly the US and Indonesia. Table 2 indicates that many countries targets are more ambitious than Australia's five per cent target. If all countries achieved their goals by 2020 then, using four different metrics suggested by the CCA for measuring extent of climate ambition[1], Australia would:

- underperform against two countries in terms of proportionate emissions reductions;
- underperform against four countries in terms of emissions intensity levels;
- underperform against three countries in terms of emission reductions from Business-As-Usual (BAU) and
- underperform against all six countries in terms of per person emissions levels.

Even if Australia maintains only a five per cent target, expected policy changes would likely see it falling far short of achieving that goal. Currently implemented policies in Australia are expected to result in the country achieving the unconditional five per cent target. However, various studies have shown that expected legislative changes, particularly to the carbon trading framework, would lead to Australia falling far short of achieving this goal.

By contrast, five out of six comparator countries are on track to achieving their emission reduction targets. Error! Reference source not found. shows whether or not countries are on track to meet their targets according to a range of scenarios:

- in the US, the successful implementation of the Climate Action Plan (CAP) will result in the country reaching its 17 per cent target, a goal that is more ambitious than Australia's on all four metrics identified by the CCA;
- China will also achieve its target if further planned policies are implemented. While the target is less ambitious than Australia's on most metrics, attaining the goal will result in a reduction in emissions intensity comparable with most developed economies;
- Indonesia is on track to achieve its target once further planned polices are implemented. The target is more ambitious than Australia's for three out of four metrics;
- the EU is firmly on track to meet its 2020 target with existing policies, with some projections estimating that it will exceed it. It is more ambitious than Australia's target for two out of four metrics; and
- Singapore is on track to deliver its unconditional target with existing policies. The target is more ambitious than Australia's using two of the four metrics.

Among the six comparators reviewed in this study, South Korea is the only one not on track to meet its emission reduction target. Although South Korea will begin an emissions trading scheme in 2015, independent analysis suggests it may still fall somewhat short of its target. Nevertheless, South Korea's efforts would be more ambitious than Australia's five per cent target for three out of four metrics considered. The contrast with Australia's performance against its projected target is stark.

[1] Proportionate reduction in emissions; deviation in emissions from business as usual; impact on carbon intensity of GDP; and impact on emissions per person.

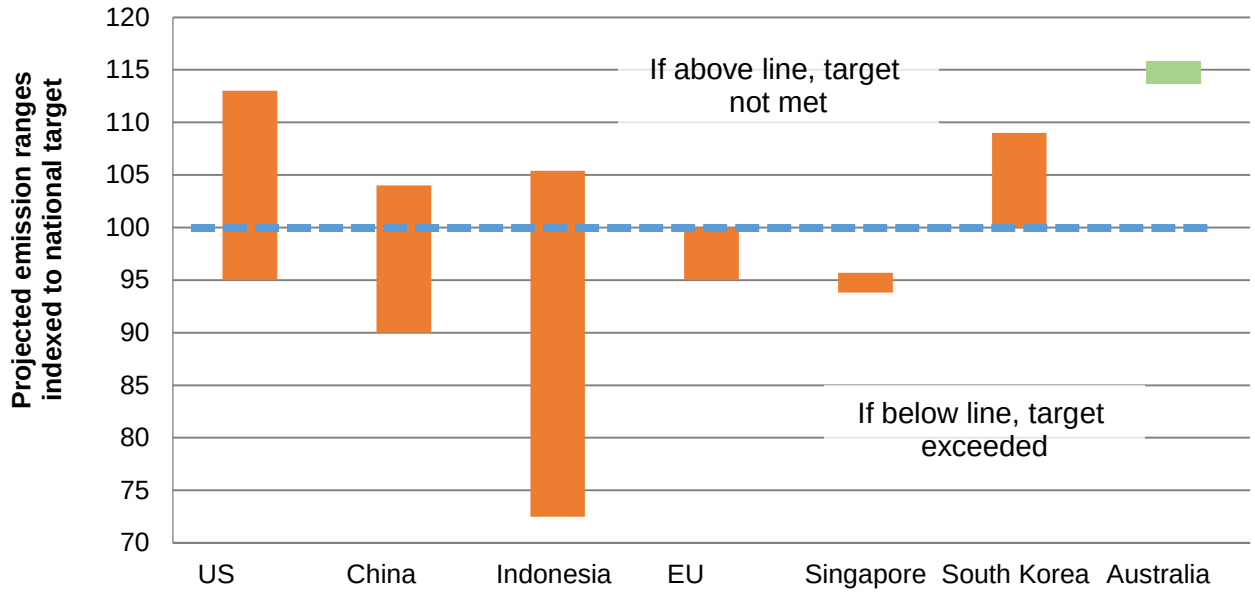
Table 2. **All comparator countries' targets would outperform Australia on the per person emissions metric**

Country		Emissions target	Reduction ambition would outperform Australia's 5% target based on:			
			Emissions proportion	Emissions intensity	BAU	Per person emissions
	Australia	Reduction of at least 5% below 2000 levels by 2020	-	-	-	-
	United States	Reduction of 17% below 2005 levels by 2020	✓	✓	✓	✓
	China	Reduction of 40-45% in emissions per unit of GDP based on 2005 levels by 2020	✗	✗	✗	✓
	Indonesia	26% reduction below a 2020 baseline rising to a 41% reduction with international assistance	✓	✗	✓	✓
	European Union	Reduction of at least 20% below 1990 levels by 2020	✗	✓	✗	✓
	Singapore	Conditional 16% reduction below BAU in 2020, with an unconditional target of 7-11%	✗	✓	✗	✓
	South Korea	30% reduction below BAU in 2020	✗	✓	✓	✓

Note: *China: Figures are robust for choice of target except for BAU where 45% reduction would result in China exceeding Australia's 5% target; Indonesia: Figures are for 26% reduction; Singapore: Figures are robust for choice of targets; BAU: business-as-usual*

Source: *Vivid Economics based on CCA*

Figure 4. **Australia is the only country that is expected to fall far short of meeting its targets**



Note: *The emissions associated with the target for each country is indexed to 100 and projections indexed accordingly. A lower figure indicates greater expected emission reduction. For the US, China, Indonesia and South Korea, projections assume implementation of policies planned but not yet implemented. For Australia, projections assume repeal of climate legislation as planned but not yet implemented. A number of countries have expressed their targets as a range. In this chart, China calculations relate to 40% emission intensity reduction target, for Indonesia 26% reduction against BAU emissions, for Singapore a 7% reduction against BAU and for Australia a 5% reduction target.*

Source: *Vivid Economics*

Current and future policies

In contrast to Australia's plans to repeal clean energy legislation, comparator countries have recently increased both their commitment and actions to tackle climate change. The leaders of the US, China, the EU, and South Korea have been vocal in recent months in their calls for greater global and domestic efforts to tackle climate change. Several countries, including the US, EU and Singapore, have also developed or renewed overarching strategy documents to achieve targets and promote sustainable energy.

Recent policy developments in comparator countries point to their commitment to achieving emissions targets and promoting economic growth through green investments. Other major policy developments in comparator countries focus on:

- Renewable energy – grants, incentives, official targets and reforms of regulations have been enacted in order to promote investment in renewables and increase capacity;
- Energy efficiency (EE) – energy management practices for large users, EE obligations, demand side management schemes and tax incentives have been increased to improve energy efficiency;
- Carbon management – Emissions Trading Schemes (ETS) are increasingly being rolled out, with five regional schemes implemented in China and one in South Korea expected in 2015. Existing schemes in the US and EU are being reformed to increase effectiveness; and

- Transport and other measures – Fuel quality and economy standards have been tightened in the US and China, while new standards will be introduced in the EU from 2021.

Table 3 summarises the key policy measures implemented over the past 12 months in comparator countries, as well as some expected developments.

Table 3. **A range of policies have been implemented over the past 12 months with more expected in the coming year**

Country		Overarching policies/ strategy documents	Renewable energy	Energy efficiency	Carbon management	Transport and other measures
	United States	Climate Action Plan launched in June 2013	New goals set for clean energy permits on public lands by 2020-25 Federal agencies to streamline permission process for transmission projects Tax credits for wind generation extended	Energy efficiency legislation expected to pass in 2014 Tightened appliances standards being rolled out Tax incentives and loan programmes to promote EE extended or introduced in 2013	Minimum standards on power plants to be introduced in 2014 Californian ETS established in January 2013 RGGI ETS tightened emissions cap in February 2014	Loan programmes to support sustainable energy technologies expanded Tightened fuel economy standards enacted
	China	Specific climate change legislation to be published in 2014	New incentives for the photovoltaic industry announced Reforms of energy management systems expected to promote more wind generation	Implementation of Green Building Action Plan introduced new standards Guidance issued by State Council to promote resource conservation	Regional ETS in five cities/ provinces commenced from June to December 2013 with two more in preparation National ETS programme of work launched	Vehicle fuel quality standards tightened
	Indonesia		Official target of 23% of energy to come from renewables set in 2014 Reforms of solar photovoltaic regulations introduced in 2013	Appliances labelling scheme and minimum standards expected to be expanded in 2014 Public institutions mandated to achieve verified energy savings		Electricity and fuel subsidies reduced in 2013 Tax incentives for fuel efficient vehicles introduced New REDD agency established

Country		Overarching policies/ strategy documents	Renewable energy	Energy efficiency	Carbon management	Transport and other measures
	European Union	Post 2020 targets for emissions reduction of 40% on 1990 levels by 2030 proposed	EU-wide binding target of renewables to account for 27% of sources by 2030 proposed Guidelines on state support for renewables published	EE Directive obliges member states to implement a range of measures by mid-2014	ETS reformed through 'backloading' of carbon permits in March 2014	Tighter vehicle fuel standards from 2021 introduced following approval in January 2014 Climate change mitigation made an explicit objective of the CAP
	Singapore	Review of national sustainable energy strategy expected in 2014	Solar Capability Scheme introduced to provide grants for solar technology	Energy management practices mandated for large energy users Dedicated scheme for SMEs to improve EE launched in July 2013 Minimum standards for commercial buildings enacted		System of rebates and penalties based on vehicle emissions introduced in 2013
	South Korea		Revised regulations to promote renewable technologies released Public and private buildings' renewable heat energy obligations are set to rise by 2020 Renewable Portfolio Standard replaced feed-in-tariff mechanism	Import and production of inefficient light bulbs to be banned	Details on a national ETS to be released in 2014 with implementation set to commence in 2015	

Note: *EE: energy efficiency; ETS: emissions trading scheme; CAP: Common Agricultural Policy; REDD: reducing emissions from deforestation and forest degradation*

Source: *Vivid Economics*

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1 Introduction

This report reviews the climate action being undertaken in six leading economies of significance to Australia. There are at least two reasons why climate action undertaken by Australia's key trading partners is significant:

- It is often argued that action by Australia to reduce emissions risks undermining the competitiveness of key sectors of its economy because other countries are not taking comparable action. Furthermore, if other countries are not acting, then the environmental credibility of Australia's emission reduction efforts could be damaged as there would be incentives for economic activity, and associated emissions, to relocate from Australia to other locations resulting in little or no reduction in global emissions (a phenomenon known as carbon leakage). By contrast, if other countries are taking action on climate change then the risk of damaging Australian competitiveness and its susceptibility to carbon leakage is much reduced.

- Second, there is growing evidence that international discussions are linking action on climate change to a broader range of issues. For instance, climate change was a central theme in an EU-US summit in March 2014 where the two blocs agreed that sustainable economic growth is only possible if climate change is tackled (The White House 2014a).

Part of the analysis looks at the historic trends in emissions in comparator countries. This compares each country's performance with that of Australia. It looks in particular at whether these countries have been able to reduce the energy intensity of their economies and the carbon intensity of their energy consumption more or less quickly than Australia in recent years. This analysis also considers the extent of renewables growth in these countries and the energy performance of its vehicle fleet.

A second part of the analysis examines the forward-looking targets, in the context of analysis which suggests that Australia is not currently on track to meet its own target, and the policies comparator countries have implemented recently to attain them. Current legislation, if fully implemented, would be sufficient for Australia to meet its unconditional five per cent target. However, if the new administration implements policy proposals, including the repeal of clean energy legislation and carbon taxes, Australia is projected to miss its own emission reduction target. Detailed modelling by the Climate Institute (2013) suggests that coalition policy would result in emissions eight to ten per cent above 2000 levels by 2020, depending on policy scenario assumptions. It is therefore pertinent to understand whether other countries are on track to meet the targets that they have set themselves. This analysis builds on earlier work by the Climate Change Authority (CCA), which compared the emission reduction ambition of Australia with its key trading partners using a variety of different metrics. It also identifies the key policies and actions that governments have undertaken or plan to introduce in order to help meet these targets.

1.1 Structure of the report

The countries covered are the US, China, Indonesia, the European Union, Singapore and South Korea. We identify these countries based on an objective assessment of the economies that both:

- are most important in delivering global emission reductions; and
- whose firms could stand to gain if Australia was taking emission reduction action which was not being matched in their host country.

The analysis for each country follows the same structure:

- First, we review the recent historic performance of the country in reducing emissions. This focuses on emissions from the energy sector, and considers whether, adjusting for population changes and GDP growth, the country has recently improved both the energy intensity of its economy and the carbon intensity of its energy use by more or less than Australia. To augment this, we also consider the fuel efficiency of the light duty fleet in each country[2] as well as trends in renewable power capacity growth.

- Second, we identify the emission reduction target(s) that the country has set itself, ordinarily as part of the pledges made in response to the Copenhagen Accord, and use the analysis provided by the CCA to compare the ambition of this target with Australia's (actual and potential) targets[3]. We also report additional evidence on the ambition of the target where it is available.

- Third, we review the latest evidence on whether or not the country is on track to meet its target(s). This synthesises both modelling undertaken within the country, either by governments or other stakeholders (e.g. academics, policy analysts) as well as analysis by international bodies such as the International Energy Agency (IEA). We assess whether the country:

    - is on track to meet its target with existing policy measures;
    - appears on track if additional identified policy measures are successfully implemented; or
    - is not on track.

- Finally, we document some of the key recent and expected future climate policy actions that the country is taking covering, for instance, carbon pricing initiatives, the promotion of renewables, support to energy efficiency as well as policies in the transport and forestry sectors where applicable.

[2] Data on trends over time are not available for this variable.

[3] The Climate Change Authority did not consider Singapore in its analysis. In this case, we replicate the CCA analysis as far as possible.

2 United States

2.1 Recent historic performance

The US has already achieved an 8.4 per cent reduction in CO_2 emissions from energy combustion in the period 2005-2011. This reduction is significant given that CO_2 emissions from energy combustion accounted for 83 per cent of the US's emissions in 2005.

It is possible to decompose these emissions into four elements. The Kaya decomposition explains trends in CO_2 emissions from energy consumption according to four factors: population, GDP per capita, energy intensity and carbon intensity using the following formula:

$$CO_2\ Emissions = Population * \frac{GDP}{Population} * \frac{Energy\ consumption}{GDP} * \frac{CO_2\ Emissions}{Energy\ consumption}$$

Figure 5 shows that the US:

- achieved an overall decline in CO_2 emissions of 8.5 per cent in the 2005 to 2011 period;
- achieved a decline in energy intensity of 10.2 per cent over the period;
- reduced its carbon intensity of energy production by 3.1 per cent;
- had stagnant real GDP per capita meaning that output contributed to the fall in emissions by approximately 0.1 per cent; and
- recorded an increase in population of 5.4 per cent which offset the other factors that had contributed to a fall in emissions.

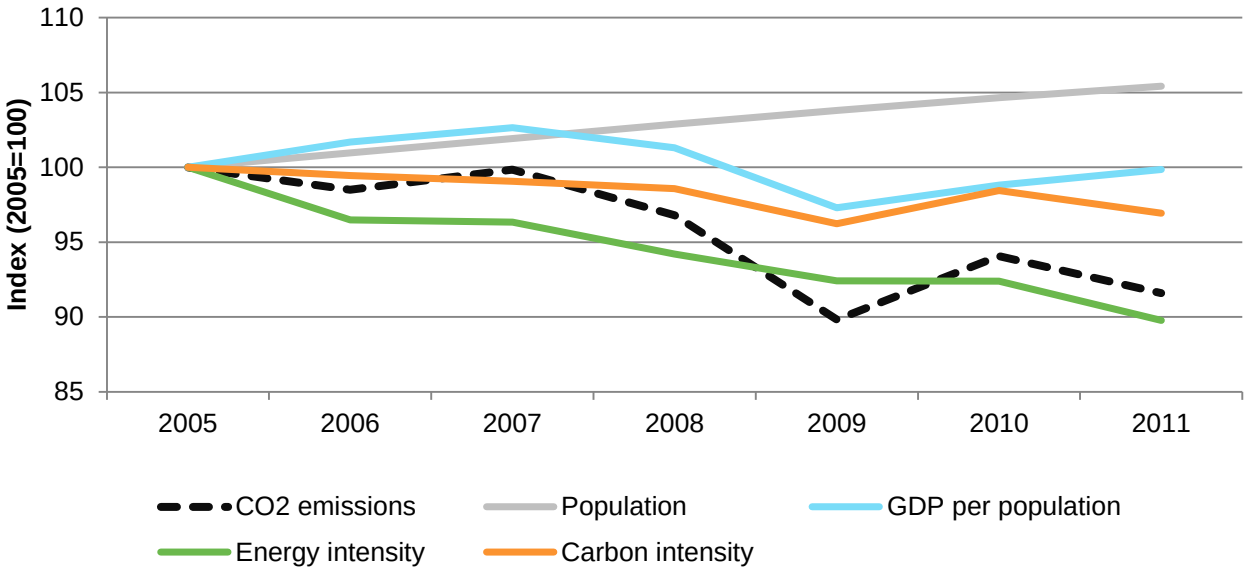
While the emissions intensity performance of Australia in recent years is comparable to the US, it underperformed for both overall emissions and energy intensity. Over the same period that the US reduced its emissions by 8.5 per cent, Australia's emissions increased by 4.3 per cent. While part of this is explained by differences in GDP performance between the two countries, the US's decline in energy intensity (10 per cent) was greater than Australia's (8.5 per cent). On the other hand, Australia achieved a slightly greater decrease in the emissions intensity of its energy consumption than the US (3.6 per cent compared to 3 per cent).

The stronger improvement in energy intensity in the US may be reflected in the most recent data on the energy intensity of the vehicle fleet of each country. IEA analysis of the fuel economy of new light vehicle registrations in 2010 shows the US fleet had a fuel economy of 8.2 lge/100km. Despite this being one of the worst scores, it nevertheless outperformed Australia's 9.1 lge/100km.

Australia also ranks behind the US for additional renewable capacity, both in proportional terms and relative to GDP growth. Australia's additional 3,000 MW of renewable capacity between 2005-11 represents growth of 32 per cent. By contrast, the US achieved additional capacity of over 43,000 MW, a 43 per cent increase. The responsiveness of growth in renewables to growth in GDP was also higher in the US:

A 1 per cent increase in GDP has been associated with a 1.49 per cent increase in renewable capacity in Australia versus 3.93 per cent in the US[4].

Figure 5. **Energy intensity has been a major factor in reducing US CO_2 emissions from energy use**



Note: *Kaya decomposition sourced from IEA* (OECD/IEA 2013a). *The Kaya identity decomposes emission as the product of population, GDP per capita, energy use per unit of GDP and carbon emission per unit of energy consumption. The components are in index form, rebased so that the value of the index for each component is 100 in 2005.*

Source: *IEA's CO_2 Emissions from Fuel Combustion, Highlights* (OECD/IEA 2013a)

2.2 Future targets

The United States has targeted a reduction in GHG emissions in the range of 17 per cent by 2020 compared with 2005. At the time the target was submitted, it was in line with anticipated legislation which has subsequently not been enacted, but President Obama's Climate Action Plan, launched in June last year, has since recommitted to the figure.

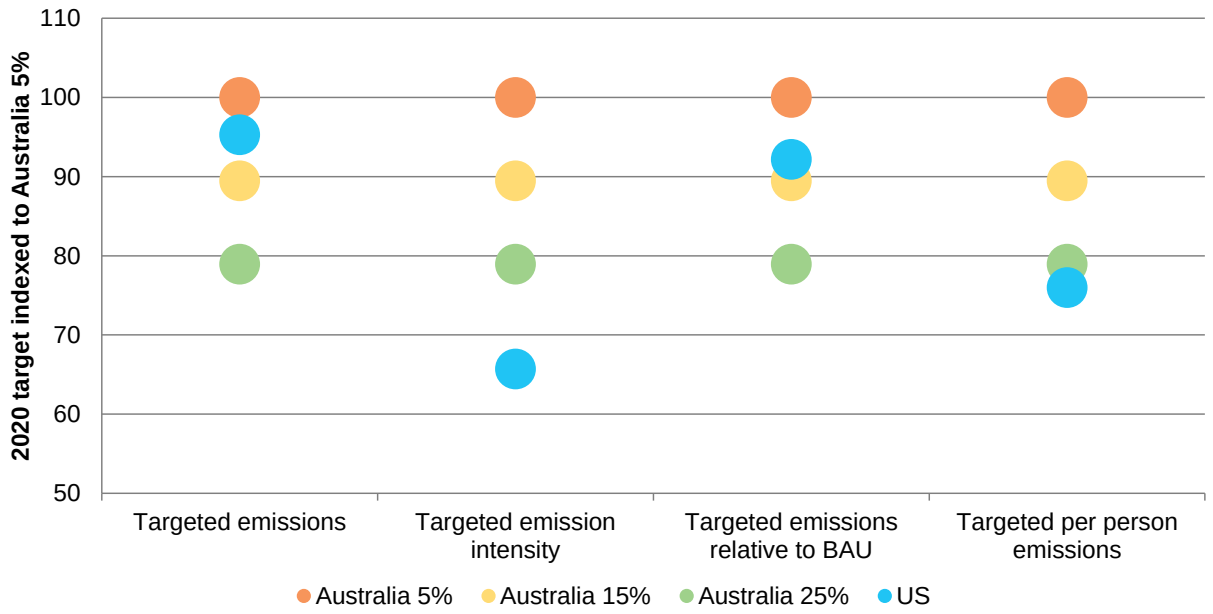
If Australia maintains a five per cent target by 2020, the US will outperform Australia across four different metrics of emission reduction ambition. This is highlighted in Figure 6 which shows how the US target compares with Australia's 5 per cent and 15 per cent target on four metrics to assess ambition as used by the Climate Change Authority (2014):

- proportional reduction in emission levels relative to 2005 levels;
- emissions intensity levels in 2020;
- proportional departure from BAU emissions; and
- per person emissions in 2020.

[4] The responsiveness of renewables capacity growth to GDP growth is calculated by running a bivariate regression of the log of renewable capacity in each year on the log of GDP each year. The figures should not be interpreted as elasticities due to data limitations. The calculation is repeated for each country in this analysis.

In each case, the success of Australia in meeting its 5 per cent target is 'scored' as 100. Each of the US 17 per cent target, Australia's 15 per cent target and Australia's 25 per cent target are scored relative to this performance. A lower number represents greater ambition to reduce emissions. It can be seen that, on all four metrics, the US's 17 per cent target is more ambitious than Australia's 5 per cent target.

Figure 6. **The US target is more ambitious than Australia's 5% target in terms of each of the four metrics considered by the CCA**



Note: *Lower value indicative of greater ambition for a given metric. US target is for a 17% reduction below 2005 levels by 2020.*

Source: *Vivid Economics based on CCA*

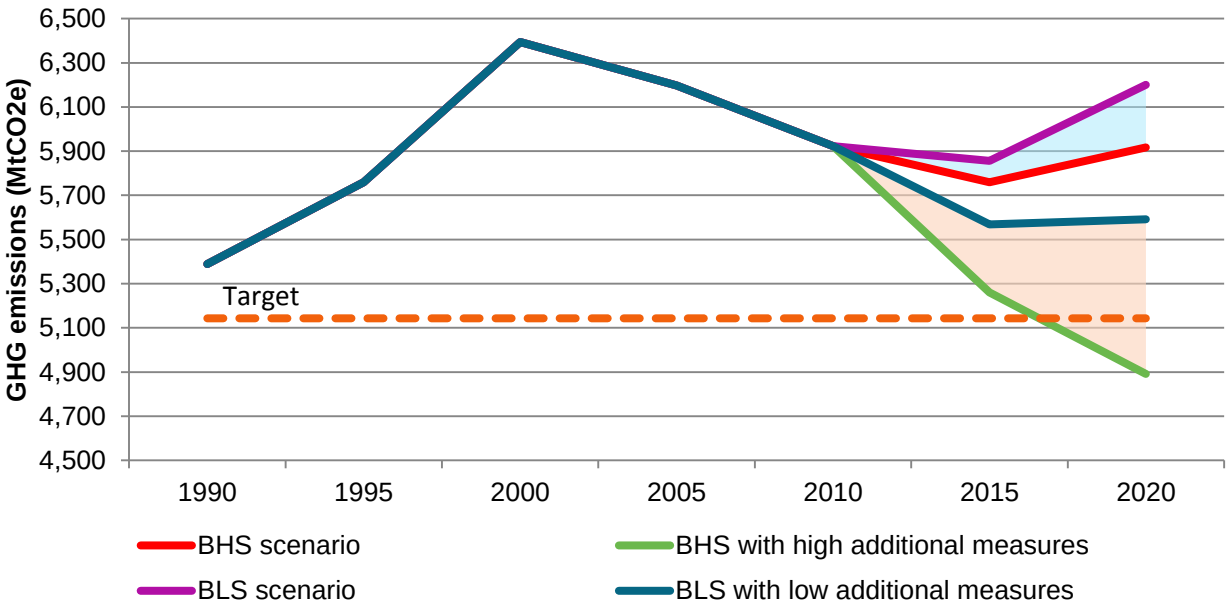
2.3 Projected trends

The CAP is projected to enable the US to meet its target, depending on emissions from land use change. The US Sixth National Communication (NC) to the UN shows baseline projections consistent with policies implemented before September 2012 (US/DOS 2014a). Figure 7 shows that the US's baseline emissions forecast would not lead to its target being reached in two scenarios for levels of carbon sequestration from land use change and forestry[5]. However, implementation of the CAP (as discussed below) is projected to lead to the US's emissions being 10 to 21 per cent below 2005 levels by 2020, depending both on whether there is high or low take up of the additional measures under the CAP as well as on emissions from land use change. The range of potential future emissions under the CAP is shown in Figure 7 below, while Table 4 shows how the combination of assumptions on take-up of additional measures and sequestration potential[6] affect whether the target will be met.

[5] Baseline high sequestration (BHS) and baseline low sequestration (BLS).

[6] The 6th National Communication explains that the high sequestration scenario is based on an extrapolation of recent forestland and forest carbon density accumulation trends, while the low sequestration estimates reflect possible slower accumulation of forestland and carbon density. High sequestration is an extrapolation based on recent forestland and forest carbon density accumulation rate trends, and low sequestration estimates reflect possible slower accumulation and carbon density.

Figure 7. **The US is projected to meet its 2020 target if it fully adopts the President's Climate Action Plan**



Note: *Projections are provided by the 6th National Communication to the UN* (US/DOS 2014a). *BHS (Baseline High Sequestration) and BLS (Baseline Low Sequestration) are baseline scenarios with high and low projected carbon LUCF sequestration levels. Baseline scenario is consistent with policies implemented before September 2012. CAP consistent projections are baseline scenario projections less the potential reductions in GHG emission from new policies and measures under the plan.*

Source: *US 6th National Communication to the UN and US 1st Biennial Report*

Table 4. **Different assumptions on the take up of measures under the CAP and on carbon sequestration lead to different projections on whether the US meets its target**

Assumption on sequestration	Assumption on take up of additional measures	% emission reduction by 2020 on 2005 levels	Meet target?[1]
High	High	21.1%	✓
Low	High	16.5%	✗
High	Low	14.4%	✗
Low	Low	9.8%	✗

Note: *The US defines target 'in the range of 17 per cent reduction' by 2020. This analysis takes 17 per cent as the threshold.*

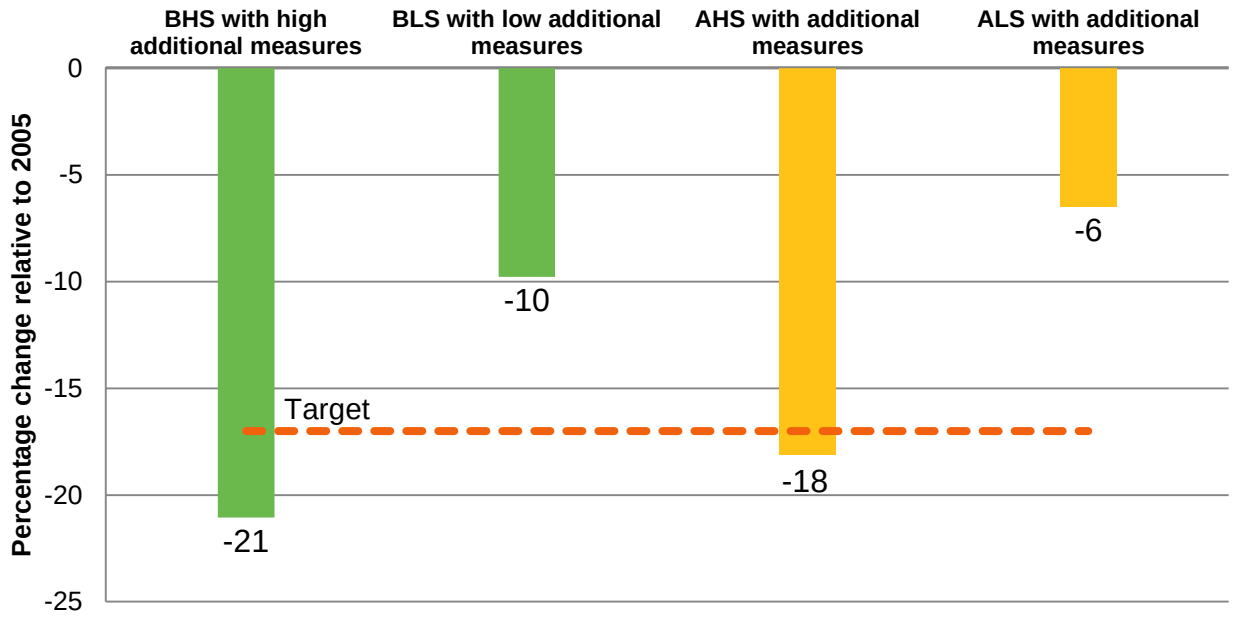
Source: *US 6th National Communication to the UN and US 1st Biennial Report*

Alternative projections also suggest that the US can meet its 2020 target with the Climate Action Plan in place. Figure 8 shows the projected reduction in US GHG emissions in 2020 from both the 6th National Communication as well as additional forecasts constructed by Vivid Economics from a range of sources. These forecasts combine the IEA's projected CO_2 emissions from energy consumption in its 'current policies' scenario and are adjusted to take account of:

- the additional emission reductions anticipated under the CAP;
- forecasts for non-CO_2 emissions from the US Environment Protection Agency (US EPA 2012); and
- Vivid Economics own forecasts for non-energy related CO_2 emissions.

They suggest that GHG emissions will be between 6 and 18 per cent lower than their 2005 level, depending on the level of uptake on the additional measures and on sequestration assumptions. The lower reductions are driven by the IEA's expectation that energy-related emissions will be higher than anticipated in the 6th National Communication.

Figure 8. **The US GHG emissions target is within a feasible range based on two different forecasts**



Note: *BHS and BLS scenarios refer to baseline projections with high and low carbon LUCF sequestration scenarios, respectively. AHS and ALS are Alternative High Sequestration and Alternative Low Sequestration scenarios, respectively. Additional reductions are estimated in the first US Biennial Report* (US/DOS 2014b). *IEA+ projections are constructed by combining energy CO_2 projections from IEA* (OECD/IEA 2013b), *projections for non-CO_2 emissions from US Environment Protection Agency estimates* (US EPA 2012) *and non-energy CO_2 projections, which are based on a Vivid Economics econometric model. Both sets of forecasts assume GDP growth of 2.7 per cent in the period 2010 to 2020. The dashed line depicts the US 2020 emissions reduction target.*

Source: *Vivid Economics based on sources above*

2.4 Recent policy developments

The current US administration has consistently reaffirmed its commitment to use energy and environment policy to address climate change. President Obama used the State of the Union address in February 2013 to indicate his willingness to take unilateral action if necessary:

> *'[I]f Congress won't act soon to protect future generations, I will. I will direct my Cabinet to come up with executive actions we can take… to reduce pollution, prepare our communities for the consequences of climate change, and speed the transition to more sustainable sources of energy'* (The White House 2013a).

The President reiterated the commitment in 2014's State of the Union:

> *'[W]e have to act with more urgency – because a changing climate is already harming western communities struggling with drought, and coastal cities dealing with floods… The shift to a cleaner energy economy won't happen overnight, and it will require tough choices along the way. But the debate is settled. Climate change is a fact. And when our children's children look us in the eye and ask if we did all we could to leave them a safer, more stable world, with new sources of energy, I want us to be able to say yes, we did'* (The White House 2014b).

Federal policy announcements and actions on climate change accelerated sharply over the past twelve months. The administration has launched a strategy document on climate change to guide policy while enacting Executive Orders to implement it. Other actions at a federal and state level continue to strengthen the US's commitment to address climate change.

2.4.1 Climate Action Plan

The President launched the CAP in June of last year detailing the administration's key policy objectives. The plan is intended to protect critical sectors of the economy and prepare the country for the impacts of climate change (The White House 2013b). A key pillar of the plan focusses on cutting emissions through the promotion of energy efficiency, supporting renewables and reducing emissions from fossil fuel power plants.

The Environmental Protection Agency (EPA) plans to impose emissions standards on power plants. Power plants have been targeted for emissions reductions given they are responsible for approximately one third of all domestic GHG emissions. The President's June memorandum, 'Power Sector Carbon Pollution Standards', directed the EPA to complete standards for new and existing power plants. The EPA (2013) released the proposed standards in September:

- new large natural gas-fired turbines, with a heat input rating greater than 850 MMBtu/h[7], will need to meet a limit of 1,000 pounds (453.6kg) of CO_2 per megawatt-hour;

[7] 850 MMbtu/h (million British thermal units per hour) is equal to 249.3MWh.

- new small natural gas-fired turbines, with a heat input rating less than or equal to 850 MMBtu/h, would need to meet a limit of 1,100 pounds (499kg) of CO_2 per megawatt-hour;
- new coal-fired units will also need to meet a limit of 1,100 pounds (499kg) of CO_2 per megawatt-hour. They would have the option to meet a somewhat tighter limit if they choose to average emissions over multiple years, thus giving additional operational flexibility.

It is expected that the standards, paired with low natural gas prices, will result in the construction of new coal-fired plant becoming uneconomic. The EPA will issue proposed standards for existing power plants in June 2014 following consultations with stakeholders. The Supreme Court is currently hearing arguments on whether GHGs should be considered air pollutants for the purposes of regulation under the 1970 amendment to the Clean Air Act. It is anticipated that similar cases could delay the implementation of standards for existing power plants.

As part of the objective of expanding power generation from wind, solar and geothermal sources by 2020, the CAP sets new goals for clean energy permits. The Department of the Interior is to issue permits for 10GW of renewables on public lands by 2020, in addition to the 10GW issued since 2012. The Department of Defence is committed to deploying 3GW of renewable energy on military installations by 2025. Federal agencies are tasked with reaching 100MW of installed renewable capacity across federally subsidised housing stock by 2020 (The White House 2013b). If successful, the measures would increase renewables' installed capacity by over eight per cent compared to current 2025 projections[8]. To further promote clean energy sources, the President directed federal agencies to streamline the permitting and review process for transmission projects. The plan also sets a target of 20 per cent of federal energy consumption to be provided by renewable sources.

Other policy changes enacted last year have directly increased the projected production of renewable energy. Legislation enacted during the year extended a US$0.023 (A$0.03)/ kWh wind energy production tax credit (PTC) as well as a 30 per cent investment tax credit to 31st December 2013. The legislation also made eligible those projects that were under construction before this revised expiry date, as opposed to the previous requirement of being placed in service. It is not clear if the PTC will be extended once again as the subsidy has expired on five occasions and Congress has renewed it five times since it was originally enacted in 1992 (Union of Concerned Scientists 2014). These provisions were the principal drivers behind the EIA increasing its projection for the share of renewable energy production in the US in 2025 to over 11 per cent, a figure which represents a five per cent increase from its previous projection[9].

The plan also aims to foster a global response to climate change with several initiatives:

- it commits to expanding bilateral cooperation with emerging economies, such as using the institutions of the Montreal Protocol, to reduce the production and consumption of hydrofluorocarbons (HFCs). At a US-China summit last summer, the two countries entered into an agreement to work towards this goal;
- the Climate and Clean Air Coalition to Reduce Short-Lived Climate Pollution, a global coalition of 30 countries launched in February 2012, will be used to tackle methane and black carbon emissions;

[8] Figures based on an April 2013 EIA projection of 156GW of installed capacity in 2025.

[9] From 10.5 per cent to 11.0 per cent.

- US fossil fuel tax subsidies will be phased out and the administration will work with other countries towards reducing their fiscal supports for fossil fuels; and
- it re-emphasises the US's commitment to mobilise climate finance and directly support countries' development of low emission development strategies.

2.4.2 State based cap and trade schemes

California established a cap and trade scheme in January 2013 as a key component of its objective to reduce emissions to 1990 levels by 2020. The initial phase of the Emissions Trading Scheme (ETS) applies to large electric power plants and large industrial plants accounting for about 36 per cent of the state's emissions. From 2015, emissions from the fuel sector will also be included, extending coverage to around 85 per cent of the state's emissions (Environmental Defense Fund 2014). The cap will be reduced by two per cent per annum until 2015 and three per cent per annum between 2015 and 2020. To minimise carbon leakage, free allowances have been allocated to electric utilities (not generators), industrial facilities and natural gas distributors. The scheme sets allowance allocation at up to 90 per cent of average emissions in each sector. The scheme started with a reserve price of US$10 (A$11.10) per annum, rising by five per cent in real terms each year to US$11.34 (A$12.58) at present. Table 5 illustrates that sale prices exceeded the reserve in each auction with a high of US$14.00 (A$15.54) reached in May 2013, a figure 30 per cent above the reserve.

Table 5. **Auction prices in the Californian ETS have reached as high as US$14 (A$15.50) per tonne**

Auction date	Number of allowances sold	Proportion of allowances sold	Reserve price		Sale price	
			US$	A$	US$	A$
November 2012	23,126,110	100%	10.00	11.10	10.09	11.20
February 2013	12,924,822	100%	10.71	11.89	13.62	15.11
May 2013	14,522,048	100%	10.71	11.89	14.00	15.54
August 2013	13,865,422	100%	10.71	11.89	12.22	13.56
November 2013	16,614,526	100%	10.71	11.89	11.48	12.74
February 2014	19,538, 695	100%	11.34	12.58	11.48	12.74
Total/ Average	81,052,928	100%			12.00	13.32

Notes: *Figures do not include sales for 2015-17 allowances. Average sale price is weighted average across the six auctions.*

Source: *Vivid Economics based on Environmental Defence Fund*

Carbon prices in Northeastern and Mid-Atlantic states participating in the Regional Greenhouse Gas Initiative (RGGI)[10] rose sharply in 2013 in anticipation of tighter emissions caps. In February 2014, the nine states involved in the RGGI reduced the emissions cap by 45 per cent from 165 million to 91 million tons (150 million to 83 million tonnes). Coupled with other reforms, the result is expected to generate 80-90 million tons (73-82 tonnes) of additional emission reductions by 2020 (RGGI 2013). This implies annual emissions in 2020 will be 14-20 million tons (13-18 tonnes) lower compared to previous projections. According to the EIA (2014), a surplus of allowances obtained in the early years of the scheme meant that prices remained close to the price floor of US$1.93/ton (A$1.95/tonne)[11] throughout 2012. In anticipation of the tighter caps, however, prices were on average 52 per cent higher in 2013, reaching a high of US$3.21/ton (A$3.23/tonne) in May. RGGI's (2013) analysis of the changes suggests that allowance prices will be approximately US$4/ton (A$4.03/tonne) in 2014, rising to US$10/ton (A$10.06/tonne) in 2020 as the cap is incrementally tightened.

2.4.3 Energy efficiency measures

Bipartisan support for energy efficiency legislation introduced in February 2014 has raised expectations of its passage through Congress. The revised Energy Savings and Industrial Competitiveness Bill was introduced in the Senate by a Democrat and a Republican following defeat of an earlier version late last year. Key provisions include:

- the establishment of a Supply Star program in the Department of Energy (DOE) to help increase the efficiency of companies' supply chains by identifying and promoting efficient practices;
- a programme to provide rebates for the purchase and installation of motor controls or transformers which reduce energy by at least five per cent;
- measures to increase the energy efficiency of federal data centres;
- technical assessments for firms to identify opportunities to maximise the energy efficiency of industrial processes and prevent pollution; and
- support for the adoption of building codes that meet or exceed model energy codes.

In early March 2014, a similar piece of legislation – the Energy Efficiency Improvement Act – passed the House of Representatives with strong bipartisan support, securing 375 votes to 36. Sponsors of the two pieces of legislation are hopeful that a reconciled energy efficiency bill can be agreed by the two chambers at an early date, although a precise date remains unknown.

The President's Climate Action Plan promotes energy efficiency with higher standards for household appliances and action across federal agencies. New minimum efficiency standards for domestic appliances and federal buildings were established in the President's first term of office. The plan indicates standards will be tightened further up to 2016 such that the total effect will reduce carbon emissions by three billion tonnes cumulatively by 2030. Since the announcement, higher energy efficiency standards have been introduced for

[10] The nine states participating in the RGGI are Connecticut, Delaware, Maine, Maryland, Massachusetts, New Hampshire, New York, Rhode Island and Vermont.

[11] All RGGI prices reported in imperial tons and converted to metric tonnes.

commercial refrigerators and external power suppliers. In order to increase access to capital markets for investments in energy efficiency, a partnership with the private sector will be initiated to work towards a standardised contract to finance federal investments in energy efficiency.

A range of tax incentives were extended in 2013 to support corporations to invest in energy efficiency and renewable technologies. Examples of supports include (DSIRE 2014):

- the Modified Accelerated Cost-Recovery and Bonus Depreciation Scheme, which allows corporates to claim accelerated depreciation for investments in a range of renewable technologies;
- the Repowering Assistance Biorefinery Program, which provides payments to biorefineries to replace fossil fuels with renewable biomass;
- the Business Energy Investment Tax Credit, a corporate tax credit available for a wide range of renewable technologies;
- the Renewable Electricity Production Tax Credit, another corporate tax credit available for a wide range of commercial and industrial applications of renewable energy technologies;
- the Energy Efficient New Homes Tax Credit, a tax credit for builders of all new energy efficient homes; and
- the Energy-Efficient Appliance Manufacturing Tax Credit, a tax credit available for manufacturers of high efficiency residential appliances, although this was only extended for certain appliances.

However, the Residential Energy Efficiency Tax Credit, a personal tax credit for domestic energy efficiency improvements, expired at the end of 2013.

Barriers to investment in energy efficiency technologies and domestic energy efficiency are being lowered with loan programmes and direct funding. In December 2013, the Department of Agriculture announced plans to provide rural electric cooperatives up to US$250 million (A$277 million) to lend to business and residential customers for energy efficiency improvements and renewable energy systems. Loans may be used for energy audits, upgrades to heating, lighting and insulation, and conversions to more efficient or renewable energy sources (Department of Agriculture 2013). The scheme is in addition to the Rural Energy for America programme which provides grants and loan guarantees directly to agricultural producers and rural small businesses for energy efficiency and renewable energy systems. More recently, the Department of Housing and Urban Development announced it will provide US$25 million (A$27.7 million) through the Multifamily Energy Innovation Fund. The scheme is designed to enable affordable housing providers, technology firms, academic institutions, and philanthropic organisations to test new approaches to deliver cost-effective residential energy.

2.4.4 Other federal policy developments

Loan programmes to support sustainable energy technologies have expanded to include Clean Capture and Storage (CCS) and innovative gas utilisation. The programmes have enabled sponsors of clean energy technologies to access capital at favourable rates. To date, US$32 billion (A$35.5 billion) has been provided for renewables and advanced vehicle technologies. In December 2013, the Department of Energy released a solicitation for US$8 billion (A$8.8 billion) in loan guarantee authority for advanced fossil fuel projects that avoid or reduce GHG emissions (Department of Energy 2014). The solicitation seeks applications for projects that cover a range of technologies including any fossil technology that is new or

significantly improved, as compared to more established technologies in service, and reduces emissions. The aim of the project is to support innovation and unlock long-term investment in clean energy technology.

Tightened fuel economy standards are paying dividends with vehicle performance reaching new highs, and further emissions standards were released in March 2014. New Corporate Average Fuel Economy (CAFE) standards for passenger vehicles were issued in August 2012. The Combined Passenger Car and Light Truck GHG and CAFE Standards are 250 grams/mile (106.3km/litre) by model year 2016, a level which will fall to 199 grams/mile (84.6km/litre) by 2021. Trends in CAFE performance, when compared with the performance levels projected to be achieved by National Highway Traffic Safety Administration, indicate that achieved CAFE performance has exceeded levels anticipated for the 2012 and 2013 model years (Schoettle and Sivak 2013). New EPA standards announced in March 2014 further reduce maximum permitted tailpipe and evaporative emissions. With phase-in schedules ranging from 2017 to 2025 depending on vehicle type, the Tier 3 regulations will lower the permissible sulphur content of fuels and set new fleet-average standards for non-methane organic gases, nitrogen oxides and particulate matter (US Environmental Protection Agency 2014).

Last November, the President signed Executive Order 13653, 'Preparing the United States for the Impacts of Climate Change', which directs federal agencies to strengthen resilience to and prepare communities for the impact of climate change. The Order (The White House 2013c):

- establishes a Task Force on Climate Preparedness, composed of state and community leaders, to report to the administration on how to remove barriers to climate investments;
- provides for federal agencies to identify policies or programmes they have enacted to support resilience-focussed actions;
- instructs agencies to share information to develop new climate preparedness tools and information; and
- directs agencies to plan for climate change related risks.

In March 2014, US Secretary of State John Kerry made climate change the subject of his first policy guidance for his department. The guidance committed to working through the UNFCCC to negotiate a new international climate agreement applicable to all countries by 2015 to take effect in 2020 (US Department of State 2014). It also committed to expanding multilateral and bilateral engagement on climate change, implementing the Global Climate Change Initiative, and leading by example at the domestic level. The guidance concluded:

> *'We need to elevate the environment in everything we do. There's nothing I'm more proud of than when we send one of our diplomats somewhere to really get out in the field and engage, to solve a problem, and to make something happen. I want all of you to feel empowered to think and operate that way on climate change. That's our mission as diplomats and that's our call to conscience as citizens of this fragile planet we inhabit. So let's get to work'* (US Department of State 2014)

2.5 Summary

In conclusion, the successful implementation of the Climate Action Plan (coupled with high carbon sequestration rates) are projected to result in the US reaching 2020 emission reduction targets that, on

a number of measures, have been judged to be more ambitious than Australia's five per cent target. The Climate Action Plan, in particular, will look to significantly reduce emissions from coal-fired power generation by introducing limits that are expected to make the construction of new coal-fired power stations uneconomic. An array of other federal fiscal initiatives will support progress, as well as a number of initiatives at the sub-national level – notably the launch of the California cap and trade scheme plus the tightening of the RGGI scheme. This builds on recent performance in the US economy that has seen it reduce its energy intensity and grow renewables more quickly than in Australia, although it has not reduced the carbon intensity of its energy consumption as quickly as Australia.

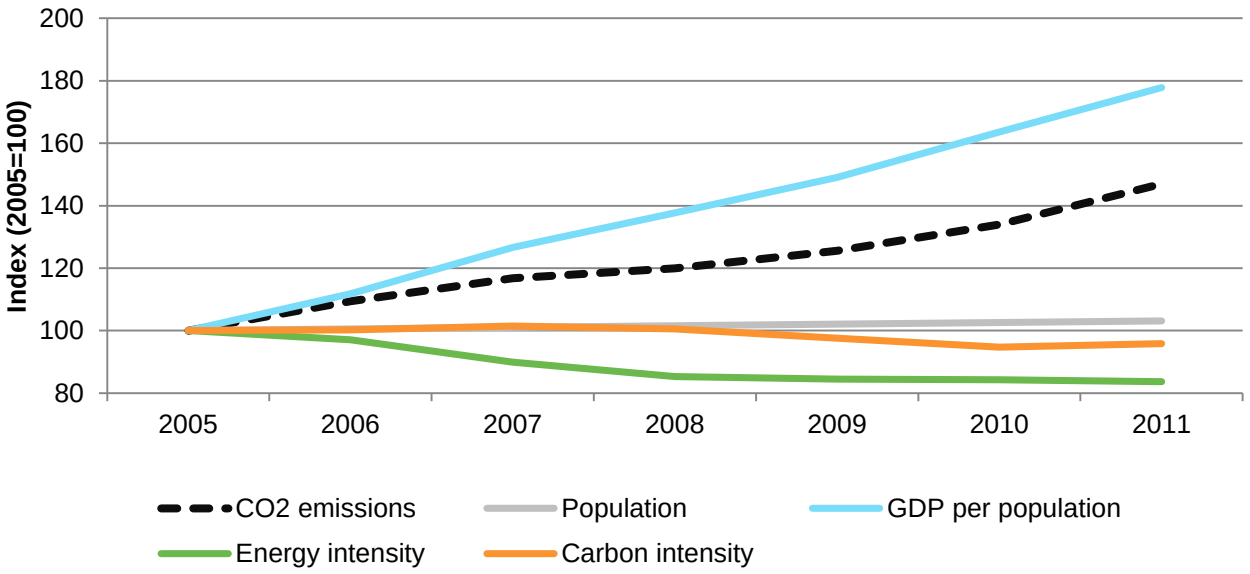
3 China

3.1 Recent historic performance

China's significant emissions growth between 2005 and 2011 was mainly driven by strong GDP per capita growth; at the same time, the energy intensity and carbon intensity of energy consumption have improved. Between 2005 and 2011, China's energy related CO_2 emissions grew by 47 per cent. Decomposing this increase into the four factors previously identified shows:

- China's emissions growth was primarily driven by increasing GDP per capita, which grew by 77.8 per cent over the period;
- there was an improvement in the energy intensity of the Chinese economy of 16.3 per cent over the period, mainly in the period 2005-2009;
- a 4.2 per cent decline in the carbon intensity of energy consumption over the period (mainly between 2008 and 2011); and
- Chinese population growth had a negligible impact on emissions.

Figure 9. **In China, GDP growth explains the trend of CO_2 energy emissions, while the energy intensity of the economy fell by almost 20 per cent**



Note: *Kaya decomposition sourced from IEA* (OECD/IEA 2013a). *The Kaya identity decomposes emission as the product of population, GDP per capita, energy use per unit of GDP and carbon emission per unit of energy consumption. The components are in index form, rebased so that the value of the index for each component is 100 in 2005.*

Source: *IEA's CO_2 Emissions from Fuel Combustion, Highlights* (OECD/IEA 2013a)

Both the energy intensity of the economy and the carbon intensity of energy consumption fell more quickly in China between 2005 and 2011 than it did in Australia. The 16.3 per cent improvement in the energy intensity of China's economy was around twice as high as Australia's over the same period, while

China's 4.2 per cent decline in the carbon intensity of energy consumption compared with a 3.6 per cent decline in Australia.

Consistent with this, tested vehicle fuel economy in China indicates that its fleet outperforms that of Australia. IEA analysis of the fuel economy of new light vehicle registrations in 2010 shows the Chinese fleet had a fuel economy of 7.7 lge/100km, a figure more than 15 per cent lower than Australia's 9.1 lge/100km.

Australia also ranks behind China for absolute and proportional additions to its renewable energy capacity. Australia's additional 3,000 MW of renewable capacity in the years 2005-11 represents growth of 32 per cent. However, China achieved additional capacity of over 184,000 MW, a 153 per cent increase over its 2005 level. In 2012, half of the hydropower installed globally was in China (Davidson 2014). Renewables growth was also more responsive to GDP growth in China: every 1 per cent increase in GDP was associated with a 1.53 per cent increase in renewables capacity, against 1.49 per cent in Australia.

3.2 Future targets

China has set a target for reducing its emissions intensity (carbon emissions per unit of GDP) by 40-45 per cent in 2020 compared to its 2005 level. It has also committed to increasing its share of non-fossil fuels to 11.4 per cent of total energy consumption by 2015 and a 15 per cent share for non-fossil fuels in primary energy consumption by 2020.

The government published intermediate targets to assist it to meet these commitments in the 12th Five Year Plan (FYP). Under the plan, China committed to three climate and energy targets (CDC Climat Research 2011):

- a 16 per cent reduction in energy consumption per unit of GDP by 2015 compared to 2010;
- a 17 per cent reduction in CO_2 emissions per unit of GDP by 2015; and
- a 21.7 per cent forest coverage rate and an increase in wood stock of 600 million m^3 by 2015.

If Australia maintains a five per cent target by 2020, it will outperform China in three out of four metrics developed by the CCA for measuring the extent of ambition across countries. This is shown in Figure 10 below using the same approach as before: Australia's performance under its five per cent target is scored at 100 for each metric with more ambitious climate action resulting in a lower index number.

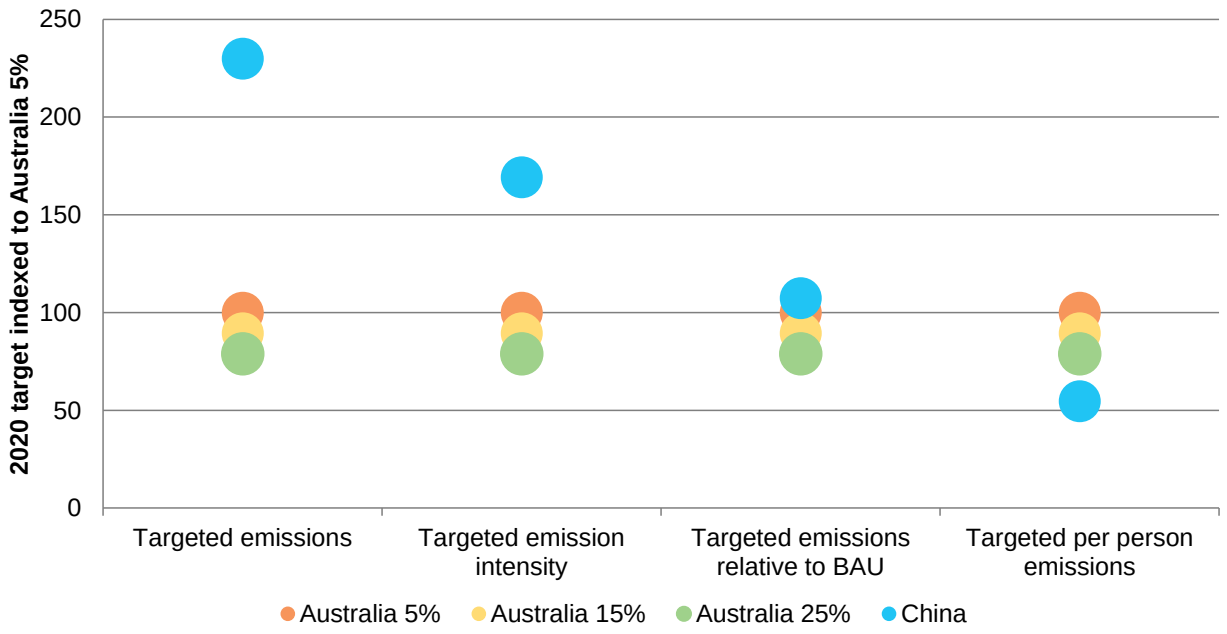
However, other analysis suggests that China's pledge broadly matches those made by many advanced economies. According to Jotzo (2010):

> *'China's target of cutting emissions intensity by 40 to 45 per cent over 15 years is very similar to the reductions in emissions intensity implicit in the targets by the large developed countries.'*

This reflects the change in the emissions intensity in China's target (rather than the absolute level of emissions intensity that it leads to). On this basis, Jotzo (2010) argues that it represents a degree of de-carbonisation of economic activity which is commensurate with developed economies and that the Chinese

emissions intensity target '*could become a model for other developing countries that wish to define their targets more concretely.*'

Figure 10. **China's 40% emissions intensity reduction target is more ambitious than Australia's 5% target in terms of emissions per person**



Note: *Lower value indicative of greater ambition for a given metric. China projection is for 40% emissions intensity reduction. Assumption of a 45% reduction yields similar results except for target relative to BAU where ambition would exceed Australia's 5% target*

Source: *Vivid Economics based on CCA*

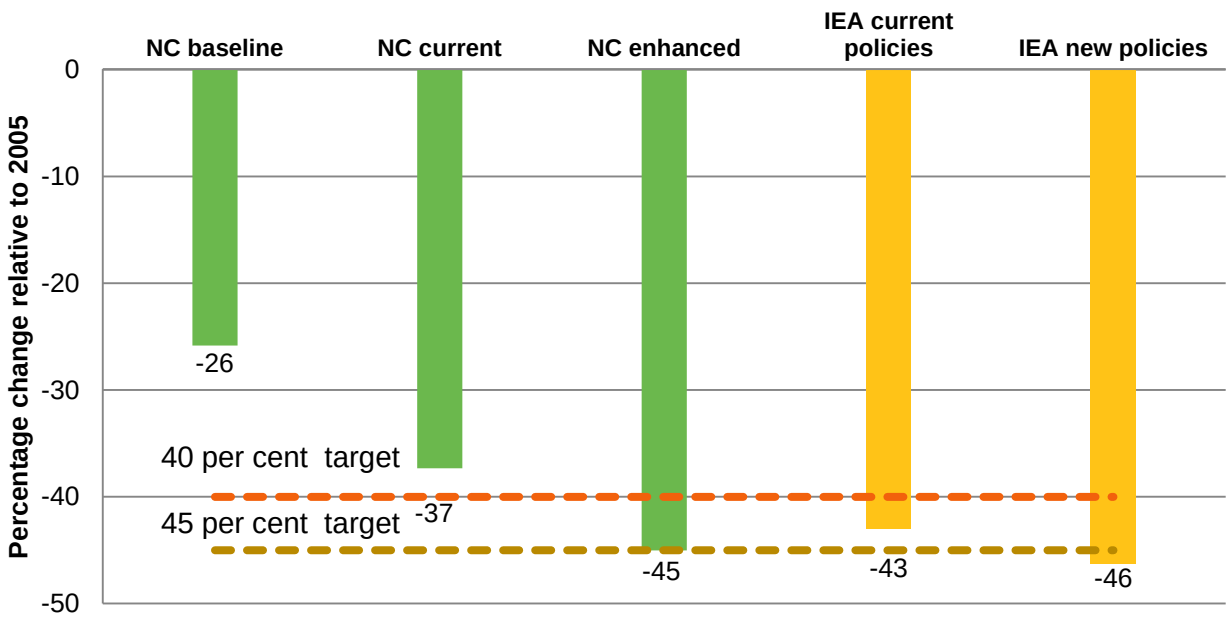
3.3 Projected trends

China projects that it will reach the 40 to 45 per cent reduction in emissions intensity compared to 2005 if it successfully implements additional (planned) policies. China's Second National Communication to the UN (China/NDRC 2012) defines an enhanced policy scenario for the evolution of energy combustion emissions, which takes account of policies and measures taken in its 11th FYP period (2006-2010) as well as further policies and measures planned for the 12th and 13th FYP spanning the decade to 2020. We augment these with non-CO_2 forecasts from US Environment Protection Agency (US EPA 2012) and CO_2 emissions from industrial processes from our own modelling. The resulting forecasts suggest that emissions intensity will fall by 45 per cent in 2020 compared to 2005. Using the National Communication's forecasts for energy-related emissions assuming no new policies and measures beyond those implemented in the 11th FYP indicate that emissions intensity will be 37 per cent lower in 2020 than in 2005.

Forecasts based on IEA projections for emissions suggest a similar outcome. The IEA provides an independent and comparable set of projections of China's energy carbon emissions. Combining these with the other sources as discussed above suggests that China's emissions intensity will be 43 to 46 per cent lower

in 2020 than in 2005, depending on whether only current policies or new policies are implemented by 2020. The combination of forecasts is shown in Figure 11.

Figure 11. **Most analyses suggest that China is on course to meet its carbon emissions pledge by 2020**



Note: *In the NC projections, energy related CO_2 emissions are sourced from the Second National Communication .It assumes a GDP growth of 7 per cent for the 2011-2020 period* (National Development and Reform Commission 2012). *IEA projections are based on the 2013 World Energy Outlook* (OECD/IEA 2013b), *which assumes a GDP growth of 8 per cent. Projections for non-CO_2 emissions are based on US Environment Protection Agency estimates* (US EPA 2012). *Non-energy CO_2 projections are based on Vivid Economics econometric model. Finally, emissions due to LUCF are assumed to be stable over the forecast horizon.*

Source: *Vivid Economics using sources above*

3.4 Recent policy developments

China is increasingly using market-based instruments to achieve GHG reduction, energy efficiency and renewable energy investment targets. Environmental and climate issues are increasingly towards the top of the political agenda. Common to many major economies, although there is not yet a comprehensive climate change law in China, legislation is expected to be published in 2014 with passage likely by 2015 following consultation with ministries and other stakeholders (Nachmany et al. 2014). In addition to efficiency and emissions targets being tightened in recent FYPs, further developments include the introduction of regional cap and trade schemes, continued investment in renewables and policies to incentivise energy efficiency.

Such measures have been among the driving forces behind predictions that the country will see a flattening or peaking of coal demand by 2020 or even earlier. Current and future Chinese coal consumption patterns have changed due to drives to reduce air pollution, structural shifts in the economy and energy intensity, growth in renewables, gas and nuclear capacity and efficiency improvements in power

plants and energy demand (Citi Research 2013). Taken together, this has resulted in some predictions that peak coal demand could be reached as early as 2015.

3.4.1 ETS and carbon pricing

Shenzhen, on the border with Hong Kong, was the first of seven regional cap-and-trade schemes to become operational in June 2013. The city commenced emissions trading in June 2013, with 635 companies accounting for 26 per cent of GDP taking part (Financial Times 2013). The firms emitted 30m tonnes of CO_2 last year, 38 per cent of Shenzhen's total emissions. Participants are set to reduce their carbon intensity by almost seven per cent between 2013 and 2015. By December, the exchange had reached a trading volume of 144,600 tonnes at a representative price of RMB83 (A$14.99).

Table 6. **Almost 1,700 enterprises are participating in five ETS schemes in China**

City/ region	Launch date	Estimated cap coverage	Number of participating enterprises	Emissions threshold for inclusion, tonnes CO_2	Approximate allowance price, January 2014	
					RMB	A$
Shenzhen	18th June 2013	~40%	635	5,000	70	13
Shanghai	26th November 2013	~50%	191	20,000	27	5
Beijing	28th November 2013	~40%	490	10,000	50	9
Guangdong	19th December 2013	~50%	242	20,000	60	11
Tianjin	26th December 2013	~60%	114	20,000	27	5

Note: *Shanghai has a separate emissions threshold for non-industrial sectors of 10,000 tonnes CO_2.*

Source: *Vivid Economics based on ICAP*

Four more cities or regions have since launched markets with a total of seven to be in place by the end of 2014. **Collectively the pilots form the largest carbon market outside Europe.** In November, emissions exchanges opened in Beijing and Shanghai with initial carbon prices trading at RMB51/tonne (A$9.21) and RMB27/tonne (A$4.88) respectively (Climate Bridge 2014) before falling back slightly in January as indicated in Figure 7. Guangdong opened trading in December when permits sold at a high of RMB61/tonne (A$11.02) while Tianjin's first auction saw carbon trade at RMB28/tonne (A$5.06) (Bloomberg 2013a). These figures are lower than the fixed price of Australia's current fixed price under its carbon pricing mechanism of A$24.15. Other regions are experimenting with similar schemes:

- Hangzhou in Zhejiang province started trading energy consumption permits last year; and
- Shenyang in northern Liaoning has launched a voluntary market for CO_2 allowances (Reuters 2014a).

Lessons from these pilots will be instrumental in developing any national ETS regime, set to be in place by the end of the decade. The regional cap and trade schemes are seen as a learning exercise for the development of a national cap and trade scheme that may be introduced by 2020. Analysis of the pilots (WRI 2014) notes that they have successfully designed essential building blocks such as:

- determining how the ETS would apply to various greenhouse gas types, sectors, emissions sizes, and accounting boundaries;
- choosing how emissions allowances will be allocated;
- establishing the size of cap and reduction trajectories; and
- the monitoring, reporting and verification of emissions.

In March 2013, under the auspices of the World Banks's Partnership for Market Readiness initiative, a programme of work to prepare for a national emissions trading scheme was launched, including issues such as coverage identification, the necessary technical and institutional requirements for an ETS and studies on a wide range of ETS design issues such as allowance allocation, MRV, price containment mechanisms, offset mechanism and market oversight (PMR Partnership Assembly 2013).

A survey of individuals working in research, industry and carbon trading institutions indicates clear expectations that China will meet its commitment to establish a national ETS. Half of the respondents expect a national ETS to be in place at or before 2018, rising to over 80 per cent who believe it will exist by 2020 (Jotzo, Kater, and de Boer 2013). Just one per cent of respondents expect that China will never adopt a national ETS. Price expectations meanwhile vary greatly between experts, suggesting that there is uncertainty about the nature and stringency of ETS and the response of the economy. They rise sharply from RMB29/tonne (A$5.24) in 2018 to RMB51/tonne (A$9.21) in 2020 and steadily to RMB68/tonne (A$12.28) in 2025.

Expert opinion suggests that a carbon tax will be established in conjunction with the national ETS. Recent reports suggest that officials will examine the impact of the regional ETS pilots and international experience to inform their decision on whether to proceed with a national carbon tax (Bloomberg 2013b). Expert opinion suggests that China will follow through on commitments to implement a carbon tax in addition to any plans for a national ETS, with almost 70 per cent of those surveyed saying it will be in place by 2020 (Jotzo, Kater, and de Boer 2013). Only 15 per cent of surveyed experts said they expect China will never adopt a carbon tax. Expected carbon tax levels rise from RMB7 tonne (A$1.26) in 2016 to RMB32/tonne (A$5.78) in 2025.

However, the expected repeal of the Australian carbon tax has been cited by Chinese authorities as a reason to slow its efforts to tackle emissions. Recent comments by China's vice-minister for finance, Zhu Guangyao, suggest that the country may be seeking to slow the implementation of a nationwide carbon tax due to concerns it would pose a costly burden to large companies (The Sydney Morning Herald 2014). While he is still in favour of fiscal measures to reduce emissions and a carbon tax remains under consideration as part of tax reforms in 2014/15, the minister cited Australia's attempts to abolish the carbon tax as a possible justification for the slowdown.

3.4.2 Renewable energy

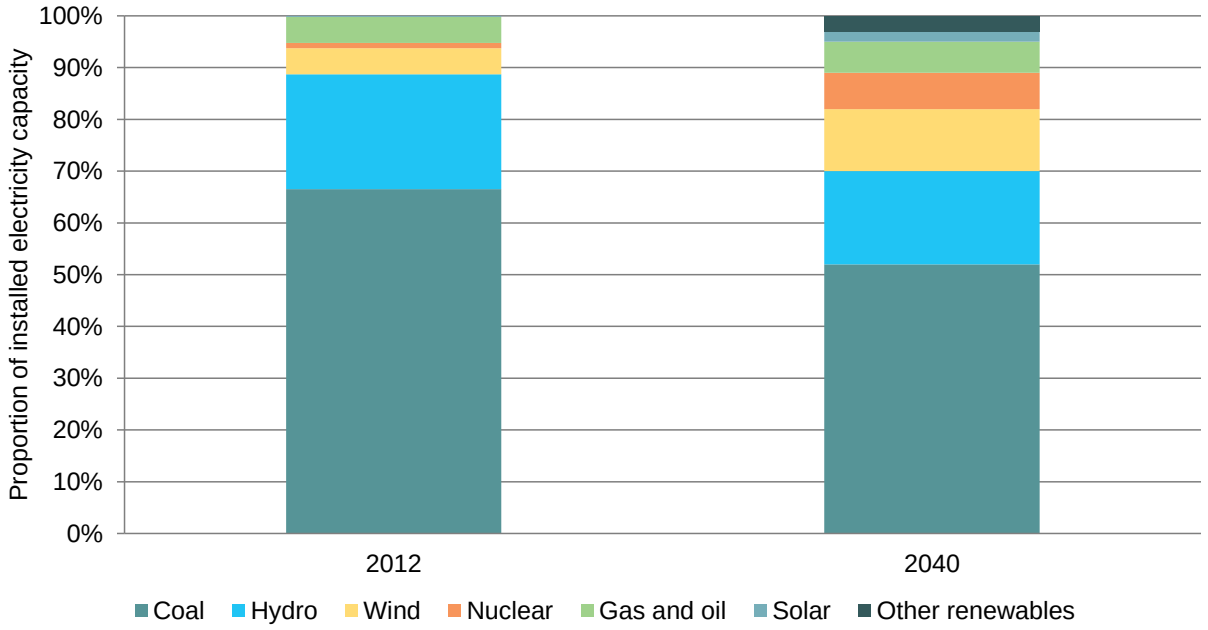
New incentives for the photovoltaic (PV) industry are intended to support ambitious plans for solar deployment announced in the 12th FYP for Solar Power Development (2011-2015). Released in September 2012, the strategy establishes a target of 21GW of installed solar capacity by 2015 with total capacity to reach 50GW by 2020. Solar deployment progress has been impressive with capacity rising to 7GW in 2012, more than double the 3GW capacity in 2011. To further support its development, in June 2013 the State Council put forward measures to promote the development of the PV industry. The regulations specify that expanding distributed PV applications should be prioritised, grid companies should purchase full amounts of PV power generation and that PV electricity price support policy should be improved (The Climate Group 2014). Pricing policy was reformed in September giving PV units a RMB0.42 (A$0.08) subsidy for every kilowatt-hour of electricity produced, replacing project-investment based subsidies. Recently, the Chinese government further increased targets for solar capacity to 35GW by 2015, 70GW by 2017, and a target of 100GW is under discussion (China Finance 2014).

The government is expected to announce reforms of energy management systems to promote greater use of wind power. China added 14GW of grid-connected wind capacity in 2013, making it the fifth consecutive year of capacity additions of greater than 10GW. However, wind farms were unable to generate 21.8 billion kWh of electricity in 2012 and 9.6 billion kWh in the first three quarters of 2013 due to wind curtailment[12] (Pengfei 2013). To address the issue, in October 2013 the National Energy Bureau announced its intention to reform energy management systems including granting wind power priority access to the grid and a quota system for power generation from renewable sources (Wind Power Monthly 2013). New targets for wind capacity were also recently increased, with capacity to reach 100GW in 2015 and 150GW in 2017 (China Finance 2014).

Current investment in renewables is expected to result in significant changes to China's energy mix by 2040. As indicated in Figure 12, the EIA anticipates that the share of coal in the country's installed electricity capacity is expected to fall from two thirds today to a little over half in 2040. Meanwhile, wind power will see a sharp increase rising from five to 12 per cent to become the country's third largest energy source. Solar and other renewables will also account for a significantly larger share of capacity rising from about 0.2 per cent to over five per cent. Taken together, by 2040 renewables will account for 35 per cent of China's installed electricity mix.

[12] Also known as spilled wind, this occurs when grid operators tell wind farm operators to reduce output because of reliability elsewhere in the grid or other constraints.

Figure 12. **The share of renewables in China's installed electricity mix is expected to increase sharply**



Source: *Vivid Economics based on EIA data*

3.4.3 Energy efficiency measures

Deductions, grants and allowances to promote energy efficient capital investment and renewable power are already well established in China. These include:

- accelerated depreciation for domestic enterprises that purchase listed renewable energy equipment;
- investments in special equipment for energy conservation may qualify for a 10 per cent tax credit;
- a custom duty and VAT exception is in place for certain imported energy efficient equipment; and
- a three year corporate tax exemption and a three year 50 per cent tax reduction on derived income is available for renewable power projects.

A number of specific policy measures were announced in 2013 to promote energy efficiency in buildings and increase resource conservation. The National Development and Reform Commission (NDRC) and the Ministry of Housing, and Urban-Rural Development (MHURD) implemented the Green Building Action Plan which introduces green building standards. By the end of 2015, 20 per cent of new urban constructions are expected to meet green building standards. In October 2013, the State Council issued guidance on resolving excess capacity in key industries suggesting that resource efficiency will be improved by eliminating out-dated production capacity. In November, the State Council issued the National Plan for Sustainable Development of Resource-based Cities in China (2013-2020) as a strategy to reform resource-based cities including measures to promote energy conservation and emission reduction (The Climate Group 2014). Linked to this, a range of financial incentives are in place to promote energy efficient building construction. Subsidies were introduced in 2012 for both the construction of new energy efficient buildings and the retrofitting of existing buildings. Grants of up to RMB50 million (A$9 million) are available for the construction of green buildings in designated green ecological city zones.

Fuel quality standards were further tightened throughout 2013 as part of a policy to achieve emissions targets and improve air quality in cities. Regulatory agencies issued new standards over the course of the year following a directive by the State Council in February calling for cleaner fuels. The China V diesel and gasoline standards were issued in June and December respectively, and will be phased in by December 2017 (The International Council on Clean Transportation 2014). Price rises for higher quality fuels were announced by the National Development and Reform Commission to incentivise refineries to meet the fuel quality improvement targets.

3.5 Summary

Projections suggest that China is on track to meet its target of a 40-45 per cent reduction in emissions intensity by 2020. This is a target that will deliver a reduction in emissions intensity that is comparable to the ambition in many developed country targets, although on other metrics the CCA analysis suggests that the target is less ambitious than Australia's (with the notable exception of per capita emissions). China has already been able to reduce the carbon intensity of its energy consumption and energy intensity of its economy more quickly than Australia in the recent past and the introduction of a series of ETS pilots, expected to be the prelude to a national ETS, makes further strong performance likely.

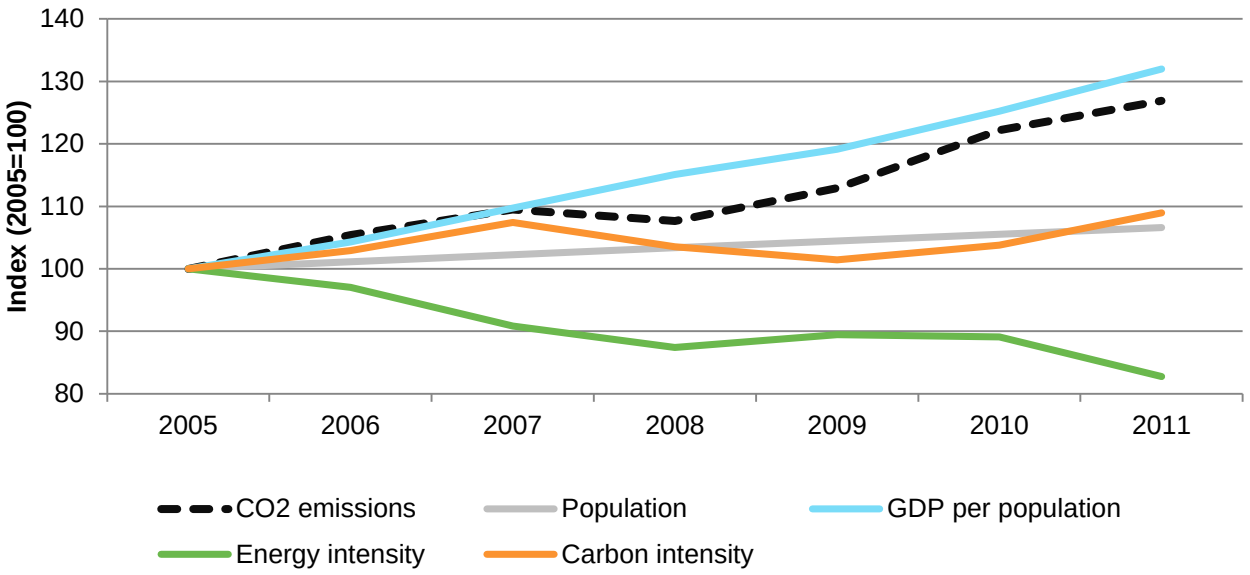
4 Indonesia

4.1 Recent historic performance

Emissions from energy use in Indonesia grew by 27 per cent from 2005 to 2011 due to strong economic growth, although energy intensity has been steadily declining. The heavy dominance of land-use change emissions in Indonesia[13], for which a decomposition analysis is not possible, means that the decomposition analysis is less significant in explaining recent emissions trends. Nonetheless, as shown in Figure 13:

- GDP per population has increased by 32 per cent, which is the main driver of high CO_2 emissions;
- energy intensity fell by 17 per cent;
- carbon intensity has increased by 9 per cent; and
- population growth had a moderate impact on emissions.

Figure 13. **Energy intensity reductions have played a large role in reducing Indonesia's CO_2 emissions**



Note: *Kaya decomposition sourced from IEA* (OECD/IEA 2013a). *Kaya identity, decomposes emission as the product of population, GDP per capita, energy use per unit of GDP and carbon emission per unit of energy consumption. The components are in index form, rebased so that the value of the index for each component is 100 in 2005.*

Source: *IEA's CO_2 Emissions from Fuel Combustion, Highlights* (OECD/IEA 2013a)

Indonesia has reduced the energy intensity of its economy much more quickly than Australia in recent years, potentially reflecting its low starting point. However, while Australia's carbon intensity of energy consumption has fallen, Indonesia's has grown. Indonesia's energy intensity reductions are almost

[13] Accounting for around 30 per cent of emissions in 2010 (World Resources Institute 2012).

twice as great as Australia's over the period. Yet while Indonesia's carbon intensity of energy consumption has increased, Australia has achieved a modest reduction in recent years.

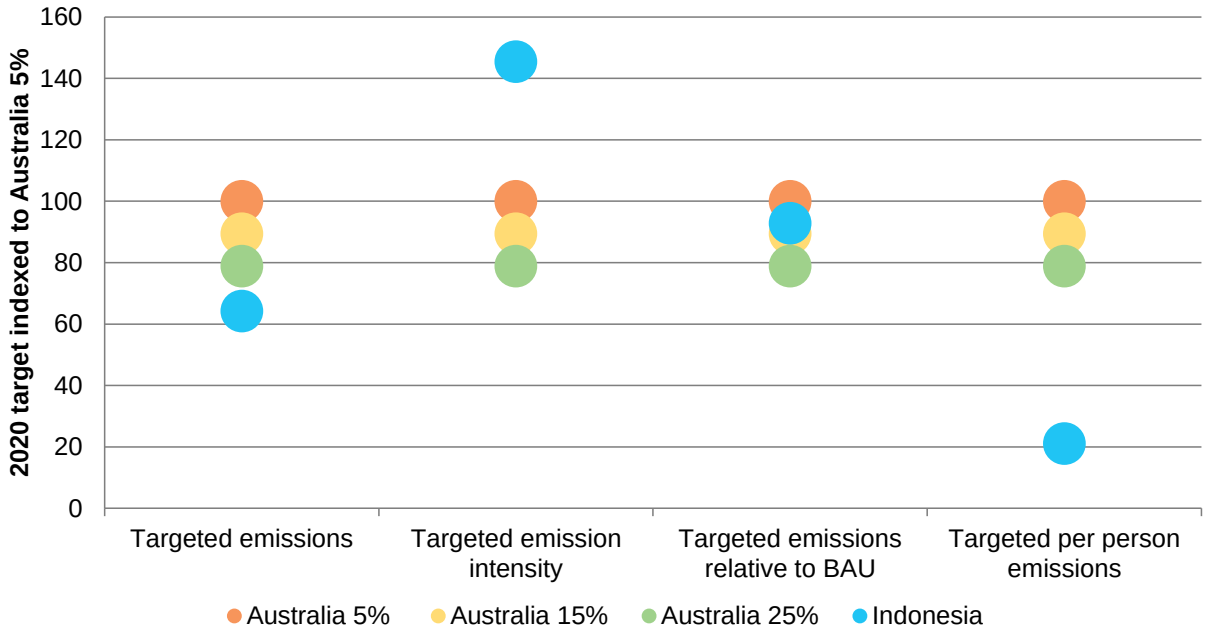
Consistent with the improvements in energy efficiency achieved by Indonesia, vehicle fuel economy in Indonesia is significantly better than in Australia. IEA analysis of the fuel economy of new light vehicle registrations in 2010 shows the Indonesian fleet had a fuel economy of 6.5 lge/100km, a figure almost 30 per cent lower than Australia's 9.1 lge/100km.

By contrast, Australia outperforms Indonesia for additions to renewable energy capacity. Australia's additional 3,000 MW of renewable capacity in the years 2005-11 represents growth of 32 per cent. In the same time frame, Indonesia achieved additional capacity of over 900 MW, a 17 per cent increase over its 2005 level. Similarly, renewables growth was less responsive to GDP growth: every 1 per cent increase in GDP in Indonesia was associated with an increase in renewables capacity of 0.46 per cent against 1.49 per cent in Australia.

4.2 Future targets

Indonesia has pledged to reduce its emissions by 26 per cent relative to BAU in 2020, and up to 41 per cent with international assistance. This implies that emissions need to be reduced relative to the baseline by around three percentage points per annum.

Figure 14. **Indonesia outperforms Australia on emission reduction ambition on three of the four metrics developed by the CCA**



Note: *Lower value indicative of greater ambition for a given metric. Indonesia target is for a 26% reduction from 2020 baseline.*

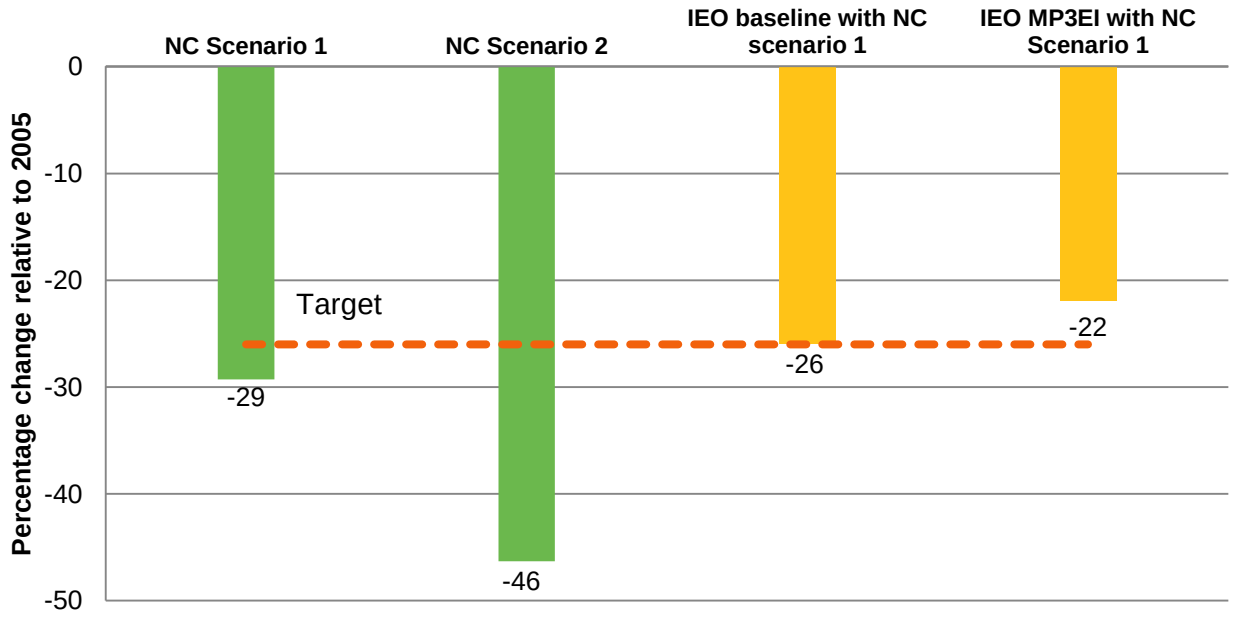
Source: *Vivid Economics based on CCA*

If Australia maintains a five per cent target by 2020, Indonesia will outperform it for three out of four metrics used by the CCA for measuring the extent of ambition across countries. This is shown in Figure 14.

4.3 Projected trends

Indonesia's Second National Communication to the UN (SNC 2010) puts the country on track to meet its 2020 target of 26 per cent reduction in emissions relative to BAU. This identifies two abatement scenarios, differing according to the cost of implementing mitigation measures and the extent of international cooperation and funding, which project emissions to be 29 per cent and 46 per cent lower compared to BAU in 2020, as indicated in Figure 15. The outcome of the two scenarios will depend on the cost of implementing the mitigation. Under the conservative scenario, most of the reduction occurs to GHG emissions from peat, accounting for 53 per cent of total reductions, compared to 21 per cent from energy.

Figure 15. **Indonesia is on course to meet or slightly fall short of its GHG emissions target**



Note: *NC Scenarios 1 and 2 are the abatement scenarios from the 2nd National Communication. IEO refers to forecasts of emissions for energy combustion from the Indonesia Energy Outlook and forecasts of other greenhouse gases from other NC scenario 1.*

Source: *Vivid Economics using sources above*

Further analysis highlights the importance of controlling coal consumption to meet the target. The Indonesian government's Agency for the Assessment and Application of Technology published two further scenarios for energy demand in Indonesia (BPPT 2012). While one of these scenarios confirms that the 26 per cent reduction target can be met, the more ambitious Master Plan for Accelerating and Expansion of Indonesia's Economic Development (MP3EI) scenario projects significantly greater use of coal to meet

Indonesian energy demand in 2020, which it suggests would result in Indonesia missing its emissions target by 4 percentage points[14].

4.4 Recent policy developments

Indonesia is the largest energy consumer in Southeast Asia, accounting for 36 per cent of the region's total primary consumption in 2011 (International Energy Agency 2013). In order to achieve emissions reductions and renewables targets, recent policy focusses on:

- reducing deforestation and land use emissions;
- expanding renewables' grid access;
- promoting energy efficiency; and
- reforming energy subsidies and other transport measures.

4.4.1 Reducing deforestation and land use emissions

Following significant delays, the government approved the establishment of a new REDD[15] agency in September 2013. In 2010, Norway pledged US$1 billion (A$1.11 billion) to support REDD activities in Indonesia as almost 80 per cent of the country's GHG emissions stem from deforestation and land use change (Embassy of Norway 2010). A task force established by the government piloted projects and started the process of mapping land ownership. However, the slow progress in transitioning the task force to a REDD agency meant that Norway disbursed just 4 per cent of funding by the end of 2013 (Perera 2014). The government has tasked the new agency with formulating forest management policies that will slow Indonesia's rate of deforestation and to draft and implement plans for a national REDD strategy. It is also expected that the agency will extend a moratorium, due to expire in 2015, on clearing new land for commercial use.

The agency will also focus on completing pilot projects in Rimba Raya, the world's largest REDD project, which was approved in Indonesia in 2013. The government approved the 64,000-hectare forest carbon project on Borneo in May. The Verified Carbon Standard, a certification standard for carbon credits, subsequently verified the project. It is expected to reduce carbon dioxide emissions by 119 million tonnes over its 30 year lifespan (The Guardian 2013). The emissions reductions will come from avoiding drainage of area's carbon dense peatlands and a fall in the conversion of forests to oil palm plantations.

4.4.2 Expanding renewables

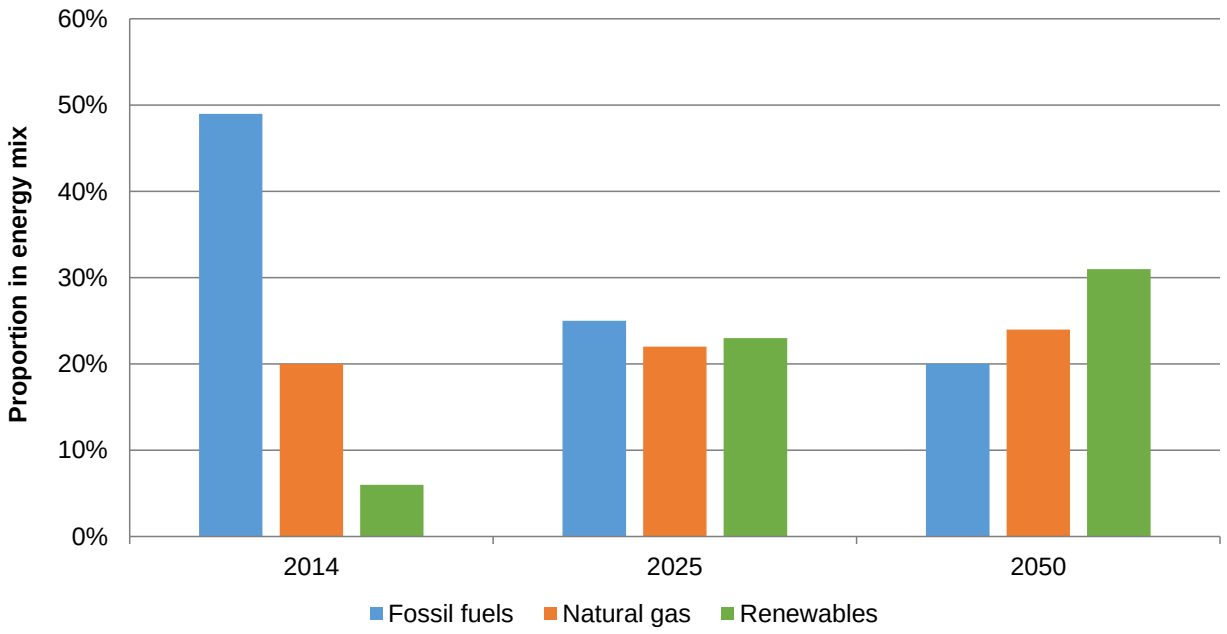
In January 2014, parliament endorsed an official target of 23 per cent of energy to come from renewable sources by 2025, rising to 31 per cent by 2050. Indonesia had previously set a 15 per cent renewables target. Figure 16 illustrates that the new energy policy have set a number of additional targets for the supply and use of energy:

[14] Energy related emissions forecasts were combined with scenario 1 from the SNC for other GHG emissions forecast to obtain the forecast of total emissions.

[15] Reducing Emissions from Deforestation and Forest Degradation (REDD) is a UN programme.

- the proportion of fossil fuels, other than natural gas, in the energy mix will be more than halved from approximately 49 per cent to less than 20 per cent in 2050;
- natural gas will rise slightly from 20 per cent to 24 per cent in 2050; and
- renewables will rise from the current level of just over five per cent to become the most important source of energy in 2050, accounting for over 30 per cent of supply.

Figure 16. **Renewables are targeted to become Indonesia's largest source of energy by 2050**



Note: *Fossil fuels refers to coal and peat but excludes natural gas.*

Source: *Vivid Economics based on Indonesia Ministry of Energy and Mineral Resources*

Despite agreement on feed-in tariffs for geothermal generation in 2012, regulatory issues continue to obstruct the technology's expansion. The country has almost 4,100 MW of geothermal potential in the pipeline for development, making it the world's number one source of geothermal development. If all plants under construction are finished by their publicly announced completion dates, Indonesia could reach almost 2 GW of installed capacity by 2018 (Geothermal Energy Association 2013). In 2012, the government agreed geographically based feed-in-tariffs of between US$0.1/kWh and US$0.17/kWh (A$0.11/kWh and A$0.19/kWh) to assist in the roll-out of geothermal projects. This replaced a previous tendering process coupled with a nationwide cap on tariffs of just under US$0.1/kWh (A$0.11) (Baker and McKenzie 2012). However, an objective to add an additional 4GW of capacity by 2014 through tariff reform and 'fast track planning' has been missed. Indonesia still struggles with regulatory issues obstructing geothermal development – land acquisition and permit issues have stalled 30 projects, many of which were proposed over a decade ago (Eco-business 2013).

Recent reforms of solar photovoltaic regulations are also intended to boost output and provide certainty to investors. In June 2013, the government passed Regulation 17 which obliges the state power company (PLN) to purchase electricity generated by photovoltaic power plants based on a capacity quota offered through public auction. The business that wins the auction signs a purchase agreement with PLN at a

pre-determined price of US$0.25 (A$0.28) per kilowatt hour or US$0.30 (A$0.33) per kilowatt hour if local components in the plant amount to 40 per cent (Schlueter 2013). Fixed pricing replaces the previous case-by-case negotiation framework and is intended to give certainty to solar producers and foreign investors. Auction winners must begin development of power generation facilities within three months of agreeing the power purchase arrangement with PLN and securing financial backing.

4.4.3 Promoting energy efficiency

Government regulations, incentives and penalties are intended to promote energy efficiency in industrial sectors, although gaps remain in implementation. A 2009 regulation on energy conservation mandated authorities to implement a comprehensive energy efficiency strategy. As part of this, it requires companies with energy consumption above 6,000 tonnes of oil equivalent (ToE) to:

- appoint energy managers and design energy conservation programmes;
- conduct regular audits, to be performed by a certified auditor (either internal or external);
- implement the recommendation of the audit process according to cost effectiveness within one to five years, depending on costs and investment viability; and
- report on the energy conservation implementation.

However, several aspects of the 2009 regulation remain to be enacted. Tax breaks have not been implemented as envisaged. Credit lines at low interest rates to banks and local governments for energy efficient investments have not yet been established and guidelines have not been published.

Other demand side measures focus on domestic energy efficiency with labelling schemes and minimum standards expected to be expanded in 2014. The energy ministry (MEMR) introduced a labelling scheme – 'More Stars, More Efficient' – for CFLs in 2011, which they intend to expand to include other products (MEMR 2013). The MEMR has more recently indicated it intends to introduce minimum efficiency performance standards for appliances, possibly commencing with air conditioning units in 2014.

Energy efficiency in the public sector is targeted with a regulation mandating government institutions to achieve verified energy savings. From July 2012, all government buildings, state-owned buildings, official residents as well as street-lighting, decorative lighting and billboards were mandated to achieve 20 per cent electricity savings and 10 per cent gasoline savings relative to 2011. In the first quarter of implementation, 71 out of 76 agencies had reduced electricity usage by an average of 8.1 per cent.

4.4.4 Reforming energy subsidies and transport measures

Electricity and fuel subsidies remain significant despite recent efforts to reduce and reform them. The Ministry of Finance (2013) projects that energy subsidies will amount to Rp282 trillion (A$27 billion) in 2014, about three per cent of GDP. However, the government has recently taken significant steps to reduce the fiscal burden of subsidies:

- in June 2013, they increased subsidised energy prices for gasoline and diesel by 44 per cent and 22 per cent respectively;
- based on quarterly increases, electricity tariffs were expected to rise by 15 per cent in 2013, although consumers with the lowest level of consumption have not been affected; and

- the energy ministry implemented a gas conversion programme to promote the development of natural gas infrastructures and the distribution of free gas converter kits for public transportation.

In addition to subsidy reforms, there are some tax incentives for fuel efficient vehicles. A 2013 regulation introduced a new classification of vehicle in Indonesia called, the 'low-cost green car' (LCGC), and levied progressively lower sales tax on vehicles with smaller engines. The change in taxes is intended to promote demand for LCGCs (GSI 2013). In addition, government cars and vehicles used in mining and plantation operations have been banned from buying subsidised fuel in order to further promote more efficient fuel usage.

4.5 Summary

Although there are some data challenges, Indonesia appears on track to be meeting an emissions reduction target that, on the three of the four indicators identified by the CCA, is more ambitious than Australia's 5 per cent reduction target. This is being driven by efforts to reduce emissions from land-use change and peat bogs, ambitious plans for renewable deployment and a slowly increasing focus on energy efficiency (including politically challenging efforts to reduce fossil fuel subsidies). Some concerns remain over the extent to which implementation challenges may constrain the ability of Indonesia to meet the challenges it has set itself.

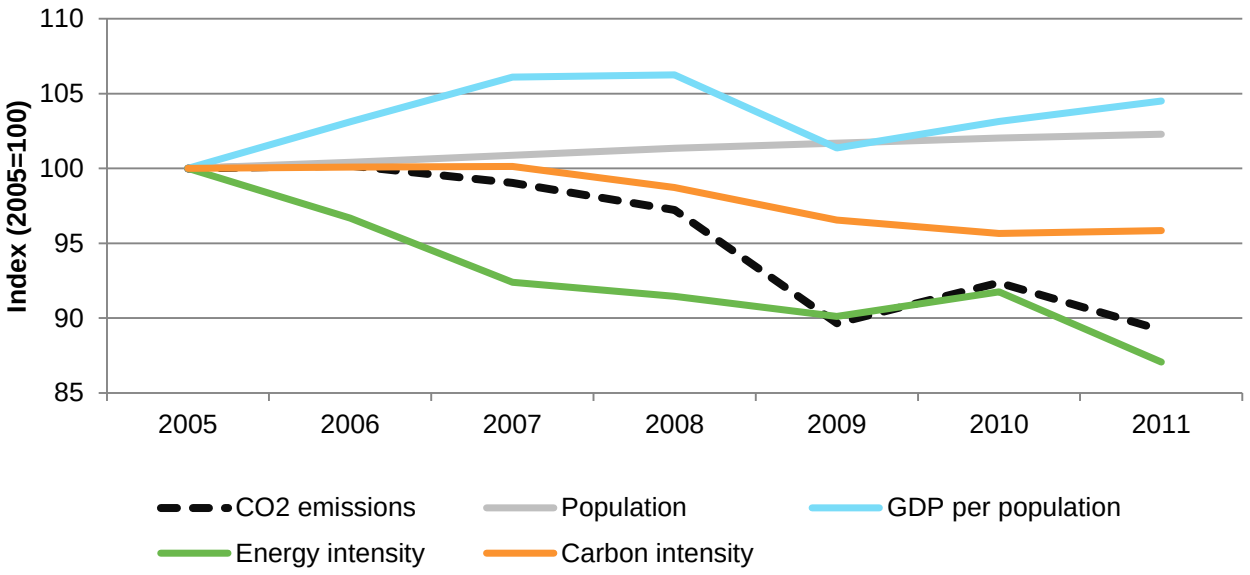
5 European Union

5.1 Recent historic performance

CO_2 emissions from energy use in EU have declined by 11 per cent in the period 2005 to 2011, driven largely by reductions in the energy intensity of GDP. Figure 17 depicts the outcome of the Kaya decomposition showing:

- a declining energy intensity of 13 per cent;
- a declining carbon intensity of 4 per cent;
- a low GDP per capita growth contributing a mere 4.3 per cent to GHG emissions growth; and
- a modest population growth of 2.3 per cent.

Figure 17. **Energy intensity has been a major factor in reducing CO_2 emissions in the EU**



Note: *Kaya decomposition sourced from IEA* (OECD/IEA 2013a). *Kaya identity, decomposes emission as the product of population, GDP per capita, energy use per unit of GDP and carbon emission per unit of energy consumption. The components are in index form, rebased so that the value of the index for each component is 100 in 2005.*

Source: *IEA's CO_2 Emissions from Fuel Combustion, Highlights* (OECD/IEA 2013a)

The EU has achieved greater declines in both energy intensity of GDP and carbon intensity of energy consumption than Australia in recent years. The EU's 13 per cent decline in energy intensity compares with a more modest 8.5 per cent in Australia, while the EU's 4 per cent decline in carbon intensity of energy production is slightly greater than the 3.6 per cent achieved by Australia.

Tested vehicle fuel economy in the EU indicates that its fleet outperforms that of Australia. An IEA analysis of the fuel economy of new light vehicle registrations in 2010 shows that the EU's fleet had a fuel

economy of 5.9 lge/100km[16]. This figure strongly surpassed Australia's 9.1 lge/100km, with one EU country, Denmark, achieving the best fuel economy, 5.2 lge/100km, of all countries surveyed.

Australia also ranks behind the EU for additional renewable capacity, both in absolute terms and in terms of responsiveness to GDP growth. Australia's additional 3,000 MW of renewable capacity in the years 2005-11 represents growth of 32 per cent. However, the EU achieved additional capacity of over 119,000 MW, a 73 per cent increase over its 2005 level. Accounting for Australia's strong economic performance over this time frame shows its growth in renewables capacity was relatively less responsive to GDP growth than in the EU. Every 1 per cent increase in GDP growth in Australia was associated with just 1.49 per cent increase in renewables capacity against 3.2 per cent in the EU.

5.2 Future targets

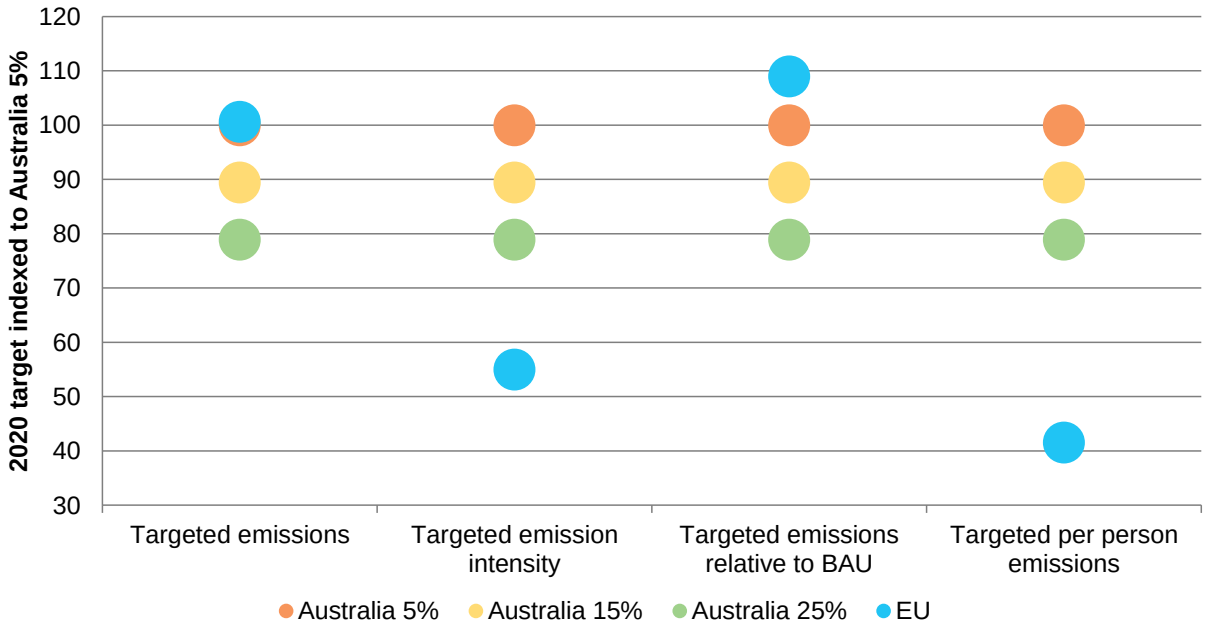
The Climate and Energy package constitutes the central policy to reduce GHG emissions in the EU. It includes the following near-term targets:

- to reduce EU greenhouse gas emissions by at least 20 per cent by 2020 based on 1990 emissions;
- for renewables to constitute 20 per cent of energy sources by 2020; and
- a 20 per cent reduction in total primary energy consumption by 2020, compared to a business as usual baseline.

If Australia maintains a five per cent target by 2020, the EU will outperform it for two of the four metrics used by the CCA for measuring the extent of ambition across countries. Figure 18 indicates that the EU will outperform Australia for per person emission levels and emission intensity levels.

[16] Average based on results from 21 member states.

Figure 18. **The EU's target is more ambitious than Australia's 5% target for emission intensity and per person emissions in 2020**



Note: *Lower figure indicative of greater ambition for a given metric. EU target is for a 20% reduction in emissions from 1990 levels by 2020.*

Source: *Vivid Economics based on CCA*

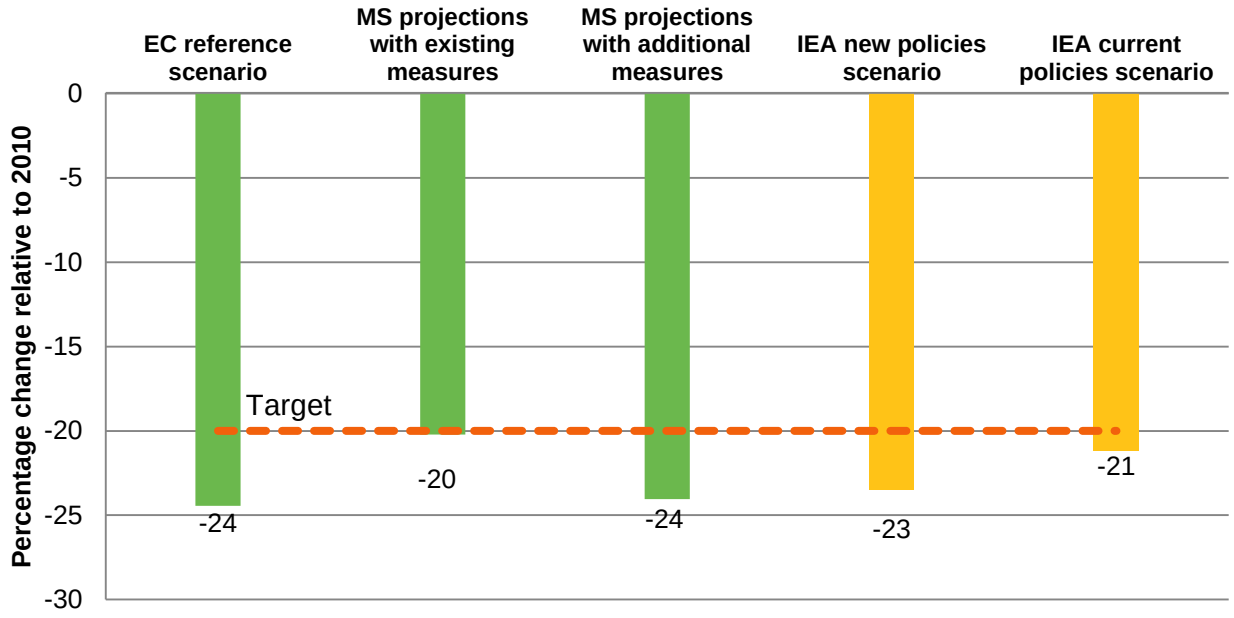
5.3 Projected trends

In its latest reference scenario, the European Commission projects EU emissions to be 24 per cent lower than their 1990 level (EC 2013). The updated EC reference scenario is consistent with policies adopted before spring 2012, as well as new policies and measures that will be implemented in the future, and which are aimed to meet binding targets set out in EU legislation. Analysis which aggregates the modelling results of individual member states confirms this result. Figure 19 shows both the EC projections and member states projections of GHG emissions[17]. The member states projections confirm that the EU is on course to meet its 2020 emissions target, even if new policies and measures were not fully adopted. Member state projections indicate that emissions will be 20 to 24 per cent lower, depending on which future measures are adopted.

Combining IEA analysis for energy related emissions with data from other sources also show that EU GHG emissions to be 21 per cent to 23 per cent lower than their 1990 levels depending on whether new policies are adopted until 2020. These scenarios combine projections of energy related CO_2 emissions from IEA (OECD/IEA 2013b), projections of non CO_2 emissions from US EPA (US EPA 2012), while emissions from other sources are assumed to remain stable over the forecast horizon. These scenarios do not include emissions from international aviation.

[17] Both targets and progress towards targets include international aviation emissions.

Figure 19. **The EU will meet its 2020 emissions reduction pledge in all scenarios**



Note: *EC reference scenario is from the EC own projection using the PRIMES model* (EC 2013). *Member states projections are from the European Environment Agency* (EEA 2013). *These scenarios include emissions from international aviation. IEA projections are adopted from IEA world energy outlook* (OECD/IEA 2013b) *for fuel related CO_2 emissions, forecasts for other anthropogenic gases are from the US Energy Protection Agency* (US EPA 2012). *Finally non fuel related CO_2 emissions are assumed stable over the forecast horizon. IEA scenarios do not include emissions from international aviation.*

Source: *Vivid Economics using sources above*

5.4 Recent policy developments

EU actions on climate change have been characterised by co-operation with the international community and leadership in terms of targets and mechanisms to attain targets. Recent EU policy efforts include:

- reforms of the ETS to improve effectiveness;
- proposals on renewable energy targets and guidelines for member states on best practice;
- new energy efficiency obligations; and
- reform of other policies to support the climate change agenda.

5.4.1 ETS reform and backloading

The economic downturn had led to significant falls in the EU ETS carbon price. Early years of the scheme saw prices hit €32 (A$48.55) per tonne. However the economic collapse of 2008 paired with a glut

in allowances had resulted in prices falling to as low as €2.81 (A$4.26) per tonne in early 2013 and a structural surplus of around 2 billion allowances.

As a result, European authorities have agreed to implement 'backloading' as a short-term measure to reduce the surplus of allowances leading to a sharp rise in carbon prices. The EC first proposed postponing the auctioning of allowances in 2011. The measure, known as 'backloading' involves redistributing 900 million allowances during Phase III of the EU ETS in order to rebalance supply and demand at present (European Commission 2014a). In December 2013, the European Parliament and European Council cleared the way for adoption of the measure, and the Climate Change Committee gave approval in January. In anticipation of the plan being agreed, carbon prices rose 62 per cent in the early weeks of 2014 to reach €6.31 (A$9.57) towards the end of February (Reuters 2014b). The EC enacted the amendment at the end of February 2014, with the aim of withdrawing almost 400 million permits this year.

The Commission has proposed longer term measures to automatically address the potential for further surpluses during phase four (2021-2028) of the scheme. In January 2014 the Commission proposed the establishment of a 'market stability reserve' to commence in 2021 (European Commission 2014a). Allowances would be placed in and released from the reserve according to market conditions, thus automatically adjusting supply to increase market stability. It would operate according to pre-defined rules leaving no discretion to the Commission or member states in its implementation. The proposal requires approval by the Council and the European Parliament in order to become law. The likelihood of the Commission's plans becoming law increased in March 2014 when 13 environment ministers, from states including France, Germany, Italy and the UK, issued a joint statement supporting the targets and calling for an early agreement across the region in order to remove uncertainty and promote investment (Energy Live News 2014). The Commission has also proposed to raise the annual emissions reductions factor to 2.2 per cent each year from 2021, compared with the current rate of 1.74 per cent (European Commission 2014a).

5.4.2 Renewable energy support policies

In January 2014, the EC proposed an EU-wide binding target for renewables to represent at least 27 per cent of energy sources by 2030. The Commission included the target in a new framework on climate and energy for 2030. In contrast to the current 20 per cent renewables target by 2020, the proposals as drafted will not translate the new goal into national binding targets. The Commission claims that this is intended to give member states flexibility in changing their energy mix in a way that is adapted to national preferences and circumstances. It has said it will attain the EU-wide renewables target by a new governance system based on national energy plans (European Commission 2014b). However, the absence of national targets means that it is not clear how this will facilitate the EU-wide goal. The European Parliament has indicated its opposition to removing the national targets, and agreement must be reached between it, the Commission and member states before a final proposal can be agreed this year (Euractiv 2014).

The EC published an update on member states' progress and compliance with implementation of the Renewable Energy Directive in 2013. The Directive mandates the Commission to issue biennial progress reports (European Commission 2013a) with the most recent showing that:

- the EU as a whole is on its trajectory towards the 2020 targets with a renewable energy share of 12.7 per cent;

- while a majority of Member States had reached their 2011/2012 interim targets by 2010, efforts will need to be increased to hit their 2020 targets given investment lead times of eight to ten years and ongoing administrative barriers; and
- compliance with the Directive is varied. The Commission has initiated infringement cases against 12 countries where it has not been fully transposed.

As member states begin to reform support schemes for renewables, the Commission has issued recommendations on best practice to guide future policy. A November communication (European Commission 2013b) proposes several mechanisms which member states could implement in order to support renewables while continuing to comply with state aid rules:

- auctions/tenders: Member states could auction a certain capacity of renewable energy production to the lowest bidder to foster competition among producers and reward the most cost-effective;
- feed-in premiums: Renewable energy producers could be paid a market price plus a premium. While the system still ensures investors receive a reasonable and safe return it also exposes them to market signals;
- quota obligations: Energy suppliers have to ensure that a certain share of the electricity they supply comes from renewable or green certificates;
- investment aid: Upfront support helps avoid the production of excess energy supply; and
- co-operation mechanisms: To ensure that renewable energy plants are built in locations where the electricity production is the cheapest, support schemes should be opened up across borders through such mechanisms.

While the communication is not a legally binding act, these principles will apply when the Commission is assessing state interventions relating to renewable support schemes or capacity mechanisms. They will also guide the future enforcement of EU state aid rules and future proposals for EU energy legislation.

5.4.3 Energy efficiency obligations

Member states are obliged to implement a range of energy efficiency obligations in mid-2014 according to recently enacted legislation. Measures in the Energy Efficiency Directive (European Commission 2013c) include:

- member states must set an indicative national energy efficiency target;
- they must achieve a certain amount of final energy savings over the obligation period, 2014 to 2020, through targeted policy measures in the domestic, industrial and transport sectors;
- large enterprises will be obliged to carry out an energy audit at least every four years, with a first energy audit to be completed by December 2015. Member states should establish incentives for SMEs to undergo audits to help them identify the potential for reduced energy consumption;
- long-term strategies for building renovation should be published by the end of April 2014. Commencing January of this year, three per cent of buildings owned and occupied by central governments should be renovated each year to the level the member state has set under the Energy Performance of Buildings Directive; and
- national assessments for co-generation and district heating potential must be developed by the end of 2015, and strategies to implement them must be identified.

In addition, tighter vehicle fuel efficiency targets are set to be introduced from 2021 following endorsement by the European Parliament in February 2014. An emissions target of 95g CO_2/km for new vehicles was first introduced by the EC in 2012. The initial proposals intended for a 2020 implementation date, but an intervention by the German government in mid-2013 resulted in a delay in its proposed introduction with the measures now set to be implemented in 2021 (BBC 2013). The target is averaged across the whole of the car fleet so those emitting more than the level agreed must be compensated for elsewhere. This proposal would reduce new cars' CO_2 emissions by 27 per cent compared to the 2015 target of 130g/km (EC NC).

5.4.4 Other measures

Reforms of the Common Agricultural Policy (CAP) for the budget period of 2014-2020 make climate mitigation and adaptation explicit objectives of the policy. The CAP accounts for about 30 per cent of the overall EU budget for the next budget period. The new measures increase carbon sinks by encouraging more grassland and the protection of forest cover. The revised policy also makes direct payments to farmers conditional upon compliance with green measures, including crop diversification, and the maintenance of permanent grassland (Nachmany et al. 2014). Other changes to the CAP include direct funding to agri-environmental measures and projects related to environmentally friendly investment or innovation.

5.5 Summary

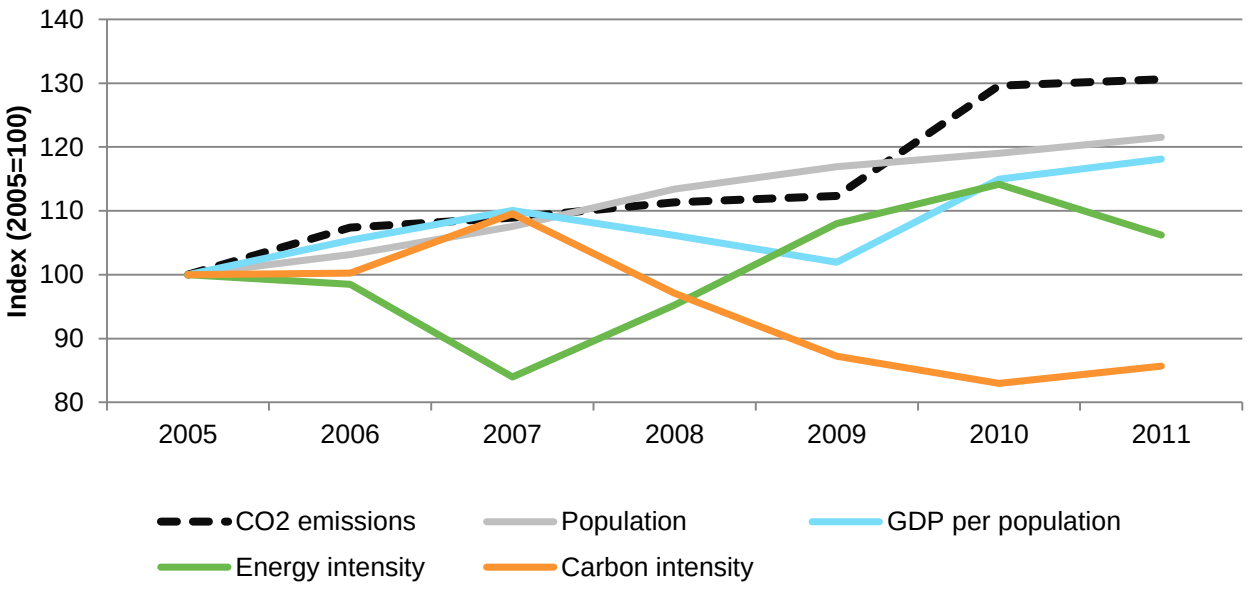
A range of forecasts suggest that the EU is firmly on track to meet its 2020 targets. Some projections suggest that it will appreciably exceed those targets. This is consistent with the recent emissions trends which have seen the EU economy reduce both the energy intensity of its economy and the carbon intensity of its energy consumption more aggressively than in Australia, while growing renewable capacity more quickly. The EU also has some of the best vehicle efficiency in the world. Steps are now under way to prepare for more ambitious emissions reductions in the medium-term, both through making short-term adjustments to the EU ETS to increase prices and in the form of discussions over what targets the region should adopt beyond 2020.

6 Singapore

6.1 Recent trends in emissions

In the period 2005 to 2011, Singapore achieved a reduction in the carbon intensity of its energy consumption of 14 per cent. This is in line with Singapore's policy to lower carbon intensity through fuel switching and is significantly greater than the equivalent performance by Australia. However, overall emissions increased driven both by robust growth in GDP per capita and population, as well as increase in the energy intensity of the economy of 6.2 per cent, significantly worse than the performance achieved by Australia. Figure 20 shows the relative contribution of each of the factors identified earlier.

Figure 20. **Singapore has achieved a significant reduction in the carbon intensity of its energy consumption**



Note: *Kaya decomposition sourced from IEA* (OECD/IEA 2013a). *Kaya identity, decomposes emission as the product of population, GDP per capita, energy use per unit of GDP and carbon emission per unit of energy consumption. The components are in index form, rebased so that the value of the index for each component is 100 in 2005.*

Source: *IEA's CO_2 Emissions from Fuel Combustion, Highlights* (OECD/IEA 2013a)

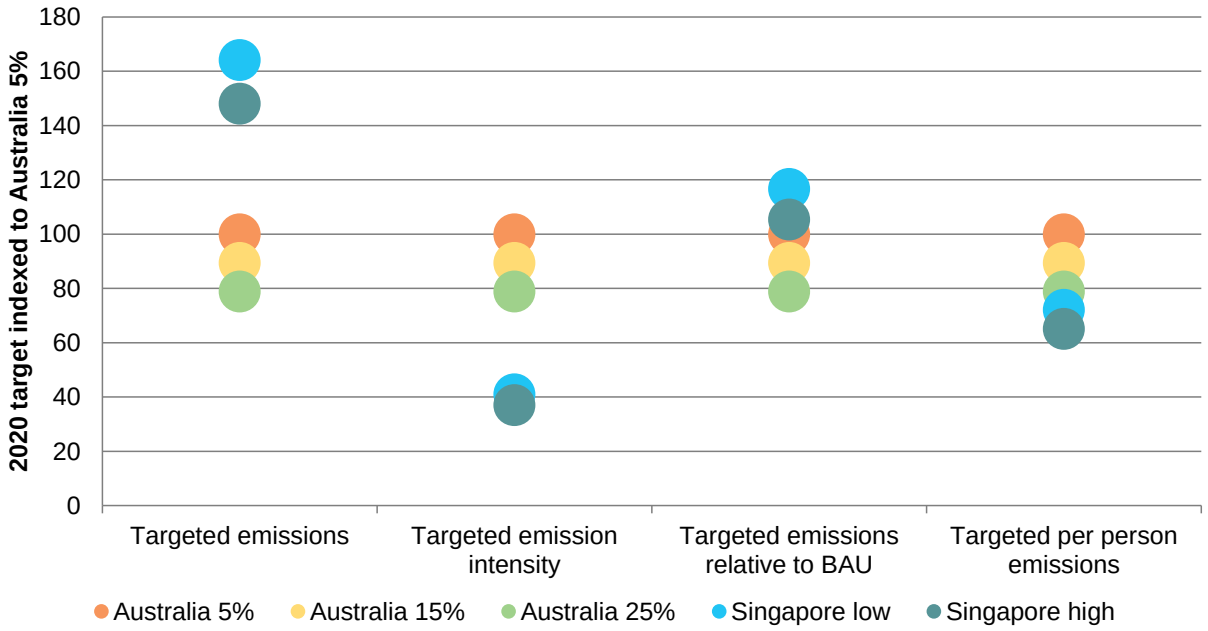
Australia ranks behind Singapore for additional renewable capacity in proportional terms. Australia's additional 3,000 MW of renewable capacity in the years 2005-11 represents growth of 32 per cent. While Singapore achieved additional capacity of just over 250 MW, this represents a 1,260 per cent increase over its 2005 level. However, given the low absolute level of renewables penetration in Singapore, this data should be treated with care and a measure of the relationship between GDP growth and renewables capacity is not provided.

6.2 Future targets

Singapore has targeted a reduction in GHG emissions of 16 per cent below BAU in 2020. While this target is contingent on a legally binding global agreement, it has nonetheless begun to implement the mitigation and energy efficiency measures, as announced under the Sustainable Singapore Blueprint in April 2009, to achieve it. In addition, Singapore is targeting a 7-11 per cent unconditional reduction in emissions to be achieved mainly through a 35 per cent reduction in energy intensity.

If Australia maintains a five per cent target by 2020, Singapore will outperform it for two out of four metrics for measuring the extent of ambition across countries. The CCA did not include Singapore in its country analysis. We have therefore sought to replicate the analysis of the CCA using information of emissions as well as projections for GDP and population, looking at the 7 and 16 per cent emission reduction targets. Figure 21 shows that Singapore's upper and lower targets are more ambitious than Australia's five per cent target for per person emissions levels and emission intensity levels.

Figure 21. **Singapore's unconditional 7 per cent target is more ambitious than Australia's 5 per cent target in terms of emission intensity levels and per person emission levels**



Note: *Lower figure indicative of greater ambition for a given metric. Singapore low represents the lower 7% emissions reduction below BAU by 2020, while Singapore high represents the higher 16% reduction below BAU.*

Source: *Vivid Economics based on CCA*

6.3 Projected trends

Singapore's National Climate Change Secretariat suggests that Singapore will reduce its GHG emissions by 11 per cent compared to Business As Usual in 2020. It estimates BAU emissions to be 77.2 $MtCO_2e$ compared to 68.7 $MtCO_2e$ in the low emissions scenario. Most of the reduction will be achieved in the power generation sector, accounting for 47 per cent of all reductions. A combination of fuel switching

and the promotion of renewables are expected to achieve these reductions. However, it is not clear to what extent this represents a reliable assessment of future emissions trends, as opposed to an aspiration of where its targeted emission reductions will derive. It should also be noted that some stakeholders have criticised the BAU projections from the National Climate Change Secretariat as being inappropriately high (Low Carbon Singapore 2010).

Projections from the Asian Development Bank also suggest Singapore emissions to lie 13 per cent below a baseline scenario in 2020 (Doshi 2013)**.** This analysis suggests that GHG emissions are projected to be 66.5 $MtCO_2e$ under a baseline scenario that is consistent with policy implemented before 2007 but that policies implemented in the period to 2010 will help to reduce emissions by 13 per cent lower than the modelled baseline by 2020. If Singapore achieves the absolute level of emissions projected by this modelling exercise then this would constitute a 25 per cent reduction in emissions relative to the National Climate Change Secretariat's BAU projection.

6.4 Recent policy developments

A review of Singapore's national sustainable development strategy is expected in 2014. Launched in 2009, the Sustainable Singapore Blueprint strategy contains a range of initiatives intended for the country to balance economic growth with environmental sustainability. The Inter-ministerial Committee on Sustainable Development, which launched the initial report, is reviewing it this year to take account of policy developments over the past five years (Ministry of the Environment and Water Resources 2014). Recent policy changes include measures to improve commercial and buildings' energy efficiency as well as incentives for more efficient transport and increased renewables investment.

6.4.1 Commercial and buildings energy efficiency

Large energy users in the industrial and energy sectors have recently been required to introduce energy management and improvement practices. The requirements apply to companies which have operational control over a business activity that exceeds 54TJ of energy per calendar year in at least two out of the three preceding calendar years (NEA 2013). The sectors targeted are:

- manufacturing and manufacturing-related services;
- electricity, gas, steam, compressed air and chilled water for air conditioning suppliers; and
- water supply, sewage and waste management services.

By October 2013, applicable companies were required to register with the National Environment Agency (NEA) and implement the following energy management practices:

- appoint an energy manager;
- monitor and report energy use and greenhouse gas emissions; and
- submit annual energy efficiency improvement plans commencing 2014.

In order to help companies improve their energy efficiency, Singapore has a range of programmes and incentives schemes in place. Some of the schemes the NEA (2013) has initiated in partnership with industry to achieve efficiency goals include:

- the Energy Efficiency National Partnership (EENP) programme: This is a platform to promote the adoption of energy management systems and share good energy efficiency practices between companies;
- the Singapore Certified Energy Manager (SCEM) programme and training grant: this offers a formal training and certification system in the area of energy management, of which a grant covers about 80 per cent of training costs;
- the Energy Efficiency Improvement Assistance Scheme (EASe): This encourages companies in the manufacturing and building sectors to carry out detailed technical assessments of their energy consumption so as to identify potential areas for energy efficiency improvements. The NEA co-funds up to 50 per cent of the cost of such energy appraisals;
- the Grant for Energy Efficient Technologies (GREET): this encourages the uptake of energy efficient technologies and supports energy efficiency retrofits, by providing a grant to offset part of the investment cost. Co-funding of up to 20 per cent of the qualifying costs is provided, capped at S$4 million (A$3.49 million) per project.

The country is also aiming to support Small and Medium sized Enterprises (SMEs) assess and improve their energy performance with a dedicated scheme. In July 2013, the government allocated S$17 million (A$14.9 million) to help approximately 300 enterprises achieve at least 10 per cent energy costs over the following three years (Spring Singapore 2013). SMEs may use Innovation and Capability Vouchers to engage one of 11 prequalified Energy Service Companies (ESCOs) to conduct an audit of their current energy usage and identify areas to improve energy efficiency. Funding is also available to install systems for long-term continuous self-monitoring of energy consumption. Finally, SMEs can avail of further funding for larger energy management projects involving optimising processes, redesigning workflows, or installing of energy-efficient equipment or technologies.

Minimum standards for commercial buildings have recently been enacted and supports for retrofits have been increased. Further schemes encourage energy efficiency at design stage:

- from the start of 2014, new regulations prescribed minimum environmental sustainability standards for existing buildings (Keung 2014);
- in July 2012, the Green Mark Incentive Scheme, which provides cash incentives to encourage energy efficient retrofits, was enhanced to provide up to 50 per cent of costs, capped at S$3 million (A$2.62 million);
- a Green Mark scheme provides funding for developers to engage environmental design consultants in the planning phase for new buildings; and
- the ‘Design for Efficiency Scheme’ encourages investors in new facilities to integrate energy efficiency improvements into manufacturing development plans in the design stage (NEA 2014). The maximum amount of funding is 50 per cent of the qualifying costs or S$600,000 (A$436,900), whichever is lower. Qualifying costs include the costs of availing of technical expertise from engineers, architects and other contractors.

6.4.2 Other emissions mitigation strategies

To promote greater energy efficiency in the transport sector, a system of rebates and penalties based on vehicle emissions was introduced in 2013. Under the Carbon Emissions-Based Vehicle Scheme (CEVS), from January of last year all new car and imported used cars with carbon emissions of less than or

equal to 160g CO_2/km qualify for rebates of between S$5,000 (A$4,369) and S$20,000 (A$17,477) (Land Transport Authority 2012). From July, vehicles with carbon emissions equal to or more than 211g CO_2/km incur a corresponding registration surcharge of between $5,000 (A$4,369) and S$20,000 (A$17,477). The scheme is applicable until the end of 2014 at which point it will be reviewed.

Despite limited scope for renewables, the country is undertaking a range of initiatives to encourage the use of renewable energy technology. Singapore has no hydro or geothermal power sources and low wind speeds. However there is limited scope for solar investment and this is being supported by the government. The Solar Capability Scheme provides grants of up to 30 percent for solar technology, capped at S$1million (A$0.87 million) per programme (KPMG 2013). The scheme's objective is to encourage the integration of solar technologies into energy efficient buildings and build the capabilities of companies engaged in engineering, architecture and system integration. In addition, the government supports research institutes, such as the Solar Energy Research Institute of Singapore, to study technical aspects of adapting solar energy to the country's context.

6.5 Summary

Singapore is on track to deliver an emissions reduction target that, on two out of four measures used by the CCA, is more ambitious than Australia's 5 per cent target. While there are some concerns about the robustness of the BAU base from which it seeks to achieve its target, independent modelling analysis identifies a significant deviation in emissions accounted for by policy action. These actions include concerted efforts to improve energy efficiency as well as incremental efforts to boost renewables.

7 South Korea

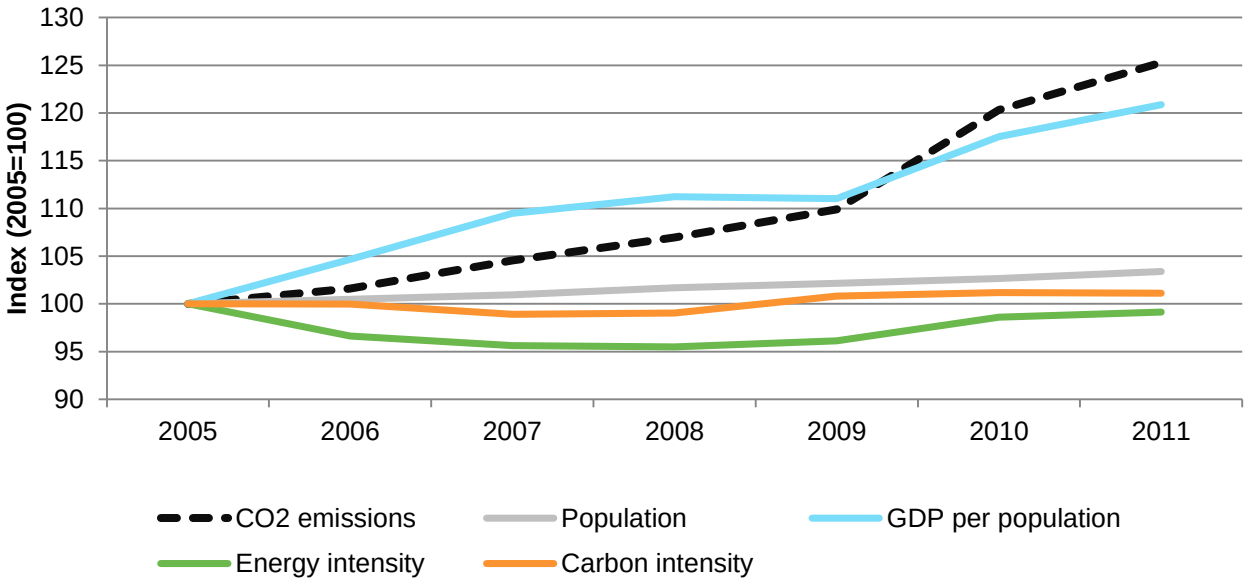
7.1 Recent trends in emissions

South Korea emissions rose by 25 per cent in the period 2005-2011 due to rapid economic growth. By contrast, carbon intensity and energy intensity had very meagre contributions to GHG emissions. Figure 22 shows the relative contribution of each of the factors identified earlier:

- Growth in GDP per capita was substantial at 20 per cent over the period, explaining the bulk of the emissions growth;
- South Korea's carbon intensity went up by 1 per cent, rising in 2008 after an initial decline;
- the energy intensity of South Koreas economy decreased by 1 per cent;
- population growth was also relatively low with a 3.4 per cent increase.

On both carbon intensity and energy intensity, Australia performed better than South Korea over this period.

Figure 22. **Strong economic growth led South Korea's CO_2 emissions from energy to increase substantially in the period 2005-2011**



Note: *Kaya decomposition sourced from IEA* (OECD/IEA 2013a). *Kaya identity decomposes emission as the product of population, GDP per capita, energy use per unit of GDP and carbon emission per unit of energy consumption. The components are in index form, rebased so that the value of the index for each component is 100 in 2005.*

Source: *IEA's CO_2 Emissions from Fuel Combustion, Highlights* (OECD/IEA 2013a)

Nonetheless, tested vehicle fuel economy in South Korea indicates its fleet outperforms that of Australia. IEA analysis of the fuel economy of new light vehicle registrations in 2010 shows the South

Korean fleet achieved a fuel economy of 7.7 lge/100km. This figure strongly outperformed Australia's 9.1 lge/100km.

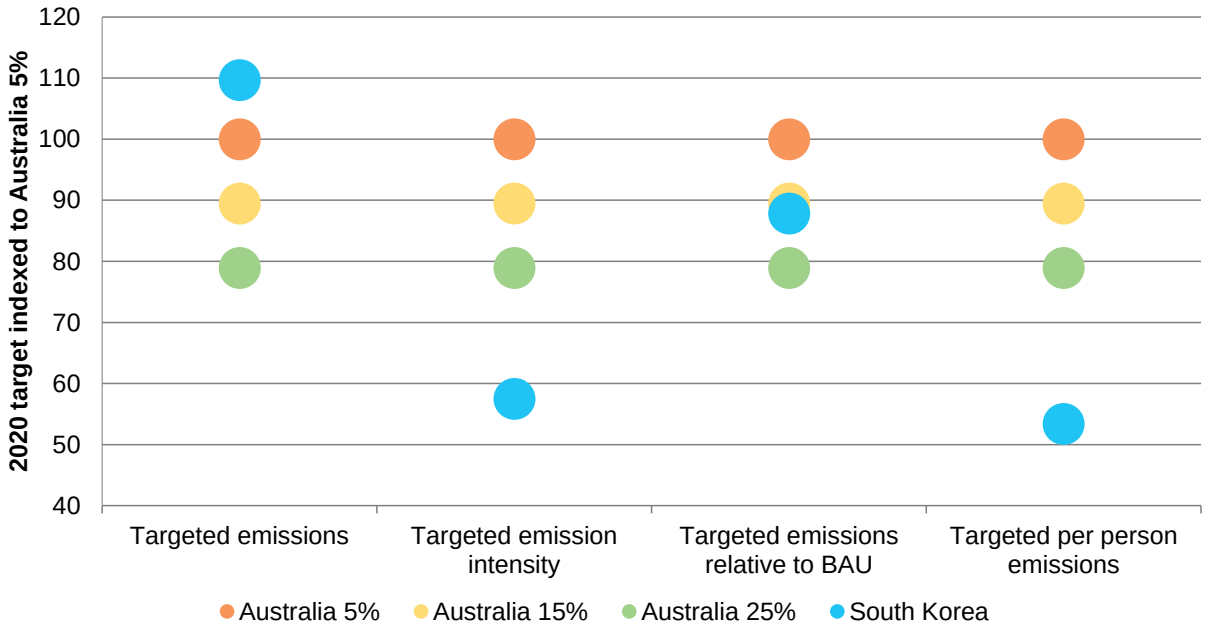
Australia also ranks behind South Korea for additional renewable capacity, both in proportional terms and in terms of responsiveness to GDP growth. Australia's additional 3,000 MW of renewable capacity in the years 2005-11 represents growth of 32 per cent. While South Korea achieved a lower absolute capacity addition, at 1,580 MW, this nevertheless represents growth of 89 per cent over its 2005 level. Growth in renewables was also more responsive to GDP growth: every 1 per cent increase in GDP in South Korea was associated with a 2.90 per cent increase in renewables capacity during 2005-11 against 1.49 per cent in Australia.

7.2 Future targets

South Korea has targeted a reduction in emissions of 30 per cent below BAU in 2020. This goal equates to an absolute reduction of four per cent below 2005 levels. This is one of the key elements of an overarching Green Growth Strategy which envisages Korea becoming a world-leader in green technologies.

If Australia maintains a five per cent target by 2020, South Korea's target will be more ambitious than Australia's on three out of four CCA metrics. As indicated in Figure 23, South Korea's 30 per cent target is more ambitious in terms of emission intensity levels, departure from BAU and per person emissions.

Figure 23. **South Korea's target is more ambitious than Australia's 5% target in terms of emission intensity, reduction from BAU and per person emission levels**



Note: *Lower figure indicative of greater ambition for a given metric. South Korea target is for a 30% reduction below BAU by 2020.*

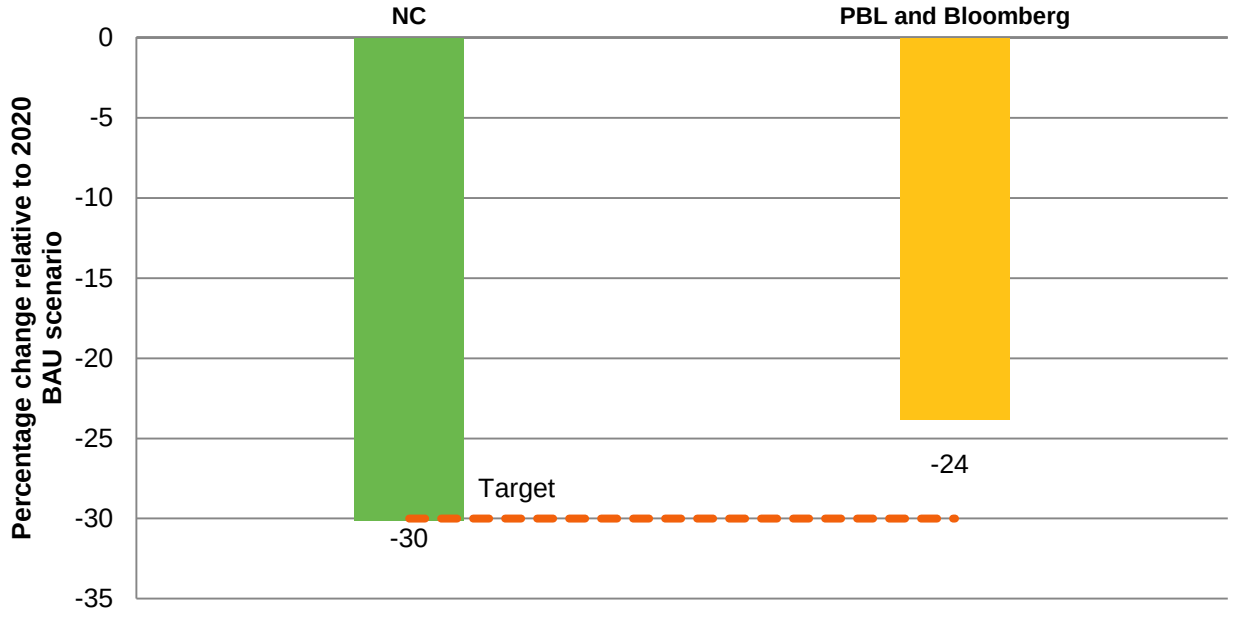
Source: *Vivid Economics based on CCA*

7.3 Projected trends

In the third National Communication to the UN, South Korea identified all of the required reductions that can enable it to meet its 2020 emissions target (Korea/MoE 2011)**.** In order to achieve an overall decrease of 234 $MtCO_2e$ in GHG emissions, South Korea projects 170 $MtCO_2e$ of abatement from the energy sector and a further 60 $MtCO_2e$ from industrial processes. To meet its target, South Korea plans to rely primarily on an Emissions Trading Scheme (discussed below), which will start operating in 2015, while emissions reductions in other sectors are much smaller.

The Netherlands Environmental Assessment Agency suggests Korea is on track to achieve a 24 per cent emissions reduction compared to BAU in 2020. The Netherlands Environmental Assessment Agency (PBL 2013) predicts emissions abatement from ETS, in combination with additional renewables deployment, to deliver approximately 185 $MtCO_2e$ of abatement, which will put South Korea's emissions 24 per cent lower than BAU in 2020. This is shown in Figure 24.

Figure 24. **Identified emissions abatement opportunities will enable South Korea to reduce emissions by a respectable 24 per cent to 30 per cent compared to BAU in 2020**



Note: *NC scenario is consistent with Korea's own projection* (Korea/MoE 2011). *PBL and Bloomberg scenario combines two studies to arrive at an up to date projection of Korea's emissions reductions in 2020.*

Source: *Vivid Economics using sources above*

7.4 Recent policy developments

South Korean President Park Geun-hye has recently re-emphasised her country's commitment to tackling climate change both domestically and abroad. At the opening address of the headquarters of the Korean-based Green Climate Fund, she stressed that her administration had established climate change as a priority issue and that it was committed to co-operate with other countries to tackle it:

> *'Climate change cannot be put off until tomorrow but is an issue that requires immediate action today from all members of the global community. All countries and international organisations, all governments and businesses and all civil societies must take action before it is too late… Together with the Green Climate Fund and the international community, Korea will actively partake in the effort to respond to climate change'* (Government of Korea 2013a).

The President committed to South Korea taking an active approach to climate change with policies that not only mitigate its effects but also help to provide opportunities for new growth engines. President Park said that her administration would designate responding to climate change as a key element of building a 'creative economy' with specific policies focussing on:

- investment in new and renewable energy sources;
- energy management systems; and
- carbon capture and storage and carbon pricing.

Korea's experience in developing technologies in these areas will be shared with the international community to '*contribute to the global spread of a system in which growth and the environment form a virtuous cycle*' (Government of Korea 2013a).

Commentators have noted that these remarks are in keeping with an increasingly positive tone towards responding to climate change from the administration in recent months. When President Kim came to office in early 2013, she downgraded the Presidential Committee on Green Growth, a high-level co-ordinating body to advance the climate agenda, to a prime ministerial committee in an apparent move to distance herself from her predecessors' green policies (Kim and Thurbon 2014). However, while the initial downgrade led to concerns the committee would not retain the same authority, a recent re-launch of the commission has given it an expanded role in drawing in contributions from academic and civil society groups (The Korea Herald 2013). It is focussed on implementing and extending previously enacted initiatives with policymakers discussing a 'Green Growth 2.0' agenda.

Consistent with this, South Korea is also taking an international lead on carbon pricing mechanisms; it was the first Asian country to pass a national economy-wide ETS into law with implementation commencing in 2015. Companies that emit over 125,000 tCO2e per annum will require allowances for each tonne of GHG emissions they produce, although the inter-ministerial task force may revise the cap. As currently envisaged, 490 of the country's largest emitters, 15 which account for roughly 60 per cent of the country's annual GHG emissions, will be subject to emission caps (Environmental Defense Fund 2013). During phase I (2015-17), 100 per cent of allowances will be freely allocated, falling to a maximum of 97 per cent in phase II (2018-2020) and 90 per cent in phase III (2021-26) with the balance auctioned in each case. Analysis of the scheme (Bloomberg New Energy Finance 2013) suggests that it is ambitious and that

the price of carbon is likely be high compared to other schemes. The government will agree the final details of the scheme, including allocation methods, controlled sectors and sectoral allowances, in mid-2014.

In August 2013 the government announced a plan to promote investment in renewable technologies by setting revised targets and reforming regulations. The 'Plan for promoting the renewable energy industry' (Government of Korea 2013b):

- increases the quota for solar photovoltaic power by 150MW in 2014 and a further 150MW in 2015 such that it will reach 1.5GW in order to facilitate the expansion of the market;
- reforms planning processes for the construction of renewable energy facilities and power lines;
- expands renewable heat energy obligations on newly constructed buildings from ten per cent in 2016-19 rising to 30 per cent by 2030;
- increases public buildings' renewable energy obligations from the current 20 per cent to 30 per cent in 2020; and
- changes the basis for subsidies for renewables from unit capacity to quantity of energy supplied.

This built on changes to the incentive regime for renewable power, where a feed-in-tariff mechanism for facilitating renewable energy production was replaced in 2012 with a system of Renewable Energy Certificates (REC) under a Renewable Portfolio Standard (RPS). This obliges the 13 largest public and private utilities to increase the share of renewables in their generation portfolios to 10 per cent by 2022. This can be achieved by building their own plant or by buying RECs from green energy suppliers. Penalty payments are charged for any shortfalls.

There are also plans for significant public investment in renewables. The government plans to invest US$8.2 billion (A$9.14 billion) in offshore wind farms in order to reach a wind capacity of 2.5 GW by 2019, from a base of just 0.3 GW in 2008.

The country has also been an early adopter of domestic energy efficiency measures, and announced it intends to ban the production and import of incandescent light bulbs after 2014. After its introduction 21 years ago, the number of products that received certification as part of the Eco-label scheme topped 10,000 in 2013. In addition, low efficiency lighting has been targeted with the incandescent lamp exit management system resulting in 99 per cent of such lighting being removed from the public sector. The move to high-efficiency lighting for the whole economy is expected to be accelerated when the production and import of incandescent bulbs is banned after 2014 (Energy Korea 2013).

7.5 Summary

South Korea has set itself an ambitious emissions reduction target – the CCA analysis suggesting that it is more ambitious than Australia's current five per cent metric on three out of the four metrics considered. While independent forecasts suggest that it is not yet on track to fully meet this target, the imminent establishment of a national ETS – which forecasts suggest will have higher prices than in any other ETS scheme currently operating – indicates that it is committed to taking significant climate action. While its historic performance in reducing either the energy intensity of the economy or the carbon intensity of its energy consumption has not been as strong as in Australia, the relative growth of renewables in Korea has been stronger and the fuel efficiency of its new light duty vehicles fleet is greater.

Appendix

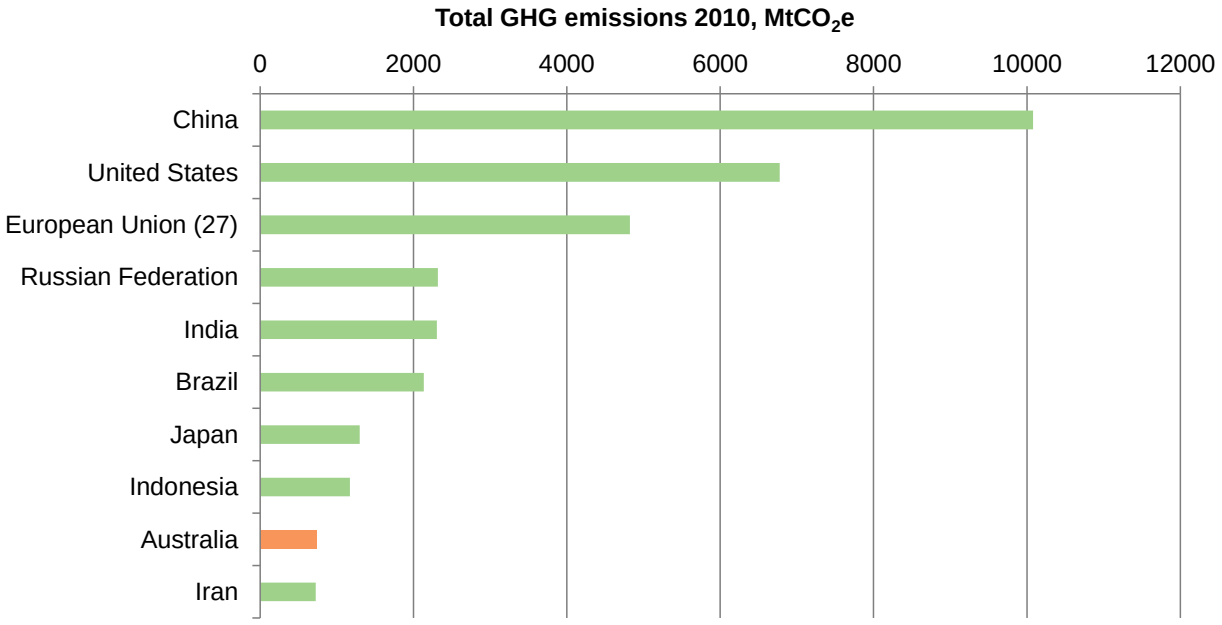
In order to compare Australia's climate change progress internationally, objective and transparent criteria are required to select appropriate comparator countries. This report used three metrics to choose countries:

- **absolute GHG emissions**: this ensures the analysis includes those countries which need to take the greatest action to avoid dangerous climate change;
- **key export competitors**: this criterion identifies the countries where producers who compete with Australia's key exporters that are vulnerable to carbon regulation (sectors that are Emissions Intensive and Trade Exposed (EITE)) are located; and
- **key import partners**: using a similar process, this examines the countries from which Australia imports significant quantities of products from EITE sectors.

These are not the only criteria that could be used to draw up a shortlist of relevant countries but they are considered to provide a reasonable basis to identify countries of greatest interest to Australia when considering its emission reduction ambition.

Absolute GHG emissions

Figure 25. **Taken together, the top three emitters account for over 22 $GtCO_2e$ per annum or 45 per cent of total**



Note: *Figures are inclusive of LULUCF.*

Source: *Vivid Economics based on WRI Cait*

Emissions data was gathered from WRI CAIT 2.0 database for 2010, the most recent complete data set available. The WRI relies on a six-gas, multi-sector data set accounting for 186 countries. As Figure 25 illustrates, China is the largest GHG emitter in absolute terms, responsible for over ten $GtCO_2e$ in 2010,

equivalent to almost one quarter of the world's total. It was closely followed by the United States, with the EU in third. Indonesia and Russia also feature in the top ten emitters.

Key export competitors

Identification of EITE export sectors

The second metric focusses on those industries which are most exposed to international competition and which might suffer if Australia was taking unilateral action to reduce emissions. This implies that the sectors in question should be:

- **large GHG emitters:** while, for example, the education, financial and information services sectors are key Australian export sectors, their negligible emissions means that the impact of climate policy on international competitiveness is minimal; and
- **susceptible to international competition:** only producers in sectors whose products are traded extensively across borders are likely to be affected negatively by climate policy.

In order to ensure objectivity when selecting relevant sectors, we used the Australian Clean Energy Regulator's list of industries that are Emissions Intensive and Trade Exposed (EITE). To qualify as EITE, a sector must meet two criteria. Firstly it must exceed a given emissions intensity threshold, as defined on the basis of weighted-average emissions per revenue or per value added over a number of years. Second, it must be trade exposed which is defined as a trade share greater than ten per cent over the course of a number of years. The trade share is the ratio of the combined value of imports and exports to the value of domestic production. In some instances, a qualitative test may apply for trade exposure where there is a demonstrated lack of capacity to pass through costs due to the potential for international competition.

In addition to EITE products as defined by the Clean Energy Regulator, we also included 'bituminous and other coal (not agglomerated)' as an EITE product, in recognition of the significance of the industry to Australian exports as well as its emissions intensity. The government established the Coal Sector Assistance Package when it introduced the carbon price.

To identify which EITE products are most important to the Australian economy, our analysis focusses on the 20 most important exports from EITE sectors. Trade information is gathered for 2012 from the UN Comtrade database using the Standard International Trade Classification, Revision 4 (SITC, Rev.4). Products are analysed according to the third level of granularity (out of four) within the SITC classification, a level which includes 1,023 goods groups. Such a level of detail ensures that products can be identified as being produced by an EITE sector or not.

Identification of the top 20 EITE sectors reveals they account for 30 per cent of Australia's exports. The number of sectors chosen ensures that any product that accounts for at least 0.05 per cent of the country's 2012 exports are included in the analysis as illustrated in Table 7.

Table 7. **Coal, natural gas, petrol refining and metal manufacturing dominate the EITE list**

Rank	Product Description	Share of exports	Value (US$ billion)
1	Bituminous and other coal, whether or not pulverised, but not agglomerated	16.64%	42.650
2	Natural gas, liquefied	5.48%	14.050
3	Alumina (aluminium oxide), other than artificial corundum	2.01%	5.156
4	Aluminium and aluminium alloys, unwrought	1.41%	3.603
5	Petroleum oils & oils obtained from bituminous minerals (other than crude)	1.32%	3.378
6	Copper, refined and unrefined; copper anodes for electrolytic refining; copper alloys, unwrought	1.16%	2.984
7	Lead and lead alloys, unwrought	0.36%	0.918
8	Zinc and zinc alloys, unwrought	0.35%	0.886
9	Nickel and nickel alloys, worked	0.24%	0.609
10	Kraft paper and paperboard, uncoated, n.e.s., in rolls or sheets	0.14%	0.369
11	Iron ore agglomerates (sinters, pellets, briquettes, etc.)	0.14%	0.351
12	Aluminium and aluminium alloys, worked	0.13%	0.325
13	Coke & semi-coke of coal, of lignite/of peat; retort carbon	0.12%	0.302
14	Copper bars, rods and profiles	0.11%	0.301
15	Articles of iron or steel, n.e.s.	0.11%	0.275
16	Flat-rolled products of iron or non-alloy steel, not clad, plated, coated, or further worked	0.10%	0.252
17	Nickel mattes, nickel oxide sinters and other intermediate products of nickel metallurgy	0.09%	0.221
18	Intermediate products of cobalt metallurgy; cobalt, cadmium, titanium and zirconium, unwrought	0.06%	0.150
19	Paper and paperboard, uncoated, n.e.s., in rolls or sheets	0.05%	0.122
20	Structures and parts of structures of iron or steel	0.05%	0.119
	Total	**30.06%**	**77.020**

Note: *nes denotes not elsewhere specified*

Source: *Vivid Economics based on UN Comtrade data and the Australian Clean Energy Regulator*

Identification of EITE export competitors

The ideal approach for identifying the location of Australia's export competitors would involve identifying the geographic markets (which may be regional, global, and so on) that Australia's exporters sell into and the location of the other producers that also sell into the same market. Unfortunately, this approach is made challenging by both limited authoritative data on the geographic extent of each of the products of interest, plus limited information on the output of products in different countries.

Instead, therefore, we use trade data to identify those countries that export significant quantities of products that are also exported by Australia's key EITE sectors. Producers in these countries may gain a competitive advantage if Australian exporters incur additional costs due to climate change legislation. An unavoidable trade-off in this approach results from the fact that producers in these countries may export a given EITE product to different markets to Australia's producers.

In order to capture a product's importance to the Australian economy, we weight each country's exports of a given EITE product according to its share of Australian exports. This is repeated for all 20 EITE products, and the resulting weighted export figures are summed for each country. The outcome is a list of countries/regions which export the most EITE products relative to their importance to the Australian economy. Table 8 shows that the top three EITE export competitors are Indonesia, the US and Russia.

Table 8. **The top ten countries account for around 55 per cent of world trade of Australia's key EITE products**

Rank	Country	Weighted share	Weighted value (US$ billion)
1	Indonesia	12.8%	16.31
2	USA	10.3%	13.04
3	Russian Federation	9.6%	12.25
4	EU-27	5.1%	6.43
5	Canada	3.7%	4.72
6	Colombia	3.3%	4.25
7	Malaysia	3.2%	4.04
8	South Africa	3.1%	3.94
9	Singapore	2.6%	3.25
10	South Korea	2.0%	2.52
	Other	44.3%	56.24
	Total	**100%**	**127.00**

Source: *Vivid Economics based on UN Comtrade and Australian Clean Energy Regulator*

Identification of EITE import sectors and competitors

We also consider where Australia imports products from EITE sectors. These producers may gain a competitive advantage in selling into the Australian market if Australia's domestic producers face an emissions constraint which they do not. A possible issue with this approach is that there may not be significant Australian production of the good in question, which is why the good is imported. However, EITE sectors are only classified when there is Australian production, so this concern is partly allayed.

Similar to the export analysis, we first examine Australia's highest EITE import products as defined by the Clean Energy Regulator. Data is gathered from UN Comtrade for 2012 using the SITC Rev. 4 database. Analysis of EITE imports into Australia reveals some overlap with EITE export sectors. Table 9 illustrates that the highest ranking EITE products imported into Australia were worth US$27 billion (A$29.7 billion) in 2012.

Table 9. **Principle EITE imports into Australia were worth almost US$ 27 billion**

Rank	Product Description	Share of exports	Value (US$ billion)
1	Petroleum oils and oils obtained from bituminous minerals (other than crude) and preparations n.e.s	6.6%	16.422
2	Structures of iron and steel	0.7%	1.721
3	Copper, refined and unrefined; copper anodes for electrolytic refining; copper alloys, unwrought	0.4%	0.963
4	Articles of iron or steel, n.e.s	0.3%	0.807
5	Other tubes and pipes of iron and steel	0.3%	0.752
6	Petroleum bitumen, petroleum coke and bituminous mixtures	0.3%	0.732
7	Paper and paperboard… in rolls or sheets	0.2%	0.607
8	Tubes, pipes and hollow profiles, seamless, of iron or steel	0.2%	0.570
9	Screws, bolts, nuts, coach screws, screw hooks, rivets, cotters, cotter pins of iron or steel	0.2%	0.500
10	Articles of paper pulp, paper, paperboard or cellulose	0.2%	0.469
11	Other tubes, pipes and hollow profiles of iron or steel	0.2%	0.459
12	Paper, paperboard, cellulose wadding and webs of cellulose fibres, coated… in rolls or sheets, n.e.s	0.2%	0.394
13	Tube or pipe fittings (e.g., couplings, elbows, sleeves) of iron or steel	0.2%	0.388
14	Polyethylene	0.1%	0.360
15	Paper and paperboard, uncoated, of a kind used for writing, printing or other graphic purposes	0.1%	0.348
16	Bars and rods of iron or non-alloy steel not further worked than hot-rolled	0.1%	0.286
17	Articles, n.e.s., of copper, nickel, aluminium, lead, zinc and tin	0.1%	0.264
18	Flat-rolled products of iron or non-alloy steel, plated or coated with zinc	0.1%	0.251
19	Flat-rolled products of iron or non-alloy steel, not clad, plated or coated	0.1%	0.224
20	Cartons, boxes, cases, bags and other packing containers, of paper, paperboard, cellulose wadding	0.1%	0.221
	Total	**10.7%**	**26.737**

Note: *nes denotes not elsewhere specified*

Source: *Vivid Economics based on UN Comtrade*

As before, the source countries of these EITE products were examined. Products are weighted according to the value of the product that Australia imports. The weighted 20 products are summed by source country. China, Japan and the US all feature in the top ten sources of EITE imports into Australia as indicated in Table 10, while Singapore ranks number one as it is a key source of refined petroleum products.

Table 10. **The top ten countries account for around 55 per cent of world trade of Australia's key EITE products**

Rank	Country	Weighted share	Weighted value (US$ billion)
1	Singapore	35.9%	9.912
2	South Korea	11.4%	3.152
3	China	9.2%	2.535
4	Japan	7.9%	2.197
5	EU	4.7%	1.295
6	Chile	3.4%	0.946
7	Malaysia	3.1%	0.868
8	USA	3.0%	0.830
9	Thailand	2.6%	0.714
10	Indonesia	2.4%	0.662
	Others	16.4%	4.350
	Total	**100%**	**27.64**

Source: *Vivid Economics based on UN Comtrade and Australian Clean Energy Regulator*

Comparator country choice

The choice of countries was based upon a comparison of the three lists. Some countries appear multiple times across the GHG emitters, EITE export competitor and EITE import sources lists. Some countries appear on all three lists while China, Russia, Japan, Malaysia, South Korea and Singapore appear on two lists each as indicated in Table 11.

Table 11. **The US, the EU and Indonesia appear on all three lists**

Rank	GHG emitters	EITE export competitors	Sources of EITE imports
1	**China**	**Indonesia**	**Singapore**
2	**USA**	**USA**	**South Korea**
3	**EU-27**	Russian Federation	**China**
4	Russian Federation	**EU-27**	Japan
5	India	Canada	**EU-27**
6	Brazil	Colombia	Chile
7	Japan	Malaysia	Malaysia
8	**Indonesia**	South Africa	**USA**
9	Iran	**Singapore**	Thailand
10	Canada	**South Korea**	**Indonesia**

Notes: *GHG emissions list excludes Australia. Countries in bold are those suggested for further analysis.*

Source: *Vivid Economics based on UN Comtrade, Clean Energy Regulator and WRI Cait*

Based upon a qualitative assessment of the three lists, the countries chosen were as follows:

- **The EU**: appears on all three lists;
- **The US:** appears on all three lists;
- **Indonesia:** appears on all three lists;
- **China:** the highest GHG emitter and the third most important source of imports of EITE products;
- **Singapore:** the largest source of EITE imports and also appears on the EITE exporters list; and
- **South Korea:** is the second most important source of EITE imports and also appears on the EITE export competitor list.

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