REPORT

SEPTEMBER 2018

Tracking progress to net zero emissions

National progress on reducing emissions across the Australian economy and outlook to 2030

Co-founded by Monash University and The Myer Foundation
and working within Monash Sustainable Development Institute

About Us

ClimateWorks Australia is an expert, independent adviser, acting as a bridge between research and action to enable new approaches and solutions that accelerate the transition to net zero emissions in Australia and our region. ClimateWorks was co-founded in 2009 by The Myer Foundation and Monash University and works within the Monash Sustainable Development Institute.

Since launch, ClimateWorks has made significant progress, engaging key decision makers from all tiers and sides of politics and business. Our collaborative, end-to-end approach to solutions that will deliver greatest impact is informed by a thorough understanding of the constraints of governments and the practical needs of business. This, combined with philanthropic funding and university ties, has earned the organisation an outstanding reputation as a genuine and impartial adviser.

In the pursuit of its mission, ClimateWorks looks for innovative opportunities to reduce emissions, analysing their potential then building an evidence-based case through a combination of robust analysis and research, and clear and targeted engagement. ClimateWorks supports decision makers with tailored information and the tools they need, and works with key stakeholders to remove obstacles and help facilitate conditions that encourage and support Australia's transition to a prosperous, net zero emissions future.

About this report

This report uses findings from the Deep Decarbonisation Pathways Project (DDPP) and compares these with the Australian Government's emissions data and projections to examine whether Australia is on track for a net zero pathway and for its first commitments under the Paris Agreement on climate change to reduce emissions by 26 to 28 per cent below 2005 levels by 2030. It assesses recent progress since 2005 and the outlook to 2030.

In common with 179 other countries who ratified the Paris Agreement, Australia has committed to keeping global warming well below 2 degrees, aiming to limit warming to 1.5 degrees and to reach net zero emissions. For developed countries like Australia, a 2 degree limit is generally accepted to mean reaching net zero emissions by 2050 – the majority of states and territories have agreed to this goal. Limiting global warming to well below 2 degrees or 1.5 degrees would require an earlier date.

Australia's current emissions reduction target is 26 to 28 per cent below 2005 levels by 2030. This is less ambitious than the Climate Change Authority's recommended target range of 45 to 65 per cent below 2005 levels by 2030 for Australia's contribution to a 2 degree goal (CCA 2015). To make sure the world is on track, all countries in the Paris Agreement have been asked to consider whether their current target is ambitious enough.

We already know Australia can reach net zero emissions by 2050. *The Pathways to Deep Decarbonisation in 2050* (DDPP) report (ClimateWorks et al 2014) identified the emissions reductions potential to put Australia on a pathway to net zero in 2050 while the economy continues to grow. There are alternative pathways also. On the net zero pathway, identified by the DDPP, Australia has the potential to reach 55 per cent below 2005 levels by 2030. This is the mid-point of the Climate Change Authority's recommended range.

Recent research suggests that faster than expected technological advances have made steep cuts in emissions easier to achieve.

Given Australia has passed the half-way point from the 2005 base year to 2030, now is an important time to take stock. This *Tracking Progress* report by ClimateWorks Australia therefore assesses how Australia is tracking against Paris commitments.

This report compares the net zero pathway to the Government's emissions figures and projections to examine whether Australia is on track for the net zero pathway and the Government's 2030 target. It assesses recent progress since 2005 and the outlook to 2030 considering current, proposed and enhanced policy scenarios. It looks at electricity, industry, buildings, transport and land sectors. The report also presents progress under the four pillars of decarbonisation: energy efficiency, low carbon electricity, fuel switching and non-energy emissions, to create detailed understanding of how emissions in Australia's economy are changing - and where they are not.

In subsequent research, ClimateWorks will release further analysis to guide priorities for Australia's transition to a vibrant, clean economy. Australia is not yet on track to that future - but there are many available opportunities that can be tapped. ClimateWorks will also investigate the prospect that new technologies can create even greater opportunities.

The Australian Government has committed itself to develop a long term emissions reduction strategy in 2020, as requested by the Paris Agreement and as recommended by the Finkel Review into the security of the electricity market. Also each of the state governments in the National Electricity Market have a goal to reach net zero emissions before 2050 and are in various stages of implementation planning. ClimateWorks will continue to support these efforts with further analysis of opportunities for emissions reductions in different sectors and pillars, and the ambitions needed for Australia to support global efforts to limit climate change.

Tracking Progress to 2030

Australia is not yet on track to meet its commitments under the Paris Agreement, but has sufficient potential to do so. Since 2005 Australia's emissions have fallen 11 per cent while the economy grew 38 per cent, but the improvement is not yet enough for our nation to be on track to reach net zero, nor the Government's current 2030 target of 26 to 28 per cent below 2005 levels. Emissions are projected to rise in most sectors - specific sector support can turn this around.

Where is Australia at?

In 2017 Australia's emissions were around 11 per cent below 2005 levels. This is an increase from their lowest point in 2013. Overall progress was due to strong reductions in the land sector, while emissions rose in most other sectors. Although there were improvements at the whole of economy level and in some sectors, improvements on average were not equivalent to the pathway to net zero emissions by 2050.

Emissions are higher in buildings, industry and transport than they were in 2005. Emissions are lower in the land sector, with the reduction being larger than increases in other sectors. Electricity emissions fell slightly.

Progress can be tracked through changes to total emissions and changes in emissions intensity[1] which show the impact of activity levels. Under business-as-usual, economic and population growth tends to increase emissions due to corresponding increases in activity. Action is therefore needed even just to keep emissions from increasing.

There were times of reasonable emissions intensity improvements in industry and buildings but, as with the electricity sector, these improvements then slowed or reversed. This occurred alongside the repeal of the carbon price and related policies. Energy intensity improved in these sectors, suggesting better energy efficiency, but not at the rate needed for net zero. And in industry, some of this improvement was driven by declines in energy-intensive manufacturing. This is discussed in the section *More detail on recent progress in industry*.

There are signs that necessary improvements rates are possible. Progress was made at times in every sector and pillar of decarbonisation. However the average rate of improvement since 2005 has fallen short. Land was the only sector to improve at the rate necessary for the pathway to net zero in 2050 and this improvement was strong enough to drive most of the reductions in Australia's total emissions.

1 Emissions intensity is the emissions per unit of activity measured by value (for example for the whole of the economy per $ GDP) or the amount of a product (for example for electricity per MWh of generation).

Where is Australia going?

Whole of Economy

Australia's total emissions would remain around 11 per cent below 2005 levels in 2030, if existing policies were retained and those in development were implemented (this scenario is referred to as proposed policies in this report)[2].

Electricity and building emissions are projected to fall under the proposed policies scenario. However, industry and transport emissions are projected to continue to rise. Land emissions are also projected to rise, but remain well below 2005 levels. More can be done and all Australian governments have the opportunity to develop further policy as part of existing policy frameworks.

Further action is needed for Australia to meet its current 2030 target and to tap into the full potential identified on the net zero pathway.

Australia has three times as much emissions savings potential as it needs to reach the 26 per cent target by 2030. Achieving all of this would reach a 55 per cent target in 2030 and be on track to net zero by 2050 (Figure 1 and Table 1).

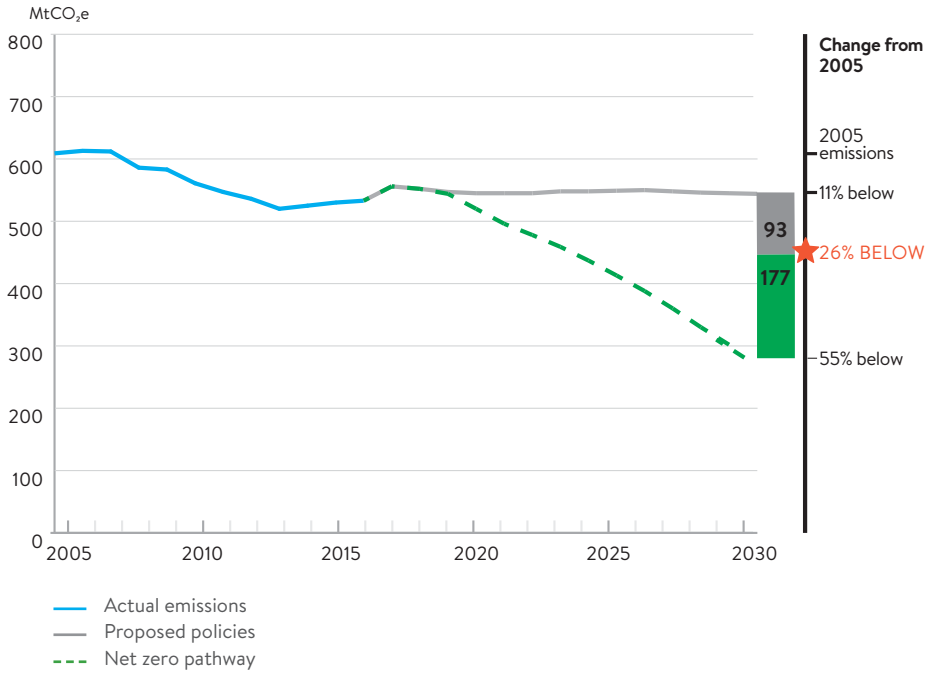
The good news is Australia can achieve this. ClimateWorks' research shows the potential for Australia to make the necessary emissions reductions - by sector and decarbonisation pillar.

In 2030, there would be a gap of around 270 $MtCO_2e$ between the proposed policies scenario and the net zero pathway. The equivalent gap to the Government's 2030 target would be around 93 $MtCO_2e$.

The largest potential to close these gaps comes from untapped opportunities in electricity and land sectors, as current and proposed policies will not unlock what is available. Further potential of around 78 and 100 $MtCO_2e$ respectively would be left untapped.

Untapped opportunities across the industry, transport and buildings sectors provide further potential of 45, 27 and 21 $MtCO_2e$ respectively (Table 1).

Figure 1. Total emissions since 2005, projected emissions to 2030 under proposed policies scenario and the net zero pathway and gap to target.



2 Proposed policies for the purposes of this report refers to all existing policies plus the National Energy Guarantee with an emissions reduction target of 26 per cent below 2005 levels in the National Electricity Market, plus current proposals for updates to the Building Code plus the least stringent target for vehicle fuel efficiency standards (see Methodology section at end for more detail).

Electricity

Emissions in the electricity sector are projected to be 21 per cent below 2005 levels in 2030 under the proposed policies scenario. In this scenario the National Energy Guarantee (NEG) achieves a 26 per cent reduction in the National Electricity Market (NEM), but this market does not cover WA and the Northern Territory and no equivalent policies are under development for these regions. Under an 'enhanced' policy scenario, with state renewable energy policies able to achieve emissions reductions that are additional to the NEG, electricity sector emissions are projected to be 29 per cent below 2005 levels by 2030. If all the potential for emissions reductions identified on the net zero pathway were achieved the sector could reach 68 per cent below 2005 emissions levels in 2030.

Most potential emissions reductions in the electricity sector are from cleaner generation. Achieving cleaner electricity generation would not only deliver direct emissions reductions, but would also enable reductions from switching to electric equipment and vehicles. There is additional potential to reduce emissions through improved energy efficiency in industry and buildings.

Industry

Industry emissions are projected to increase to 10 per cent above 2005 levels in 2030 in the proposed policies scenario, due to economic growth without sufficient improvement in emissions intensity. There is potential to do better through improvements in energy efficiency, reductions in process emissions and fuel switching. If all identified potential were unlocked, the sector could reach 30 per cent below 2005 levels.

Buildings

Building emissions are projected to be 11 per cent below 2005 levels in 2030 in the proposed policies scenario. Further potential of 21 $MtCO_2e$ would remain untapped. This could come from cleaner electricity and greater energy efficiency. If all identified potential were unlocked, the sector could reach 69 per cent below 2005 levels.

Transport

Transport emissions are projected to increase to 29 per cent above 2005 levels by 2030 in the proposed policies scenario. Further potential of 27 $MtCO_2e$ would remain untapped, primarily available through energy efficiency improvements beyond those from the fuel efficiency standards already in development. Fuel switching provides some further potential in the near term but will become larger beyond 2030. If all identified potential is unlocked, the transport sector could reach 4 per cent below 2005 levels by 2030. There is strong potential for improvements in emission intensity, but projected economic and population growth is likely to limit absolute reductions in the medium term.

Land

Land emissions are projected to increase from 2016 levels to 45 per cent below 2005 levels by 2030 in the proposed policies scenario. Further potential of 100 $MtCO_2e$ would remain untapped, mainly from revegetation and activities to store carbon in the land.

About the data

In this report, ClimateWorks uses data from Australian Government sources and the DDPP to analyse Australia's progress on emissions reductions. The DDPP was published in 2014 (www.climateworksaustralia.org/project/national-projects/pathways-deep-decarbonisation-2050-how-australia-can-prosper-low-carbon). It applied technical and economic assessment to demonstrate an illustrative pathway for the Australian economy to reach net zero emissions by 2050, while maintaining economic prosperity. The project found that deep decarbonisation can be achieved while trade and the economy grows - including real GDP and real export value. ClimateWorks Australia and the Australian National University led the project; CSIRO and the Centre of Policy Studies provided economic modelling. The pathway was based on feasible, least-cost options to reach net zero emission by 2050 through action in Australia by applying the four pillars of decarbonisation.

About the ratings

To calculate recent progress ratings for this report (see pages 8 - 12), ClimateWorks calculated the average annual rates of improvement to 2030 on the net zero pathway and compared these with actual annual rates of improvement.

For the outlook to 2030 ratings (see pages 8,9,13,14) ClimateWorks calculated the emissions reductions potential available in 2030 on the net zero pathway (after adjusting to account for current emissions and energy use) relative to the 'reference case'. The reference case assumes that there is no change in emissions intensity in each sector from 2017. The ratings assess what share of this total potential is projected to be unlocked under the proposed policies scenario.

Can Australia get on track for net zero?

Without further policies, Australia will not be on track for the net zero pathway or the Government's 2030 target. ClimateWorks' research previously identified potential emissions reductions on the net zero pathway and this report shows where this potential is not yet being unlocked. The national process of developing Australia's long term emissions reduction strategy provides an opportunity to unlock this remaining potential and get on track to achieving net zero emissions by 2050, as do similar processes in many state and territory governments.

There are positive signs from Australia's recent progress – we have reduced emissions strongly at times and can regain this momentum and transition to a clean economy.

Emissions reductions have come from a range of different sectors and different pillars of decarbonisation - energy efficiency, cleaner electricity and non-energy emissions.

Australia's emissions reduced at a rate close to the net zero pathway between 2009 and 2013 – while the economy grew at an average of 3 per cent a year. Land sector emissions reduced at over double the rate of the net zero pathway between 2007 and 2012 - through reduced land clearing and tree planting. Non-energy emissions from industry reduced at a rate greater than the net zero pathway between 2011 and 2014, while activity grew.

There are also positive signs from other countries. The global economy is changing rapidly, with renewable energy now the dominant source of new electricity capacity, and industry switching to cleaner production.

Australia enjoys world leading renewable energy resources along with potential to store carbon in the land. However this potential is yet to be used to its full extent – further policies are needed to support businesses, households and investors to make the most of opportunities available. This report shows where Australia has the most to gain from further action.

Table 1: Summary of recent progress and outlook to 2030

	EMISSIONS $MtCO_2e$[1]						PERCENTAGE CHANGE FROM 2005			2030: EMISSIONS REDUCTIONS GAP UNDER PROPOSED POLICIES $MtCO_2e$	
	2005		2017[3]		2030 Proposed policies estimate		2017[4]	2030		For Government target	For net zero pathway (untapped potential)
								Proposed policies	Net zero pathway (full potential)		
Whole of economy	609		540		544		-11%	-11%	-55%	93 (26% - 28% below 2005)	271
Electricity[2]	197	[197][2]	191	[191]	156	[156]	-3%	-21%	-68%		78[5]
Industry	220	[147]	237	[163]	235	[174]	+8%	+6%	-30%		45
Buildings	107	[14]	112	[17]	95	[16]	+5%	-11%	-69%		21
Transport	84	[82]	101	[98]	109	[103]	+19%	+29%	-4%		27
Land Sector[6]	172	[170]	62	[60]	95	[94]	-64%	-45%	-103%		100

Notes:

1 Emissions include direct and indirect emissions from each sector. The numbers in square brackets exclude indirect emissions from electricity use.

2 Emissions from electricity are given both for the electricity sector and included in emissions for the end use sector (e.g. industry). At the whole of economy level they are only counted once and are the sum of numbers in the square brackets subject to rounding.

3 Data is given for 2017 for the whole of economy and electricity sector, but is only available for 2016 for the other sectors. Therefore the sector numbers do not sum. The whole of economy figure for 2016 is 533 $MtCO_2e$. The electricity figure for 2016 is 191 $MtCO_2e$.

4 Data is given for 2017 for the whole of economy and electricity sector, but is only available for 2016 for the other other sectors. The whole of economy figure for 2016 is -13 per cent. The electricity figure for 2016 is -1 per cent.

5 Untapped potential in electricity excludes 15 $MtCO_2e$ of demand side reductions which are included under the end use sectors.

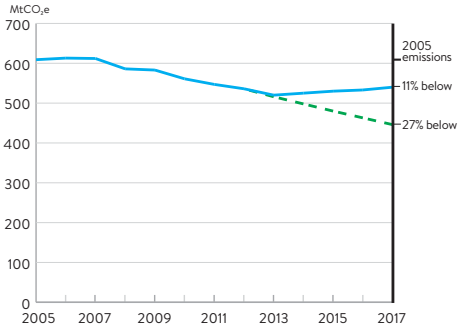
6 Estimates of land sector emissions vary by accounting methods and have a higher level of uncertainty than other sectors. Historic and projected data are sourced from different Government data sets so accounting differences may partly explain changes between 2016 and 2017. The level of projected change to 2030 is therefore also subject to a higher degree of uncertainty.

Sources: for 2016 data annual inventory (DoEE 2018), source for 2017 data quarterly inventory (DoEE 2018) and ClimateWorks analysis, source for 2030 projections Government projections (DoEE 2018) and ClimateWorks analysis.

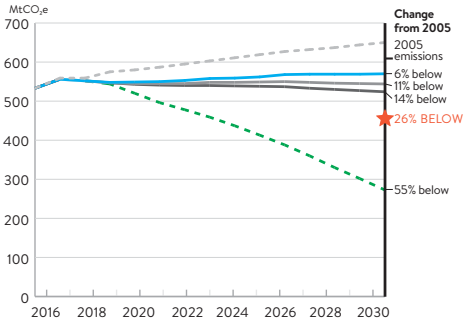
Whole of economy

RATINGS
Net zero compatible
Current gov't target compatible
Insufficient
Highly insufficient
No improvement
Data unavailable

RECENT PROGRESS

Rating	Overall sector performance	Key influencing factors
	Emissions – actual Emissions – net zero pathway	Factor that drove emissions reductions Factor that impeded emissions reductions
 WHOLE OF ECONOMY Average rate of reduction in emissions was less than a third than that needed for the net zero pathway.		Very strong reductions in the land sector - mainly from clearance restrictions & carbon farming Energy efficiency improved due to better technologies - supported by policy in some cases Renewable energy improved emissions intensity of electricity - due to policy support and reduced technology costs Policy uncertainty & repeals reduced drivers for emissions reductions Little policy support for changes in some sectors/technologies - industry, agriculture or fuel switching Activity growth outpaced emissions intensity improvements since 2013

OUTLOOK TO 2030

Rating	Overall sector performance	Key influencing factors
	Reference case Government projections Proposed policies Enhanced policies Net zero pathway	Factor that drives emissions reductions Factor that impedes emissions reductions
 WHOLE OF ECONOMY Emissions reductions unlocked under proposed policies would be around a third of potential available in 2030 on the net zero pathway.		Further shift to cleaner electricity from investment in new renewable energy driven by policy and reduced technology costs (but proposed 26% electricity target is not enough to improve overall emissions to 26% nor reach net zero pathway) Some energy efficiency improvements in buildings & transport driven by policy and market trends Non-energy emissions reductions from phase down of synthetic greenhouse gases (but none projected from land sector) Policy lacking in many areas - particularly industry, transport, land sector and for fuel switching

Whole of economy cont.

RATINGS

- Net zero compatible
- Current gov't target compatible
- Insufficient
- Highly insufficient
- No improvement
- Data unavailable

RECENT PROGRESS

Performance by pillar of decarbonisation

USE ENERGY MORE EFFICIENTLY	PRODUCE LOW CARBON ELECTRICITY	SWITCH TO ELECTRICITY & CLEANER FUELS	NON ENERGY EMISSIONS
All sectors achieved some energy efficiency improvements. Average rate of energy efficiency improvement was half rate of net zero pathway. Rate of improvement for most sectors at quarter the rate. Decline in manufacturing (the most energy intensive subsector) led to apparent improvements in average energy intensity, partially counterbalanced by increased mining activity.	Increased renewable energy reduced total emissions and emissions intensity (especially when demand declined) - supported by policy and declining costs. Rate of improvement reached around 4% p.a. at times - more than half rate of net zero pathway - but slowed in periods of uncertainty. High intensity ageing coal plants staying in system slowed transition.	Progress on electrification and shift to lower carbon fuels proceeded very slowly, despite opportunities with favourable benefit-cost ratios - especially in buildings and industry.	Non-energy emissions intensity improved rapidly at 7% p.a.to 2017 - on track to net zero. Decrease due to significant emission reductions in land use and forestry, and some in industry. Momentum has slowed in later years with improvement rate down to 4% p.a.

OUTLOOK TO 2030

Performance by pillar of decarbonisation

USE ENERGY MORE EFFICIENTLY	PRODUCE LOW CARBON ELECTRICITY	SWITCH TO ELECTRICITY & CLEANER FUELS	NON ENERGY EMISSIONS
Potential for around 95 $MtCO_2e$ reductions on the net zero pathway from all energy efficiency improvements. Around 45 $MtCO_2e$ unlocked in the buildings and transport sector by proposed policies and global market trends. Industry improvements uncertain. Without further policies over half of the identified potential remains untapped.	Potential for around 120 $MtCO_2e$ reductions on the net zero pathway from supply of cleaner electricity - with renewable energy reaching nearly 70% share. Around half potential expected to be unlocked under proposed policies. Around 78 $MtCO_2e$ of identified potential remains untapped.	Very few emissions reductions expected from switching to electricity or to cleaner fuels under proposed policies. And limited expected improvement in electricity emissions intensity prevents full benefits from electrification.	Potential for over 130 $MtCO_2e$ emissions reductions from non-energy emissions reductions in land and industry. Very little of this would be unlocked under proposed policies. Policy not yet expected to substantially reduce land clearance or incentivise plantings despite additional potential of around 100 $MtCO_2e$. Proposed policies expected to drive little industrial improvement.

Key findings on recent progress

Whole of economy

Australia's emissions were 11 per cent below 2005 levels in 2017[3]. This was largely due to reductions in non-energy emissions, particularly in the land sector. However, energy emissions have increased such that total emissions have been rising since 2013.

There were good improvements in emissions intensity. If Australia sustained this rate of improvement in emissions intensity, it could meet the Government's 2030 target. Between 2005 and 2013 the rate of improvement approached that of the net zero pathway but then weakened, so the average rate was slightly above half.

Since 2013 emissions intensity has not improved fast enough to offset growth in the economy. Australia's economy is following a path where greater activity is creating higher emissions rather than transitioning and unlocking opportunities for clean growth.

Overall improvements in energy efficiency came from lower energy intensity in most sectors and structural shifts to less intensive industries. There was little shift to cleaner fuels or electrification, despite some opportunities having benefits in excess of costs - especially in buildings and industry sectors.

Electricity[4]

Total emissions from the electricity sector were 3 per cent below 2005 levels in 2017. Electricity both produced fewer total emissions and was cleaner compared to 2005. This improvement reversed in 2015 and 2016. Emissions fell again in 2017. Emissions intensity reduced at a rate of 4 per cent per year at times, but slowed when policy uncertainty constrained investment. If it had been sustained, this highest rate would have been compatible with meeting the Government's 2030 target, although it would still have been around half the rate needed for a net zero pathway. On average, the improvement rate was much too slow to reach the net zero pathway.

Progress in the sector was largely driven by the Renewable Energy Target (RET) and other policies combining with declining technology costs and the retirement of ageing power plants. The RET encouraged new renewable generation - large scale and on homes and workplaces. Since the repeal of the carbon price, no policy has supported the orderly exit of high intensity, ageing coal fired generators and this has slowed transition.

Industry

Total emissions from industry were 8 per cent above 2005 levels in 2016. Emissions intensity improved strongly between 2009 and 2014 - more than 3 per cent per year. If sustained, this highest rate would have been compatible with meeting the Government's 2030 target, and more than half the rate needed to meet the net zero pathway. Since that time it has not kept pace with industrial growth. At times there was good improvement in some decarbonisation pillars - notably non-energy emissions during the period when a carbon price and related policies were in place. Indicators worsened over recent years and average improvements were not on track for the net zero pathway - or on track for the Government's 2030 target.

While industry energy intensity has improved overall since 2005, energy intensity of mining and manufacturing has worsened. This is discussed further in the section: *More detail on recent progress in industry*.

Buildings

Total emissions from the building sector were 6 per cent above 2005 levels in 2016. Emissions intensity mostly fell from 2005, but activity growth outpaced the fall. Emissions intensity improved at a fifth of the rate of the net zero pathway.

Improvements in the sector were driven strongly by cleaner electricity. Energy efficiency also improved consistently, but this was at a quarter of the rate of the net zero pathway. The sector did not fully unlock opportunities in energy efficiency and fuel switching - including those with favourable benefit-cost ratios.

Transport

Total emissions from transport were 19 per cent above 2005 levels in 2016. Emissions intensity fell from 2005, but this was not enough to outpace increased activity. The rate of improvement in emissions intensity was a third of the rate needed for the net zero pathway.

Energy intensity fell as vehicles became more fuel efficient. However, Australia's drop in vehicle emissions intensity and its shift to electric vehicles lags behind comparable countries. Shares of electricity and bioenergy in the transport fuel mix are still below 1 per cent.

Land sector

Total emissions from the land sector were 64 per cent below 2005 levels in 2016. Australia's very strong declines in land sector[5] emissions and emissions intensity to date have been on track to a net zero pathway. This decline has underpinned Australia's overall emissions reductions since 2005.

3 Source for data to 2016 annual inventory (DoEE 2018), source for data to 2017 quarterly inventory (DoEE 2018) and ClimateWorks analysis.
4 For the purposes of this report, emissions from electricity are included under the electricity sector and also by end use sector (e.g. industry). At the whole of economy level they are only counted once.
5 Land use including forestry and agriculture and the impact of changes to land use.

Key findings for outlook to 2030

Whole of economy

Australia has the potential to reach 55 per cent below 2005 levels by 2030 on the net zero pathway. However, in the proposed policies scenario, Australia's emissions are projected in 2030 to be almost unchanged from where they are today, at about 11 per cent below 2005 levels. This creates a gap of around 93 $MtCO_2e$ in 2030 to the Government's current 26 per cent 2030 target and around 271 $MtCO_2e$ in 2030 compared to the net zero pathway.

To fill this gap, Australia has three times as much emissions savings potential as it needs to reach the Government's 26 per cent target by 2030 from proven technology. Untapped potential remains largest from cleaner electricity and the land sector at around 78 and 100 $MtCO_2e$ respectively. Untapped opportunities in industry, transport and buildings sectors comprise 45, 27 and 21 $MtCO_2e$ respectively. The land sector is the only one where Australia's estimated progress by 2030 is projected to remain well below progress since 2005.

It is still possible to build on areas of recent momentum. Further policies to guide investment and build a clean economy are needed to unlock untapped potential. This is urgent if Australia is to transition to our future economy fairly and cost-effectively.

Electricity

There is potential for electricity sector emissions to reach 68 per cent below 2005 levels by 2030 on the net zero pathway – with renewable energy at around a 70 per cent generation share. In comparison, electricity emissions are projected to be 21 per cent below 2005 levels in 2030 in the proposed policies scenario[6]. This assumes governments agree on the NEG as proposed, with a target of 26 per cent emissions reductions below 2005 levels by 2030 for the NEM. A further 78 $MtCO_2e$ potential from cleaner electricity has already been identified - this is likely to increase as costs fall further. Action by the states is currently driving reductions and may unlock still more, should policy design allow state renewable energy targets be additional to the National Energy Guarantee. ClimateWorks' analysis shows electricity emissions could be at 29 per cent below 2005 levels by 2030 in this enhanced policies scenario. Further reductions in electricity generation from Australia's existing coal assets will be critical to moving the sector closer to the net zero pathway. There is 15 $MtCO_2e$ potential to reduce emissions through improved energy efficiency in industry and buildings.

Industry

The industry sector has the potential to reduce emissions to 30 per cent below 2005 levels by 2030 on the net zero pathway. Reductions would result from energy efficiency measures, fuel switching and reducing non-energy emissions. In contrast, industry emissions are projected to be 6 per cent above 2005 levels in 2030 in the proposed policies scenario.

Note there is high uncertainty whether current trends and policies will create energy efficiency improvements. Recent patterns in Australia show little improvement in energy efficiency - this is contrary to longer term and global trends. Even assuming an ongoing rate of improvement in energy efficiency[7], ClimateWorks' analysis suggests that industry will need to substantially accelerate progress to reach the net zero pathway or to contribute significantly to achieving the Government's 2030 target.

Buildings

The building sector has the potential to reach 69 per cent below 2005 levels by 2030 on the net zero pathway. However, building emissions are projected to be only 11 per cent below 2005 levels in 2030 in the proposed policies scenario. Standards for new buildings and appliances (including more stringent standards already in development) are expected to drive most improvements. The remaining untapped potential includes many opportunities that have favourable benefit-cost ratios.

Transport

The transport sector has potential to reach 4 per cent below 2005 levels by 2030 on the net zero pathway. This seemingly small potential comes about because, while there is a large potential to improve emissions intensity in the sector, economic and population growth are projected to limit absolute reductions. Transport emissions are projected to be 29 per cent above 2005 levels by 2030 in the proposed policies scenario. Energy efficiency in petrol and diesel vehicles would see reasonable progress if the Australian Government implements the least stringent option for fuel efficiency standards. The more stringent option would reduce emissions further – but still short of the potential available. ClimateWorks' analysis estimates that proposed policies, would lead to very weak progress in shifts to electricity and low carbon fuels.

Land sector

Land sector emissions, including agriculture and forestry, have the potential to reach 103 per cent below 2005 levels by 2030 on the net zero pathway. This is broadly consistent with historical emissions reductions between 2005 and 2016. Potential future reductions could be achieved mainly through revegetation projects and afforestation. However almost none of this would be unlocked in the proposed policies scenario. Emissions are projected to increase to 45 per cent below 2005 levels by 2030. While the current Emissions Reduction Fund will create emissions reductions over the period to 2030, the impact of the policy is projected to tail off and very few reductions are projected in 2030. There is substantial interest in implementing emissions reduction projects in the land sector, but policies would need to be strengthened to tap into this potential.

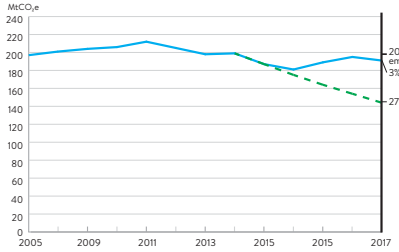
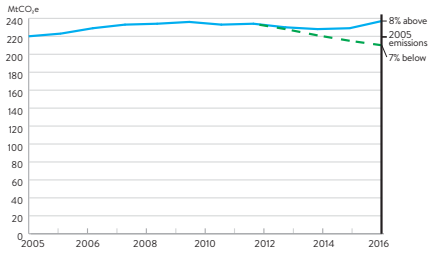
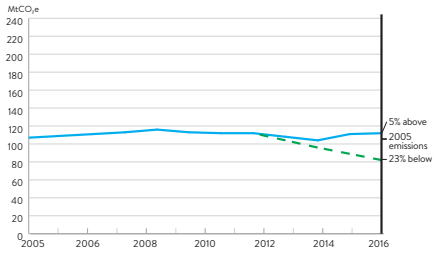
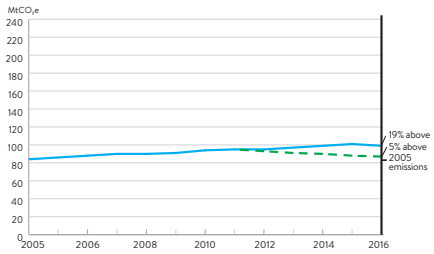
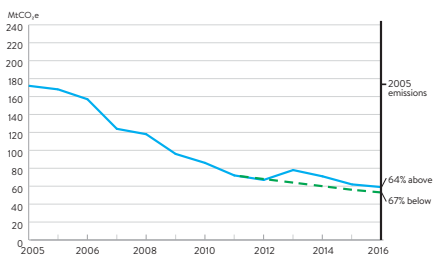
6 This reduction is less than 26 per cent because the NEG only covers 82 per cent of national electricity emissions as it only applies to the NEM which excludes WA and NT

7 The estimate for energy efficiency in industry is highly uncertain due to a lack of data - ClimateWorks has therefore not provided a rating for industrial energy efficiency. For modelling purposes, we assumed a low improvement rate of 0.4 per cent per annum (the long-term historical average) to approximate autonomous improvement levels.

Recent progress

BY SECTOR AND PILLAR OF DECARBONISATION

RATINGS	IMPROVEMENT RELATIVE TO PATHWAY TO NET ZERO BY 2050
Net zero compatible	On track
Current gov't target compatible	More than half the rate of improvement
Insufficient	Between half and quarter the rate of improvement
Highly insufficient	Less than quarter the rate of improvement
No improvement	None
Data unavailable	

Sector rating		Overall sector performance	Key influencing factors
		Emissions – actual Emissions – net zero pathway	Factor that drove emissions reductions Factor that impeded emissions reductions
37% of 2016 emissions	ELECTRICITY*	Electricity emissions and emissions intensity fell as renewable generation grew. Both increased in 2015 & 2016 as policy changes reduced investment. In 2017 emissions fell but not back to lowest point, and well above the net zero pathway. Emissions intensity improvements were at less than a quarter the rate of the net zero pathway.		Policy and declining costs drove new renewable energy capacity Annual electricity demand higher than 2005, despite declines 2011 to 2014 Policy uncertainty slowed investment Carbon price repeal & increasing demand reversed decrease in coal generation High prices limited the use of gas for generation
42% of 2016 emissions inc electricity use (29% excl.elec'y)	INDUSTRY & WASTE	Industry emissions increased as greater activity outpaced improved emissions intensity. Some improvements on track to net zero at times, e.g. non-energy emissions, others not. Indicators worsened in recent years. Emissions intensity improvements were less than a third the rate of the net zero pathway.		Strong reductions in non-energy emissions due to carbon price/related policies when in force Structural shift towards less energy intensive activities Growth in mining, especially LNG, outpaced reductions in emissions intensity Little policy driving improvements since policy repeals
21% of 2016 emissions inc electricity use (3% excl.elec'y)	BUILDINGS	Buildings emissions increased as greater activity outpaced improved emissions intensity. Intensity improvement largely driven by cleaner electricity. Emissions intensity improvements were at less than a fifth the rate of the net zero pathway.		Increased renewable energy (grid and on site) reduced electricity emissions Improved energy efficiency of new buildings, lighting and appliances Reduced emissions and energy intensity not balancing activity growth Policy not driving progressive change in new buildings, weak for existing buildings
19% of 2016 emissions inc electricity use	TRANSPORT	Transport emissions increased substantially, as greater activity outweighed improved emissions intensity. Emissions intensity improvements were a third the rate of the net zero pathway. Energy efficiency improved, but not in line with opportunities and electrification rates were low.		Vehicles more efficient, driven by global improvements Passenger, freight and aviation activity growth outpaced efficiency improvements Australia's vehicles less efficient than our peers and no policy yet driving improvements Little policy driving electrification of transport
12% of 2016 emissions inc electricity use	LAND SECTOR	Land sector emissions decreased sharply and emissions intensity improved strongly in most years. Improvement rates for land in line with net zero pathway, as reductions balanced lack of improvement in energy efficiency or fuel shift in agriculture and forestry.		Land clearance reduced substantially compared to 2005, largely due to stricter legislation Policy created a credible carbon market, particularly for vegetation projects Energy use increased from 2009 Little policy supporting changes in agriculture

*Note: see Footnote 4 on page 10 for how electricity emissions are included in the analysis.

Recent progress

BY SECTOR AND PILLAR OF DECARBONISATION

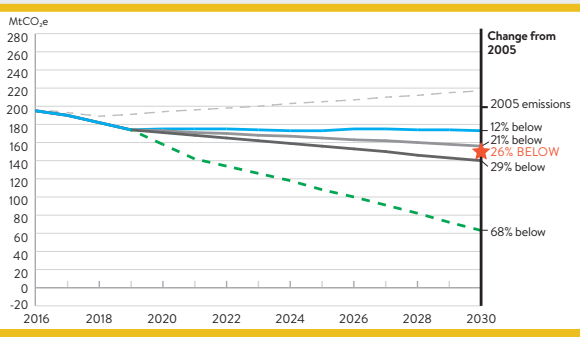
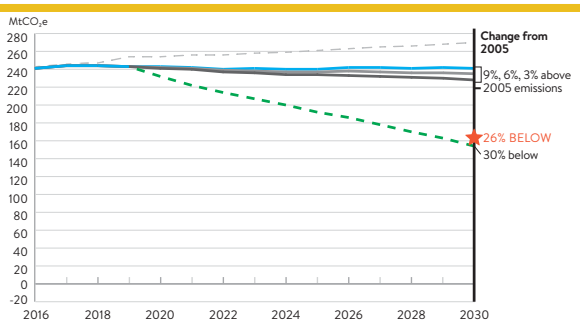
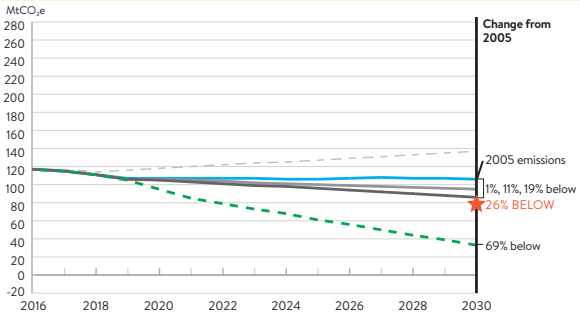
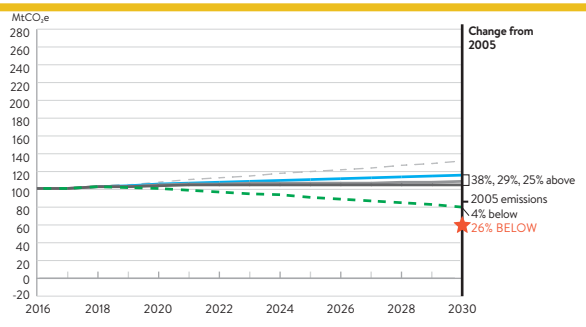
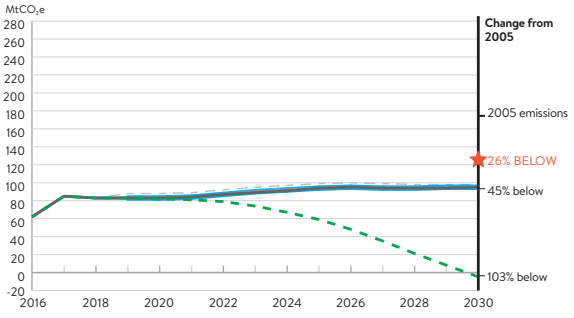
RATINGS	IMPROVEMENT RELATIVE TO PATHWAY TO NET ZERO BY 2050
Net zero compatible	On track
Current gov't target compatible	More than half the rate of improvement
Insufficient	Between half and quarter the rate of improvement
Highly insufficient	Less than quarter the rate of improvement
No improvement	None
Data unavailable	

Sector rating	Performance by pillar of decarbonisation			
	USE ENERGY MORE EFFICIENTLY	PRODUCE LOW CARBON ELECTRICITY	SWITCH TO ELECTRICITY & CLEANER FUELS	NON ENERGY EMISSIONS
ELECTRICITY	Data unavailable	Renewable generation grew from 9% to 15% share by 2016, reducing emissions. Policy (RET, carbon price) & demand reduction drove strong emissions reductions until 2014. Policy repeal & review contributed to emissions increases in 2015 and 2016. Strong growth in renewable energy investment followed renewed policy certainty.	Emissions intensity of direct fuels decreased - largely due to the proportion of coal generation decreasing by 16% and an increase gas generation. Shift to cleaner fuels slowed after 2015 since carbon price repeal and gas price increases.	Data unavailable
INDUSTRY & WASTE	Overall, energy intensity of industry improved by 5%, with strong performance since 2014. Manufacturing and mining showed no improvement since 2005, with overall performance driven by structural shifts.	Same as above Changes due to renewable generation installed on site or purchased through contracting with a specific generator are accounted for under the electricity sector. Emissions from electricity use across the sector are included in analysis for the sector totals.	Emissions intensity of direct fuel use improved – decreasing 8%. A shift to cleaner fuels drove improvement in the early years. Pattern of direct fuel use showed no sign of industry switching to electricity - particularly in manufacturing.	Non-energy emission intensity improved - the mining and utility sectors achieved reductions of 34% and 29% respectively. Rate of improvements in line with net zero while the carbon price in force, but progress varied since.
BUILDINGS	Energy efficiency improvements in the buildings sectors improved consistently since 2005. Progress not on track to net zero - opportunities not being used include those with favourable benefit-cost ratios.	Same as above	Share of electricity use in the buildings sector increased between 2005 and 2011 by 6%, then decreased by 4% between 2011 and 2016 despite many opportunities to electrify providing benefits in excess of costs.	Data unavailable
TRANSPORT	Energy intensity in transport sector improved 12% between 2005 and 2016, decreasing at approximately 1% p.a. Progress not on track to net zero - opportunities not being used include those with favourable benefit-cost ratios.	Same as above	Share of electricity in total energy remained approximately 1% since 2005. Share of bioenergy less than 1% in 2016. Slight shift to less intensive fuels e.g. LPG. Transport not using opportunities to shift to electricity or biofuels, unlike trends in other countries.	Data unavailable
LAND SECTOR	Overall progress is minimal. Energy intensity decreased 17% between 2005 and 2011 then reversed back to near 2005 levels. Significant opportunities not being used include those with favourable cost-benefit ratios.	Same as above	In agriculture and forestry, the share of electricity use decreased 3% between 2005 and 2016. Emissions intensity of direct fuel use decreased slightly with a minor shift to less carbon intensive fuels e.g. LPG. Significant opportunities not being used.	Average non-energy emissions intensity decreased at rate consistent with net zero. Strong reductions in land use, land use change and forestry emissions to 2012, net sequestration since. Agriculture dominated by livestock emissions - changes mostly due to activity levels, no clear trends for intensity.

Outlook to 2030

BY SECTOR AND PILLAR OF DECARBONISATION

RATINGS	ABATEMENT UNLOCKED IN 2030 (share of total potential from reference case to net zero pathway unlocked by proposed policies)
Net zero compatible	More than 75% potential unlocked
Current gov't target compatible	50 to 74%
Insufficient	25% to 49%
Highly insufficient	0% to 24%
No improvement	None
Data unavailable	

Sector rating	Overall sector performance	Key influencing factors
	Reference case; Government projections; Proposed policies; Net zero pathway; 'Enhanced' policies	Factor that drives emissions reductions; Factor that impedes emissions reductions
ELECTRICITY		Renewable Energy Target and state policies encouraging new generation investment Further reductions in costs of renewable energy generation & storage Energy efficiency improvements in other sectors reduces need for new generation, creating lower costs A target of 26%, as currently proposed for the NEG, will reduce emissions, but not unlock full potential available
INDUSTRY & WASTE		Ongoing technology improvements to energy efficiency Phase down of ozone depleting substitutes Increased activity in mining not projected to be balanced by intensity improvements Little policy supporting energy efficiency or emissions reductions
BUILDINGS		Energy efficiency improvements supported by new building and appliance standards Cleaner electricity Fuel switching from gas to electricity - but far below potential Policy on new buildings and appliances not driven by trajectory to net zero Little policy driving change in existing buildings
TRANSPORT		Global forces and some policy driving fuel efficiency improvements Shifting to electric vehicles - at cost parity before 2025 Vehicle efficiency policy not unlocking all opportunities Weak shifts to other cleaner fuels Strong growth in domestic aviation
LAND SECTOR		ERF reductions continue initially then tail off by 2030 without new policy Plantation harvesting expected to outbalance planting Diesel use expected to grow Current policy not projected to maintain support for carbon farming market, even for vegetation projects

Outlook to 2030

BY SECTOR AND PILLAR OF DECARBONISATION

RATINGS	ABATEMENT UNLOCKED IN 2030 (share of total potential from reference case to net zero pathway unlocked by proposed policies)
Net zero compatible	More than 75% potential unlocked
Current gov't target compatible	50 to 74%
Insufficient	25% to 49%
Highly insufficient	0% to 24%
No improvement	None
Data unavailable	

Sector rating	Performance by pillar of decarbonisation			
	USE ENERGY MORE EFFICIENTLY	PRODUCE LOW CARBON ELECTRICITY	SWITCH TO ELECTRICITY & CLEANER FUELS	NON ENERGY EMISSIONS
ELECTRICITY	Energy efficiency measures by the end use sectors create emissions reductions on the demand side - these are covered in the sectors. Potential of 34 $MtCO_2e$. Proposed policy would unlock 18 $MtCO_2e$.	Potential emissions reductions 121 $MtCO_2e$. Proposed policy scenario and market trends would unlock 42 $MtCO_2e$ - mostly due to ongoing impacts of the RET. If state renewable energy targets were additional to the NEG this could unlock a further 16 $MtCO_2e$.	Data unavailable	Data unavailable
INDUSTRY & WASTE	Potential emissions reductions 24 $MtCO_2e$. Insufficient data available to project future improvement rates with reasonable certainty. Recent patterns suggest little overall industry improvement but projecting based on long term trends would create reductions.	Same as above Changes due to renewable generation installed on site or purchased through contracting with a specific generator are accounted for under the electricity sector. Emissions from electricity use across the sector are included in analysis for the sector totals.	Potential emissions reductions 6 $MtCO_2e$. Current policies and market trends could unlock less than 2 $MtCO_2e$. No other announced policy.	Potential emissions reductions 29 $MtCO_2e$. Current policies and sectoral trends could unlock 8 $MtCO_2e$ (in waste and phase down of synthetic greenhouse gases). No other announced policy.
BUILDINGS	Potential emissions reductions 40 $MtCO_2e$. Proposed policies and market trends could unlock 22 $MtCO_2e$ through building code, appliance standards & state schemes.	Same as above	Potential emissions reductions approximately 1 $MtCO_2e$. Current policy not expected to unlock many opportunities - insufficient improvement in emissions intensity of electricity prevents full benefits from switching.	Data unavailable
TRANSPORT	Potential emissions reductions 31 $MtCO_2e$. Proposed policies and market trends could unlock 21 $MtCO_2e$ (vehicle fuel emissions standards). Enhanced policies (most stringent of proposed vehicle standards) could unlock a further 3 $MtCO_2e$.	Same as above	Potential emissions reductions 18 $MtCO_2e$. Proposed policies and market trends could unlock less than 1 $MtCO_2e$ - insufficient improvement in emissions intensity of electricity prevents full benefits from switching.	Data unavailable
LAND SECTOR	Data unavailable	Same as above	Data unavailable	Potential emissions reductions 103 $MtCO_2e$. Current policies could unlock 3 $MtCO_2e$ - due to ongoing impacts of the ERF. No other announced policy.

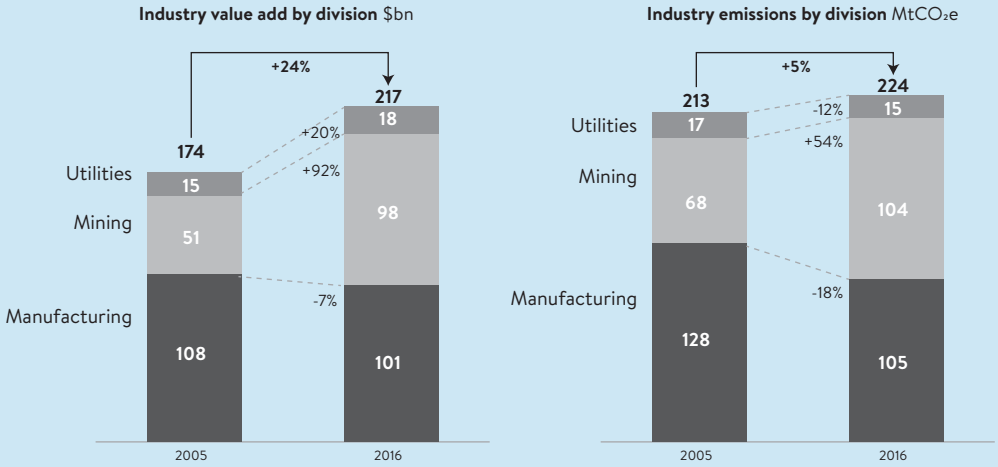
More detail on recent progress in industry

Since 2005, industry has changed significantly, with mining now generating similar levels of value-added and emissions to manufacturing.

Absolute emissions in the main industrial sectors have increased by 5 per cent since 2005[8]. This was predominantly due to over 50 per cent growth of emissions in mining. In contrast absolute manufacturing emissions decreased by approximately 20 per cent. In 2016 mining and manufacturing had similar levels of emissions.

Increased activity in mining subsectors has been considerable, with a $47 billion increase in value-added recorded from 2005 to 2016. Value-added in manufacturing subsectors reduced by approximately $7 billion, driven by decreases in 'petroleum, coal, chemical and rubber products; machinery and equipment'; and 'other manufacturing' subsectors (-19, -11 and -25 per cent respectively). Mining is now on par with manufacturing in terms of activity levels - it was less than half in 2005.

FIGURE 3. Left: Value-added by industry division, $bn; Right: Absolute emissions by division, $MtCO_2e$

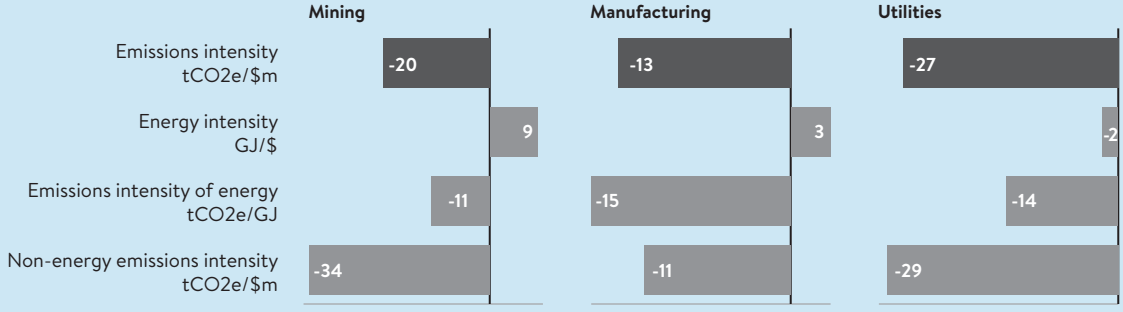


Each industrial division achieved improvements in emissions intensity between 2005 and 2016, with an overall decrease of 16 per cent. This suggests that emissions growth and economic activity decoupled over the period. Mining subsectors reduced emissions intensity faster (-2 per cent per year) than manufacturing subsectors (-1 per cent per year), which helped compensate for some of the strong growth in activity.

These improvements in emissions intensity were driven by reductions in non-energy emissions intensity, as well as improvements in the average emissions intensity of energy.

An increase of energy intensity was observed in both mining and manufacturing. However mining had relatively lower energy intensity than manufacturing, so the shift in activity toward mining decreased overall industrial energy intensity.

FIGURE 4. Key intensity indicators by subsector. % Change between 2005 and 2016



8 The 5 per cent increase is for the main industrial subsectors (in mining, manufacturing and utilities), but excludes construction emissions and some refrigerant emissions (due to data uncertainty). Total industrial emissions increased by 8 per cent since 2005.

Most of the improvement in non-energy emissions intensity was achieved between 2011 and 2014, at a rate consistent with the pathway to net zero emissions.

The emissions intensity of non-energy emissions in the industry sector, fell 21 per cent between 2005 and 2017. Most of this occurred between 2011 and 2014, with an 18 per cent improvement over just three years. This period corresponds with the period of carbon price legislation.

Improvements in electricity emissions intensity contributed to emissions from electricity remaining stable despite increased use.

Electricity use as a proportion of total energy use by industry remained stable at 20 per cent since 2005. However emissions from electricity use were approximately 50 per cent of total industrial energy emissions due to the high emissions intensity of electricity compared to other fuels used. The emissions intensity of grid electricity reduced 12 per cent since 2005. Total industry electricity use increased 15 per cent, yet this caused only a 1 per cent increase in electricity emissions because electricity became cleaner.

For direct fuels, most of the reduction came from changes in fuel mix.

The emissions intensity of direct fuel use in industry has reduced 8 per cent since 2005. This was driven by increasing gas use at the expense of coal. The proportion of gas use in total energy use increased by approximately 9 per cent in the mining and manufacturing subsectors while the proportion of coal consumption declined 33 per cent. This trend was caused by a shift away from coal in direct fuel uses (due mostly to a decrease in primary iron and steel production) accompanied by a large increase in gas use (due mostly to strong growth in Liquefied Natural Gas production).

Energy intensity worsened while energy prices increased.

It would be expected that energy price increases would lead to improvements in energy efficiency, thereby causing a reduction in energy intensity. However, energy price increases occurred alongside energy intensity increases in both mining and manufacturing since 2005. There were improvements at the sector level but these were driven by the relative decrease in manufacturing activity – the more energy intensive subsectors. In mining subsectors, a 92 per cent increase in value-added coincided with a 110 per cent increase in energy consumption. Similar trends were present in manufacturing subsectors with activity declining more rapidly than energy consumption.

Currently, there is little federal policy to incentivise industrial energy efficiency - few projects are accredited through the Emissions Reduction Fund. Energy Efficiency Opportunities legislation was repealed in 2014.

Recent Progress Data

SECTOR	INDICATOR	MEASURE	UNIT	2005	2012	LATEST YEAR		HISTORICAL DATA (2005 - LATEST YEAR)	DDPP (2012 - 2030)
WHOLE OF ECONOMY	Activity	Production	$m GDP	$1,223,153	$1,498,021	$1,692,092	(2017)	2.7%	2.6%
	Absolute emissions	Emissions	$MtCO_2e$	609	536	540	(2017)	-1.0%	-3.6%
	Emissions intensity	Emissions intensity	tCO2e / $m GDP	498	358	319	(2017)	-3.6%	-6.0%
	Energy efficiency	Energy intensity	GJ / $m GDP	2,843	2,658	2,474	(2016)	-1.3%	-2.7%
	Low carbon electricity	Emissions intensity	tCO2e / MWh						
	Fuel shift - electrification	Proportion of direct fuel in total energy consumption	GJ (direct) / total GJ	0.8	0.8	0.8	(2016)	0.0%	-0.6%
	Fuel shift - direct fuel	Emissions intensity of direct fuel use	tCO2e (Direct) / GJ	0.06	0.06	0.06	(2016)	-0.2%	-0.9%
	Non-energy emissions	Non-energy emissions intensity	tCO2e / $m GDP	203	103	85	(2017)	-7.0%	-6.6%
ELECTRICITY	Activity	Production	MWh	228,649,700	250,740,174	257,428,585	(2016)	1.1%	1.6%
	Absolute emissions	Emissions	$MtCO_2e$	197	199	191	(2017)	-0.3%	-7.5%
	Emissions intensity	Emissions intensity	tCO2e / MWh	0.9	0.8	0.8	(2016)	-1.2%	-7.8%
	Energy efficiency	Energy intensity	GJ (Primary) / MWh generated						
	Low carbon electricity	Emissions intensity	tCO2e / MWh	0.9	0.8	0.8	(2016)	-1.2%	-7.8%
	Fuel shift - electrification	Proportion of direct fuel in total energy consumption	GJ (Direct) / total GJ						
	Fuel shift - direct fuel	Emissions intensity of direct fuel use	tCO2e (Direct) / GJ	0.9	0.9	0.9	(2016)	-0.6%	-7.8%
	Non-energy emissions	Non-energy emissions intensity	tCO2e / $m GDP						
INDUSTRY	Activity	Production	$m value-added	$174,181	$197,194	$216,755	(2016)	2.0%	2.3%
	Absolute emissions	Emissions	$MtCO_2e$	220	234	237	(2016)	0.4%	-2.7%
	Emissions intensity	Emissions intensity	tCO2e / $ m value-added	1,229	1,132	1,035	(2016)	-1.6%	-5.2%
	Energy efficiency	Energy intensity	GJ / $m value-added	8,484	8,879	8,085	(2016)	-0.4%	-2.0%
	Low carbon electricity	Emissions intensity	tCO2e / MWh						
	Fuel shift - electrification	Proportion of direct fuel in total energy consumption	GJ (Direct) / total GJ	0.8	0.8	0.8	(2016)	0.1%	-0.5%
	Fuel shift - direct fuel	Emissions intensity of direct fuel use	tCO2e (Direct) / GJ	0.05	0.05	0.05	(2016)	-0.7%	-0.7%
	Non-energy emissions	Non-energy emissions intensity	tCO2e / $m value-added	464	412	388	(2016)	-1.6%	-5.7%
TRANSPORT	Activity	Production	$m GDP	$1,223,153	$1,498,021	$1,659,604	(2016)	2.8%	2.6%
	Absolute emissions	Emissions	$MtCO_2e$	84	95	101	(2016)	1.6%	-1.8%
	Emissions intensity	Emissions intensity	tCO2e / $m GDP	69	63	61	(2016)	-1.2%	-4.2%
	Energy efficiency	Energy intensity	GJ / $m GDP	963	895	851	(2016)	-1.1%	-2.9%
	Low carbon electricity	Emissions intensity	tCO2e / MWh						
	Fuel shift - electrification	Proportion of direct fuel in total energy consumption	GJ (Direct) / total GJ	1.0	1.0	1.0	(2016)	0.0%	-0.5%
	Fuel shift - direct fuel	Emissions intensity of direct fuel use	tCO2e (Direct) / GJ	0.07	0.07	0.07	(2016)	0.0%	-1.3%
	Non-energy emissions	Non-energy emissions intensity	tCO2e / $m GDP						

Recent Progress Data (continued)

SECTOR	INDICATOR	MEASURE	UNIT	2005	2012	LATEST YEAR		HISTORICAL DATA (2005 - LATEST YEAR)	DDPP (2012 - 2030)
BUILDINGS - weighted index of commercial and residential buildings data	Activity	Production	Index	1.0	1.2	1.3	(2016)	2.5%	2.6%
	Absolute emissions	Emissions	Index	1.0	1.0	1.1	(2016)	0.5%	-7.7%
	Emissions intensity	Emissions intensity	Index	1.0	0.9	0.8	(2016)	-1.9%	-9.9%
	Energy efficiency	Energy intensity	Index	1.0	0.9	0.9	(2016)	-0.9%	-3.5%
	Low carbon electricity	Emissions intensity	Index						
	Fuel shift - electrification	Proportion of direct fuel in total energy consumption	Index	1.0	1.0	1.0	(2016)	-0.2%	-4.5%
	Fuel shift - direct fuel	Emissions intensity of direct fuel use	Index	1.0	1.1	1.1	(2016)	0.8%	-0.1%
	Non-energy emissions	Non-energy emissions intensity	Index						
RESIDENTIAL BUILDINGS	Activity	Production	No. households	7,704,154	8,710,771	9,342,028	(2016)	1.8%	1.5%
	Absolute emissions	Emissions	$MtCO_2e$	56	59	55	(2016)	-0.2%	-8.0%
	Emissions intensity	Emissions intensity	tCO2e / household	0.01	0.01	0.01	(2016)	-1.9%	-9.4%
	Energy efficiency	Energy intensity	GJ / household	53	52	49	(2016)	-0.8%	-3.2%
	Low carbon electricity	Emissions intensity	tCO2e / MWh						
	Fuel shift - electrification	Proportion of direct fuel in total energy consumption	GJ (Direct) / total GJ	0.5	0.5	0.5	(2016)	-0.2%	-5.1%
	Fuel shift - direct fuel	Emissions intensity of direct fuel use	tCO2e (Direct) / GJ	0.04	0.05	0.05	(2016)	0.7%	0.0%
	Non-energy emissions	Non-energy emissions intensity	tCO2e / household						
COMMERCIAL BUILDINGS	Activity	Production	$m value-added	$670,461	$835,934	$944,159	(2016)	3.2%	3.4%
	Absolute emissions	Emissions	$MtCO_2e$	50	53	57	(2016)	1.1%	-7.5%
	Emissions intensity	Emissions intensity	tCO2e / $ m value-added	0.07	0.06	0.06	(2016)	-2.0%	-10.6%
	Energy efficiency	Energy intensity	GJ / $m value-added	419	375	371	(2016)	-1.1%	-3.9%
	Low carbon electricity	Emissions intensity	tCO2e / MWh						
	Fuel shift - electrification	Proportion of direct fuel in total energy consumption	GJ (Direct) / total GJ	0.3	0.3	0.3	(2016)	-0.2%	-3.8%
	Fuel shift - direct fuel	Emissions intensity of direct fuel use	tCO2e (Direct) / GJ	0.05	0.05	0.06	(2016)	1.0%	-0.2%
	Non-energy emissions	Non-energy emissions intensity	tCO2e / $m value-added						
LAND SECTOR	Activity	Production	$m value-added	$36,932	$42,347	$40,338	(2017)	0.8%	2.5%
	Absolute emissions	Emissions	$MtCO_2e$	172	72	62	(2016)	-8.9%	-6.0%
	Emissions intensity	Emissions intensity	tCO2e / $m value-added	4,654	1,710	1,527	(2016)	-9.6%	-8.3%
	Energy efficiency	Energy intensity	GJ / $m value-added	2,747	2,319	2,734	(2016)	0.0%	-1.4%
	Low carbon electricity	Emissions intensity	tCO2e / MWh						
	Fuel shift - electrification	Proportion of direct fuel in total energy consumption	GJ (Direct) / total GJ	0.9	0.9	0.9	(2016)	0.3%	-1.0%
	Fuel shift - direct fuel	Emissions intensity of direct fuel use	tCO2e (Direct) / GJ	0.07	0.07	0.07	(2016)	-0.1%	-0.4%
	Non-energy emissions	Non-energy emissions intensity	tCO2e / $m value-added	4,419	1,517	1,313	(2016)	-10.4%	-8.3%

Outlook to 2030 with emissions reductions potential by category

SECTOR ($MtCO_2e$ in 2030)	CATEGORIES	EMISSIONS REDUCTIONS UNLOCKED IN 2030 BY SCENARIO AND CATEGORY ($MtCO_2e$)[1]			
		Government projections	Proposed policies	Enhanced policies	Net zero pathway
ELECTRICITY[2] **154**	Solar PV and solar thermal	28	42	58	121
	Wind and other renewables				
	Improvement in fossil fuel generation				
	Demand side electricity reduction	17	18	19	34
INDUSTRY **63**	Energy efficiency of industrial practices, assets and equipment	8	8	8	24
	Electrification of industrial equipment and processes	0	0	0	4
	Switch to cleaner fuels	2	2	2	6
	Implement best practice to reduce industrial process and fugitive emissions (oil & gas, metals, cement, refrigerants) and potential development of carbon capture and storage	4	4	4	19
	Reduction in waste emissions	4	4	4	10
BUILDINGS **41**	Energy efficiency in new builds, retrofits, appliances and equipment	18	22	22	40
	Electrification & fuel shift of building equipment	-1	-1	-1	1
TRANSPORT **49**	Energy efficiency in new passenger and freight vehicles	15	21	25	31
	Increased uptake of electric vehicles, plug-in hybrids, fuel cell vehicles	1	1	1	9
	Switch to gas and bioenergy for freight transport	0	0	0	8
LAND SECTOR **103**	Afforestation and avoided deforestation	3	3	3	87
	Best practice agriculture	0	0	0	16
WHOLE OF ECONOMY	Total of potential unlocked by policy scenario[3]	80	106	126	377
	Additional potential unlocked by each policy scenario[3]	80	26	20	n/a
	Reference case emissions	650	650	650	650
	Residual emissions in 2030	570	544	524	273
	% reduction from 2005 levels	-6%	-11%	-14%	-55%

1 Emissions reductions are calculated as the potential from reference case to the net zero pathway.

2 Supply and demand side electricity emissions reductions included under the electricity sector and by end use sector (e.g. industry).

3 These potential reductions do not include the demand side electricity reduction potential in electricity to prevent double counting.

Methodology

Recent progress:

The analysis for recent progress uses Government data for emissions and energy statistics to calculate rate of improvement in emissions and emissions intensity at the whole of economy and sector level. The analysis also calculates rates of improvement for indicators for the four pillars of deep decarbonisation at the whole of economy and sector level. See data table for the choice of measure.

ClimateWorks scored performance from 2005 to the year of latest data by comparing the actual improvement rates to the compound average improvement rates identified by the Deep Decarbonisation Pathways Project for the net zero pathway between 2012 and 2030. The thresholds for the ratings are shown in the legends at the head of the tables on recent progress on pages 11 and 12.

Outlook to 2030:

The analysis for outlook to 2030 uses Government emissions projections, results from the Deep Decarbonisation Pathways Project, published official data on the impact of policies and published third party modelling to calculate the amount of abatement under three different scenarios. The analysis measures potential abatement in each scenario from the 'reference case'. This is an emissions projection that assumes that the emissions per unit of activity is frozen at 2016 levels. Activity rates in this scenario are the same as the three other modeled scenarios. ClimateWorks assumes autonomous improvement of 0.4 per cent per annum for industrial energy efficiency improvements (the long-term historical average) in the absence of robust data. The three scenarios are as follows:

- Government projections are consistent with Australia's emission projections 2017 released by the Department of the Environment and Energy.
- Proposed policies includes the National Energy Guarantee with a target of 26 per cent below 2005 emissions levels in the National Electricity Market, current proposals for updates to the Building Code in 2019 and the least stringent target from current proposals for vehicle fuel efficiency standards. A target of 26 per cent below 2005 for the NEM (without state targets being additional) would unlock 15 $MtCO_2e$ of potential reductions beyond Government projections. The proposals for the Building Code would unlock 4 $MtCO_2e$ of potential and vehicle fuel efficiency standards would unlock 7 $MtCO_2e$ of potential. The National Energy Productivity Plan primary energy target would be met under this scenario.
- Enhanced policies includes the policies as above except state renewable energy targets for Victoria and Queensland are assumed to be additional to the National Energy Guarantee and vehicle efficiency standards are assumed to meet the most stringent target.

ClimateWorks scored the projected performance by comparing the amount of emissions reductions unlocked under each scenario in 2030 relative to the potential identified on the pathway to net zero. The ratings are decided based on the proposed policies scenario. The thresholds for the ratings are shown in the legends at the head of the tables on outlook to 2030 on pages 13 and 14.

Estimates of land sector emissions (especially for land use, land use change and forestry) vary by accounting methods and have a higher level of uncertainty than other sectors. Government inventory data is used for historic data and Government projections data is used for the outlook to 2030. These have accounting differences which may partly explain changes between emissions in 2016 and 2017. The level of projected change to 2030 in the land sector is therefore subject to a higher degree of uncertainty.

References and data sources

Climate Change Authority 2015, *Final report on Australia's future emissions reduction targets*, Melbourne

ClimateWorks Australia, ANU, CSIRO and CoPS 2014, *Pathways to Deep Decarbonisation in 2050: How Australia can prosper in a low carbon world: Technical report*, ClimateWorks Australia

Commonwealth of Australian Governments Energy Council, 2017, *Energy security board advice - National Energy Guarantee*: viewed June 2018

Saddler, H., 2018, *National Energy Emissions Audit, Electricity Update July 2018*: viewed July 2018 with additional data received from the author

Government emissions data and projections: annual emissions - national greenhouse gas inventory: viewed June 2018; quarterly emissions data - Quarterly Update of Australia's National Greenhouse Gas Inventory: viewed June 2018; Australia's emission projections 2017: viewed June 2018

Australian Energy Update 2017: viewed June 2018

Resources and Energy Quarterly: viewed December 2017

ABS datasets for motor vehicle use (9208.0), population projections (3222.0) and national accounts (5206.0): viewed June 201

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