TRACKING PROGRESS TOWARDS A LOW CARBON ECONOMY

ClimateWorks AUSTRALIA

1. NATIONAL PROGRESS REPORT

Overview of national progress in reducing emissions across the Australian economy

July 2013

About us

Five years ago, The Myer Foundation and Monash University realised that Australia needed a new approach to drive action on climate change. One that understood the interests of business, government and investors and was trusted to be an independent, credible adivsor in Australia's transition to a prosperous low carbon future.

That's why they partnered to create ClimateWorks Australia - an independent, research-based, non-profit organisation committed to catalysing reductions in greenhouse gas emissions in Australia.

Since then, ClimateWorks has built a reputation as a trusted, credible and fact-based broker by working in partnership with leaders from the private, public and non-profit sectors.

With strong links to the US-based ClimateWorks Foundation, ClimateWorks Australia also benefits from an international network of affiliated organisations that support effective policies for greenhouse gas reduction.

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We also extend our sincere appreciation to the experts, businesses and organisations that we interviewed or consulted for this project. A full list of acknowledgements is included in each sector report in the *Tracking Progress* series.

ClimateWorks bears sole responsibility for the ideas expressed in this and the other reports in the *Tracking Progress* series.

TRACKING AUSTRALIA'S PROGRESS TOWARDS
A LOW CARBON ECONOMY

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This report may also be downloaded at
www.climateworksaustralia.org/tracking-progress

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Australia's progress toward

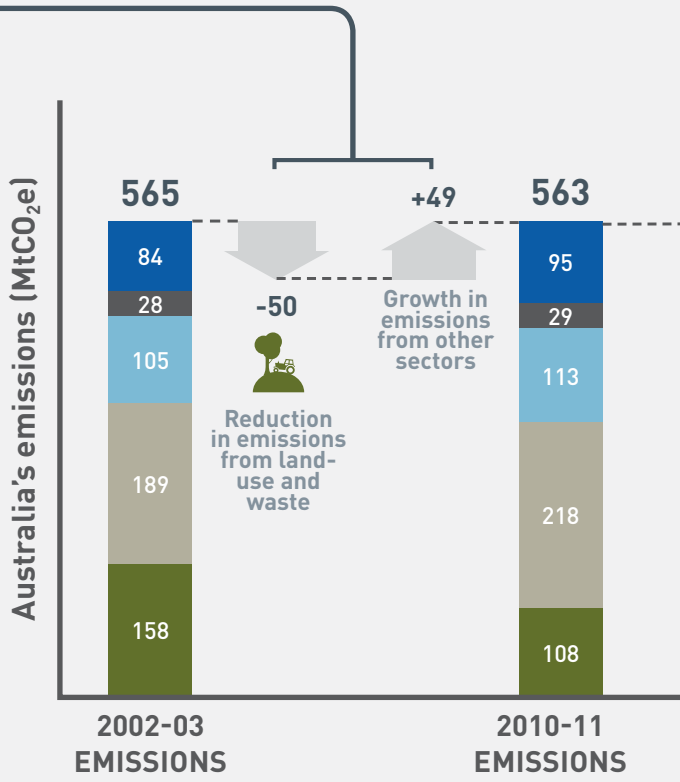
Recent Progress

Australia has embarked on the transition to a low carbon economy, with an increase in activity across the economy to improve energy efficiency and reduce greenhouse gas emissions.

1

THE AUSTRALIAN ECONOMY HAS GROWN STRONGLY OVER THE LAST DECADE, BUT EMISSIONS HAVE REMAINED STABLE

This was mostly due to reduced deforestation, increased plantation forestry and reduced coal generation which resulted from a combination of more renewables and lower demand for grid-supplied electricity



Legend

- POWER
- BUILDINGS
- INDUSTRY
- LAND-USE AND WASTE
- TRANSPORT & OTHER*

POWER

Emissions from power generation dropped by 13% between '08-'09 and '12-'13

5%
Reduction of 5% in demand for grid-supplied electricity since its peak in 2009–10, equivalent to the annual electricity consumption of Tasmania

12%
Large-scale renewables now produce 12% of Australia's energy, up from 7% in 2003-04

14%
Coal generation decreased by 14% since 2003-04, mostly replaced by lower emissions gas and renewables

INDUSTRY

Strong improvements in energy efficiency and process emissions partially offset large increases in production

800,000
Over the last 4 years, large industrial companies saved as much energy as around 800,000 households use in a year

95%
Highly potent PFC emissions from Aluminium reduced by 95% since 1989-90

58%
Self-generated electricity and other off-grid electricity has increased by 58% between 2008-09 and 2011-12, mostly using lower emissions gas

BUILDINGS

Improvements in energy efficiency of new buildings and distributed energy

32%
New offices now use about 32% less energy for heating, cooling and other base building uses than offices built 10 years ago

6
Most states improved residential energy efficiency standards from 5 to 6 stars in 2010

+1,000,000
Over 1 million homes now have solar panels installed, more than any other country

LAND-USE AND WASTE

Large reductions in net emissions from de- & re-forestation more than offset growth in other sectors since 2002-03

52%
Annual area deforested halved since 2003, and area of plantation forests increased by 21%

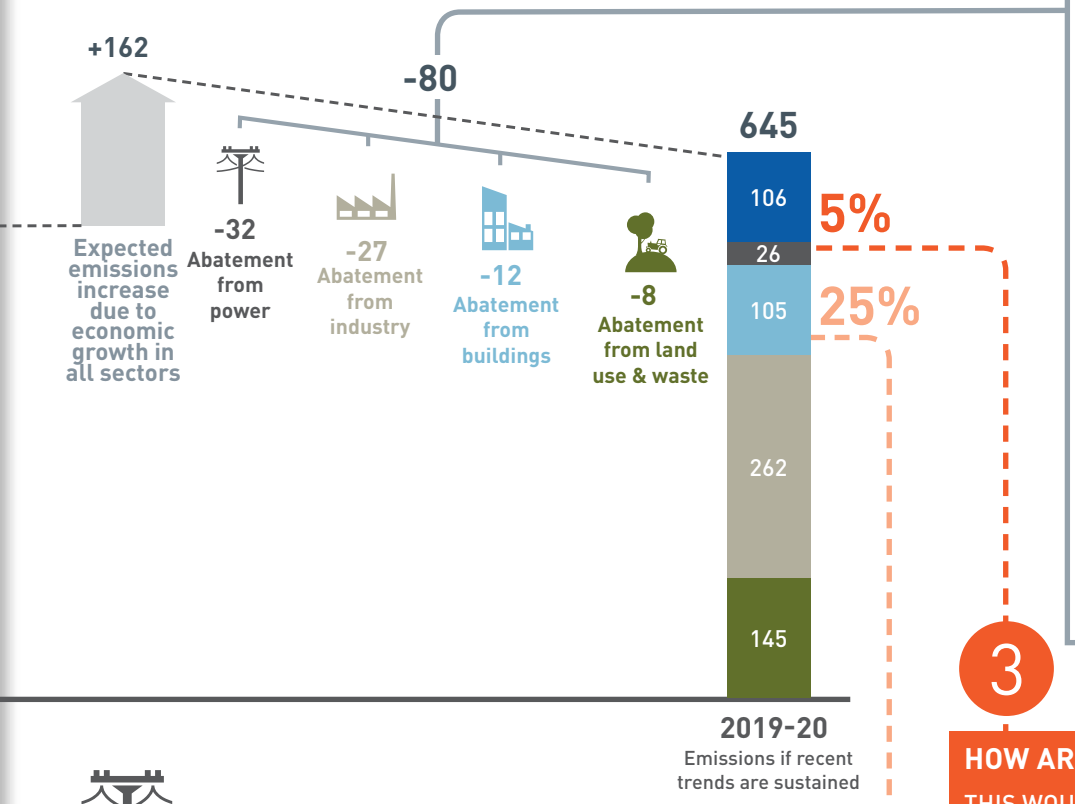
3,000,000
Almost 3 million hectares (equivalent to 4.2 million football fields) of land being managed to reduce emissions from wildfires

200,000
Increased capture of methane from landfills and wastewater treatment plants, now used to generate enough electricity to power over 200,000 homes

*This report does not investigate emissions reductions from transport. This sector will be included in future reports. A very small volume of emissions from other activities are not covered in the scope of the report.

ds a low carbon economy

Outlook to 2020



2

IF RECENT LEVELS OF EMISSION REDUCTION ACTIVITY ARE SUSTAINED, IT WOULD REDUCE BY HALF THE EXPECTED GROWTH IN EMISSIONS TO 2019-20.

If the pipeline continues to deliver emissions reductions, and recent trends are sustained, emission reduction activity would be led by continued industrial and residential energy efficiency and renewable energy including large-scale wind and smaller-scale solar PV.

3

HOW ARE WE DOING?

THIS WOULD GET US OVER 40% OF THE WAY TOWARDS THE 5% MINIMUM 2020 EMISSIONS REDUCTION TARGET.

The remaining years from now to 2019-20 provide time to identify increased incentives to support local action, explore the role of international offsets, and consider increasing the target.

4

OUR POTENTIAL

AUSTRALIA HAS THE POTENTIAL TO REDUCE EMISSIONS BY AT LEAST 25% BELOW 2000 LEVELS, THE MINIMUM ADVISED BY IPCC SCIENTISTS.

Major remaining opportunities lie in further increasing renewables, avoided deforestation, reforestation, increased energy efficiency in buildings and industry, and a decrease in fugitive emissions from coal mines.

POWER

Strong pipeline of renewable energy projects and slow growth in energy demand expected to bring power emissions down further by 2019-20

113%

Meeting the Renewable Energy Target would more than double renewable generation between 2012-13 and 2019-20

INDUSTRY

Across-the-board improvements expected, partially offsetting strong growth in emissions from higher future production

600,000

Energy efficiency projects already in the pipeline could save as much energy annually as 600,000 homes use in a year

BUILDINGS

Improved energy standards for buildings and appliances in homes, and distributed energy continuing to increase

7%

Recent improvements in energy standards expected to drive a reversal of historic growth in energy use per household, leading to a 7% decline by 2019-20

LAND-USE AND WASTE

Future activity highly dependent on policy certainty and future carbon revenues

30%

By 2019-20, waste from 30% of Australian pigs is expected to be used to generate electricity for their farms

ClimateWorks AUSTRALIA

1.1 Executive summary

Recent progress

Strong improvements in large-scale renewable energy, reduced deforestation, increased industrial energy efficiency and an increase in distributed solar PV have driven progress to date.

Whole-of-economy: Over the past decade there has been no growth in Australia's greenhouse gas emissions despite economic growth of 31 per cent between 2002-03 and 2011-12. This has been achieved as a result of significantly reduced deforestation and increased plantation forestry, together with some improvement in other sectors. Since 2008-09, emission reductions from Industry and Power have accelerated, led by significant increases in renewable energy, a drop in demand for grid-supplied electricity and a tripling in the rate of energy efficiency improvement in large industrial companies.

Power: Emissions intensity of grid-supplied electricity generation has decreased, as a result of a 14 per cent decrease in black and brown coal generation since 2003-04. This has been a combined result of growth in wind generation to meet the Renewable Energy Target, a post-drought recovery in hydro generation, growth in gas generation and reductions in demand for grid-supplied electricity – contrary to previous expectations of continued growth. Emissions have declined by 13 per cent between 2008-09 and 2012-13.

Industry: Industry emissions intensity has been decreasing, with a large increase in energy efficiency activity, lower overall emissions intensity of electricity used, and improvement in the emissions intensity of processes in the aluminium and cement industries. Improved flaring and venting practices in oil and gas production have reduced the growth in fugitive emissions. Despite a 25 per cent increase in industrial value added[1] between 2002-03 and 2011-12, it is estimated that emissions have only increased by 13 per cent, helped by these abatement activities.

Buildings: The energy intensity of Australia's buildings has decreased slightly between 2002-03 and 2010-11, led by improvements in building efficiency standards as well as energy efficiency of equipment, appliances and lighting. Buildings are also generating more of their own electricity, with large increases in residential solar PV in particular. These activities, combined with the decrease in the emissions intensity of grid-supplied electricity, have helped to slow the growth in emissions resulting from additional new buildings, and increased ownership of appliances and space-conditioning. Between 2002-03 and 2010-11, commercial building floor space increased by about 17 per cent and the number of households increased by 0.9 million or 12 per cent, but over the same period total emissions from buildings increased by only 8 per cent.

Land-use and waste: Overall, emissions from forestry, agriculture and waste fell by 32 per cent from 2002-03 to 2010-11, due to large reductions in deforestation and increases in plantation forestry, as well as increased capture of waste gas from landfills and wastewater. Emissions reductions from forestry, agriculture and waste have offset the growth in emissions from other sectors of the economy.

Drivers of industrial energy efficiency

Energy price rises was the most significant driver of energy efficiency activity mentioned by companies interviewed for this report, along with the carbon price and the Energy Efficiency Opportunities (EEO) program. 82 per cent of respondents indicated that the carbon price has had a highly or moderately significant impact, mainly by increasing senior management focus and attention devoted to managing current and future carbon risks and liabilities.

1 'Value added' refers to the total value of goods and services produced by an industry, after deducting the cost of goods and services used in the process of production (ABS 2013)

Outlook to 2020

If the pipeline of projects continues to deliver emissions reductions, and recent trends in abatement activity are sustained, emission reductions would be led by continued industrial and residential energy efficiency and renewable energy including large-scale wind and smaller-scale solar PV.

Whole-of-economy: Without any actions to reduce emissions, economic growth between 2010-11 and 2019-20 would drive a 29 per cent per cent increase in emissions, led by increased industrial energy use and fugitive emissions, as well as harvesting (and not replanting) of plantation forests. However, if recent levels of emissions reduction activity are sustained, emissions would be reduced by 80 $MtCO_2e$ to be 645 $MtCO_2e$ in 2019-20. This would get Australia over 40 per cent of the way towards the minimum 5 per cent emissions reduction target by 2019-20 through domestic action alone.

Around 73 per cent of the opportunity identified in the *Low Carbon Growth Plan for Australia* would remain uncaptured, and the remaining years from now to 2019-20 provide time to identify increased incentives that could help capture these opportunities for local action, which could deliver a 25 per cent reduction in our national emissions (compared to 2000 levels).

There also remains time to explore the role of international offsets in achieving our national target, and to consider increasing the current minimum 5 per cent target. Whether recent trends can be sustained or increased is dependent on a range of factors including future electricity and fuel prices (particularly gas prices), technological improvements, sustaining current levels of regulatory support and incentives, and resolution of regulatory barriers and policy uncertainties.

Power: Higher demand for grid-supplied electricity from an increase in industrial activity, more buildings and increased use of appliances will drive emissions up between now and 2019-20. This growth would be more than offset if recent trends in abatement activity are sustained – specifically, if energy efficiency in industry and buildings continues to improve at the same rate, and the Renewable Energy Target is met. If trends in these activities continue, generation from existing coal assets would decline by an additional 2 per cent from 2012-13 to 2019-20, leading to an 11 per cent decrease in emissions intensity of grid-supplied electricity from 2012-13 to 2019-20.

Industry: Australia's industrial sector is expected to continue to grow strongly between now and 2019-20, particularly in LNG production, coal and metal ore mining and alumina production and despite no growth assumed from manufacturing.

This growth would drive strong increases in energy use and fugitive emissions in particular. However, continued improvements in energy efficiency and process emissions intensity (especially in cement and chemicals) would contain growth in the sector's emissions to around 20 per cent from 2010-11 to 2019-20, offsetting nearly half the increase in emissions due to economic growth.

Buildings: Increases in the total number of Australian households and volume of commercial building floor space, coupled with an increase in the use of energy-consuming appliances, would drive up emissions from buildings by 19 per cent by 2019-20 with no further abatement activity. This increase would be more than offset if recent trends in energy efficiency improvements to buildings and appliances continue, and the rate of installation of solar panels and other on-site power generation is sustained. Emissions from buildings are also heavily impacted by changes in the Power sector, which determine how much emissions are released for each unit of grid-supplied electricity consumed.

Land-use and waste: The strong reductions in emissions from Land-use and Waste over the last decade are not currently expected to continue, with plantation forests expected to be harvested for timber and not replanted, new plantation rates expected to remain low, and livestock numbers expected to recover post-drought. Most of the potential for future activity to reduce emissions from Land-use and Waste is dependent on certainty of future revenues from government initiatives such as the Carbon Farming Initiative (CFI) and the carbon price.

Unlocking further industrial energy savings

Of the industrial companies interviewed, those that identified and implemented the most energy savings saved three times more energy than average companies and ten times more than those who identified and implemented the least. This suggests that there is considerable scope for additional savings within the sector. The most effective corporate practices for improving energy efficiency were found to be regular analysis of energy data, inclusion of energy management considerations in operational guidelines, and senior management oversight of energy management. Respondents that reported a high score for implementation of these practices achieved three times more savings than those that did not. A range of factors continue to inhibit further uptake of energy efficiency activity, including access to internal capital, the payback period for projects, opportunity cost and operational risk.

How do different sectors compare?

The emissions reduction activities that have grown most strongly between 2002-03 and 2012-13 (or the latest year for which data is available) are reduced deforestation and increased afforestation, followed by renewable energy and industrial energy efficiency.

Looking forward to 2019-20, if recent trends are sustained, the largest emissions savings would come from the Power sector (32 $MtCO_2e$), followed by the Industrial sector (27 $MtCO_2e$) and then Buildings (12 $MtCO_2e$). A small amount of abatement (8 $MtCO_2e$) would come from Land-use and Waste.

Activities to reduce emissions in Buildings and Industry were expected to be the first of the opportunities identified in the *Low Carbon Growth Plan for Australia* taken up, as many of these are energy efficiency opportunities that can deliver a financial return to the investor. Activities in Power (beyond what is required to meet the Renewable Energy Target) and Land-use and Waste were expected to require additional incentives or a higher carbon price than currently exist, without which they mostly do not deliver a financial return to the investor. These expectations largely align with the results in this report.

This activity would offset a portion of the growth in emissions to 2019-20, led by strong growth (81 $MtCO_2e$) in industrial emissions, particularly from LNG production and mining.

How much potential remains?

The sectors with the greatest estimated uncaptured potential to reduce emissions are Land-use and Waste (93 $MtCO_2e$) and Power (69 $MtCO_2e$), followed by Buildings (29 $MtCO_2e$) and then Industry (21 $MtCO_2e$). These estimates are based on the potential to reduce emissions in each sector identified in the *Low Carbon Growth Plan for Australia* (see section 1.3.4 below for further detail).

Key activities that could be undertaken to further reduce Australia's emissions include:

- **Power:** Further shift from coal generation through increased large-scale renewable energy (including beyond the large-scale RET target of 41,000 GWh by 2020), increased gas generation, and further further reductions in demand for grid-supplied electricity in other sectors.
- **Land:** Significant remaining opportunities across the range of activities eligible for the Carbon Farming Initiative, particularly in avoided deforestation and afforestation.
- **Industry:** Increased uptake of energy efficiency, and decrease in fugitive emissions through the capture and combustion of methane from gassy coal mines.
- **Buildings:** Improved building standards and operational performance for all buildings, and increase in retrofitting opportunities for existing residential and especially commercial buildings.

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What lessons can we learn?

The variation between activity levels in different sectors can be explained by a combination of macroeconomic factors and the impact of policy and regulatory programs.

Within this context, some common themes in the results suggest the following implications for maintaining and increasing the implementation of low carbon activity in Australia:

- **Price signals are powerful:** Activity trends are strong in sectors that can respond easily to effective price signals, while funding support has stimulated activity in companies and households. Sectors facing a multiplier of the carbon price have seen particularly strong uptake of new technology to reduce emissions.
- **Uncertainty is a drag:** There is less evidence that activities to reduce emissions will take place in the future in areas that have higher upfront costs and rely on an expectation of stable and sufficient policy drivers or incentives over the longer term for their financial return on investment.
- **Regulation is reliable:** Where regulation sets a minimum standard or requirement, there is clear evidence of steady, ongoing abatement activity. Verification is often required to ensure that regulations are working as intended.
- **Macroeconomic factors can still throw a curve ball:** Some of the largest changes in emissions per sector are linked to macroeconomic factors. Changes in these factors can outweigh or weaken the momentum from emissions reduction activities.

1.2 Index of progress

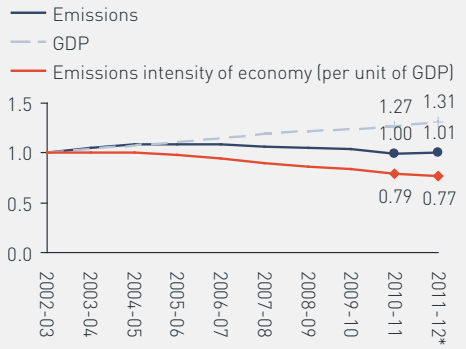
Whole-of-economy

Recent progress

Emissions stable despite economic growth

Strong reductions in deforestation and increases in afforestation have contributed a major share of abatement in the last decade. In addition, there has been a strong increase in renewable energy generation and industrial energy efficiency.

Exhibit 1.1: Change in emissions and emissions intensity, indices (DIICCSRTE 2013a, ABS 2013, ClimateWorks team analysis)



What factors influenced the abatement activity?

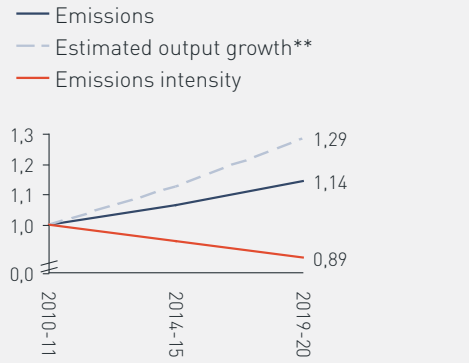
- State regulation of land clearing
- Renewable Energy Target
- Rising energy prices
- Carbon price and energy reporting programs
- Buildings and appliances standards
- New energy uses in buildings

Outlook to 2020

Current trend would deliver 27% of identified potential

If current trends are sustained, emissions reduction activity would be led by continued industrial and residential energy efficiency, and uptake of renewable energy such as large-scale wind and smaller-scale solar PV.

Exhibit 1.2: Change in emissions and emissions intensity, indices (DIICCSRTE 2013a, ClimateWorks team analysis)



What factors will influence abatement activity?

- Renewable Energy Target
- Slow growth of electricity demand
- High energy prices and carbon price
- Carbon revenue uncertainty
- Potential changes to land clearing regulations
- Growth in gas production and mining
- Possible gas price increases

Change relative to historical levels & expectations

- No improvement or backwards
- Patchy or limited improvement
- Some improvement
- Moderate improvement
- Strong improvement

Legend

- Upside factors
- Downside factors

Share of potential identified in the *Low Carbon Growth Plan* (LCGP) that current trend would deliver

- No abatement captured
- Little abatement captured (1–25%)
- Some abatement captured (26–50%)
- Moderate abatement captured (51–75%)
- Significant abatement captured (>75%)

Legend

- Upside factors
- Downside factors

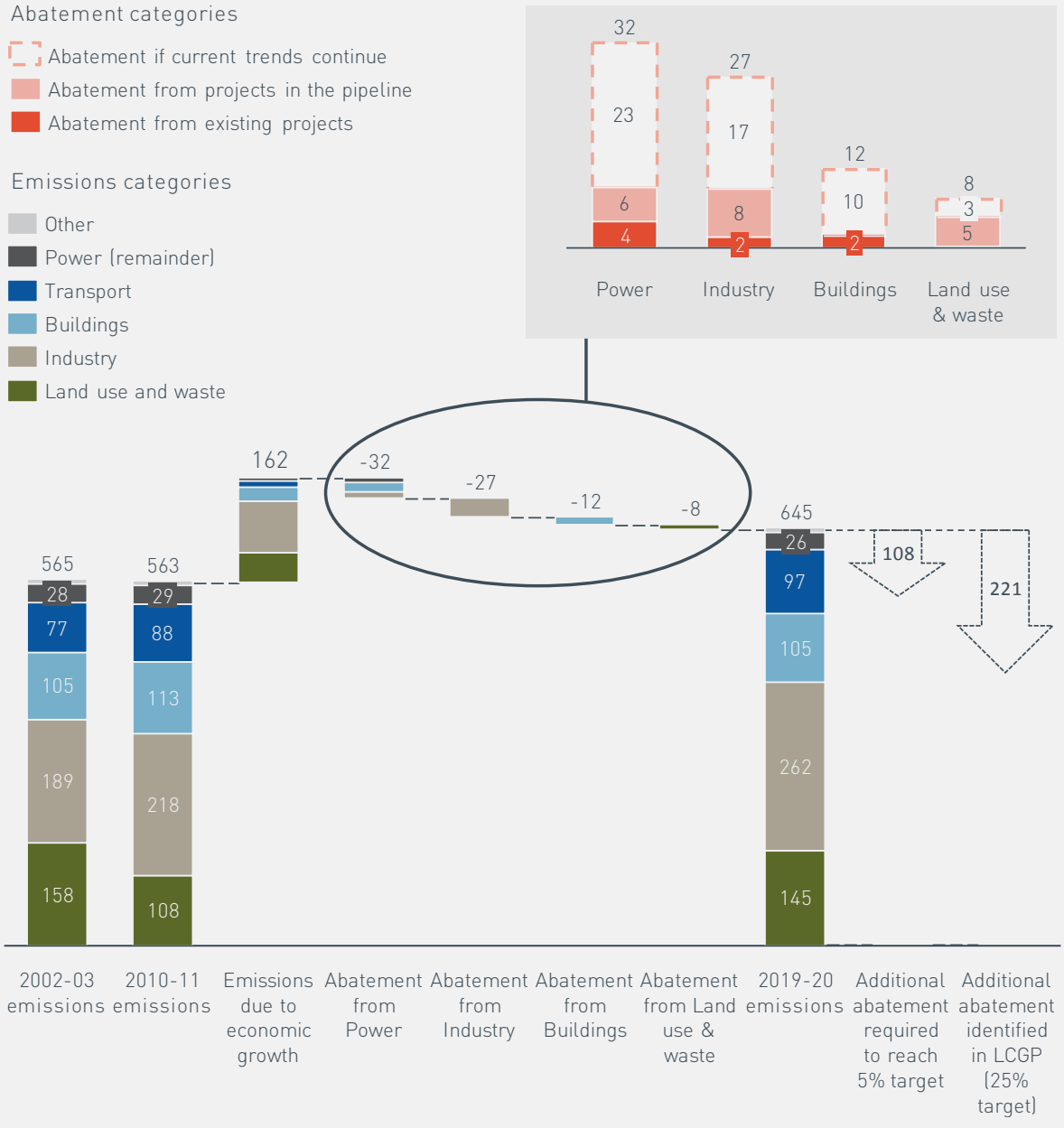
* 2011-12 emissions data is preliminary only
** Estimated based on emissions growth with no further abatement activity, which mostly reflects output growth in each sector.

Between 2002-03 and 2010-11, Australia's emissions remained stable despite strong economic growth, driven by a 32 per cent decrease in Land-use and Waste emissions which counterbalanced emissions growth in other sectors of the economy. If there is no further abatement activity beyond 2009-10*, Australia's emissions would increase by 29 per cent by 2019-20, a result of strong growth in the resources sector (in particular natural gas production, coal and metal ore mining) and increases in forestry emissions (as plantation forests are harvested and not replanted).

However, if current trends are sustained, abatement activity would deliver 80 $MtCO_2e$ of emissions reductions, halving the growth in Australia's emissions from 29 to 15 per cent.

The Power sector would contribute 32 $MtCO_2e$ of this abatement through a decrease in grid-supplied electricity emissions intensity, driven by an increase in large-scale renewable energy, and a reduction in coal-fired generation. Industry, with 27 $MtCO_2e$ of abatement, would be the second largest contributor if current trends are sustained, driven primarily by continued improvements in energy efficiency. The Buildings sector would contribute 12 $MtCO_2e$ through reduced electricity consumption per household and increased solar PV uptake. Land-use and Waste would contribute a further 8 $MtCO_2e$, with a strong increase in waste methane capture, but limited activity in reduced deforestation and carbon sequestration expected in the current context.

Exhibit 1.3: Australian emissions, $MtCO_2e$ (DIICCSRTE 2013a, ClimateWorks team analysis)



*Abatement from 2009-10 to 2010-11 has been captured as abatement from existing projects in the graph above.

Recent progress

Assessment of sector improvement in emissions reduction activity

POWER

SEE REPORT 2

The emissions intensity of Australia's power generation decreased by 8% from 2008-09 to 2012-13, with overall emissions decreasing by 13% since 2008-09

- **Demand:** Demand for grid-supplied electricity across Australia decreased by 5% between 2009-10 and 2012–13, contradicting strong growth projections
- **Renewables:** Generation of large-scale renewables has grown by 62% between 2003-04 and 2012-13, led by an increase in wind and a recovery in hydro generation
- **Fossil fuels:** Generation from coal decreased by 14% between 2003-04 and 2012-13, and gas generation doubled

INDUSTRY

SEE REPORT 3

Strong improvements in energy efficiency and process emissions offset by large increases in production

- **Energy efficiency:** Energy efficiency improvements of around 1.3% per annum between 2007-08 and 2009-10, in line with international leaders
- **Energy mix:** 5% improvements in emissions intensity of industrial energy use from 2002-03 to 2011-12
- **Industrial processes:** Strong improvements in aluminium, cement and chemicals led to 10% decrease in the emissions intensity of those sectors between 2002-03 and 2010-11
- **Fugitive emissions:** Increase in coal field intensity has countered improvements from oil and gas production

BUILDINGS

SEE REPORT 4

Improvements in energy efficiency of new buildings and distributed energy mostly offset by additional buildings and increased use of electricity by electronics and space conditioning in homes

- **New commercial:** Strong improvement in new offices base buildings, and likely improvements in remaining bulding types due to increased standards
- **Existing commercial:** Energy intensity per m^2 has improved by an average 0.3% per annum
- **New residential:** Increased efficiency standards have decreased heating and cooling energy consumption of new homes by 17% since 2010
- **Existing residential:** Energy use per household improved on average by 0.3% per annum driven in particular by improved appliance, water heating and lighting efficiency
- **Distributed energy:** Over 1 million small scale solar systems now installed across Australia, and cogeneration is believed to have increased

LAND-USE AND WASTE

SEE REPORT 5

Large reductions in net emissions from de- and re-forestation have more than offset growth in other sectors since 2002-03

- **Deforestation:** The annual area deforested has halved since 2003, leading to a 45% reduction in emissions
- **Afforestation:** Total area of plantation forests increased by 21% in the last decade, but dropped sharply since 2007
- **Waste:** Between 2002-03 and 2010-11, there has been a 60% increase in abatement of waste gas
- **Agriculture:** Limited emissions reductions to date, despite improvement in some areas e.g. piggery methane capture

Recent Progress

Change relative to historical levels & expectations

- No improvement
- Limited improvement
- Some improvement
- Moderate improvement
- Strong improvement
- Data unavailable

Legend

- Factor that has driven emissions reductions
- Factor that has impeded emissions reductions

POWER

Key achievements

- Wind generation now accounts for 31% of all renewable generation, enough to power 1 million households
- Fuel efficiency levels were maintained in coal assets, despite reduced utilisation which can affect efficiency

Key influencing factors

- Improved energy efficiency in buildings and industry
- Renewable Energy Target driving investments in new renewable capacity
- Carbon price

Case studies

AGL's Macarthur Wind Farm is estimated to produce 1.2 TWh of electricity a year, equivalent to powering 220,000 average Victorian households.

INDUSTRY

Key achievements

- It is estimated that EEO companies have implemented savings reducing their energy use by 5%
- Highly potent PFC emissions from aluminium were reduced by 95% since 1989-90

Key influencing factors

- Rising energy prices
- Energy reporting programs
- Carbon price
- Increased production, particularly in mining and natural gas

Case studies

Anglo American's Moranbah North waste coal mine gas facility abates and displaces about 1.3 million tonnes of CO_2e each year, producing enough energy to power approximately 48,000 homes.

Through energy efficiency and greenhouse gas saving opportunities, Toyota reduced the intensity of CO_2 emissions per vehicle by 20% between 2005–06 and 2011–12.

BUILDINGS

Key achievements

- Ban of electric hot water heaters likely to reduce water heating emissions by almost 50% in new homes
- Australia has over 1 million homes with a solar PV system installed, more than any country in the world
- Green Star offices emit nearly half less than offices built to meet 'minimum standards'

Key influencing factors

- Strengthening of building standards
- Competition in high end office market
- Renewable Energy Target
- Decreasing technology costs
- Lack of verification that performance meets standards
- New energy uses

Case studies

In 2012, 32 existing commercial buildings used the Buildings Alive Pulse energy monitoring platform to better manage energy consumption, saving an average of 200 tCO_2e each and over 6,000 tCO_2e across the portfolio.

A quarter of all homes built by graduates of the Master Builders Australia Green Living Builders program were more efficient than the minimum 6 Star NatHERS requirement

LAND-USE AND WASTE

Key achievements

- Total area of forest plantation reached 2 Mha in 2011, equivalent to 2.8 million soccer fields
- Landfills and waste water treatment plants now generate enough energy to power more than 200,000 homes

Key influencing factors

- State regulation of land clearing
- Tax concessions for forestry
- Revenue from carbon offsets
- Energy generation and renewable energy certificate for biogas

Case studies

Blantyre pig farm in New South Wales has reduced greenhouse gas emissions by approximately 250 tCO_2e per year through the collection of effluent gases which are then used to power a biogas system that returns electricity to the grid.

Outlook to 2020

Share of *Low Carbon Growth Plan* potential that current trend would deliver

POWER

SEE REPORT 2

A strong pipeline of renewable energy projects and slow growth in grid electricity demand are expected to see overall power sector emissions decline by 2019–20, delivering 32% of the LCGP potential

Demand: Reduction in demand from manufacturing and residential buildings (including solar PV) to contain demand rise to 6% growth from 2010–11 to 2019–20

Renewables: Meeting the Renewable Energy Target (RET) would more than double renewable generation by 2019-20, delivering 40% of the LCGP potential

Fossil fuels: Expected future demand and increased renewables are expected to keep coal generation at 2012-13 levels, delivering 20% of LCGP potential

INDUSTRY

SEE REPORT 3

Across-the-board improvements expected to deliver 57% of LCGP potential, partially offsetting strong growth in emissions from higher future production

Industrial energy efficiency: Continuation of current high levels of energy efficiency is possible, and would deliver 53% of LCGP potential

Energy mix: Continued shift to gas would lead to an 8% decrease in emissions intensity

Industrial processes: Step change expected in Chemicals, and continued improvements in Cement likely to capture nearly all the LCGP potential

Fugitive emissions: Improved efficiency of oil and gas production but limited improvements in coal mining are set to deliver 43% of LCGP potential

BUILDINGS

SEE REPORT 4

Strong improvements in energy efficiency in homes and increases in solar PV uptake are expected if recent trends are sustained, but limited improvements expected overall in non-office commercial buildings. This would deliver 30% of the LCGP potential

New commercial: Expected improvements in small group of market leaders, but no data on other building types

Existing commercial: Energy intensity per square metre on trend to reduce by 3% by 2020, delivering 8% of LCGP potential

New residential: Recent trends would deliver an estimated 8% reduction in the maximum allowable energy to heat and cool new homes, or 15% of LCGP potential

Existing residential: Reversal of historic growth in residential electricity use expected from recent improvements in standards for new builds and appliances. On track to capture nearly two third of LCGP potential

Distributed energy: Solar PV could reach about 13% of residential electricity use in 2020, exceeding LCGP potential

LAND-USE AND WASTE

SEE REPORT 5

Only 8% of LCGP potential would be captured, with regulatory uncertainty limiting carbon sequestration activity, and forestry emissions increasing as plantation forests are harvested and not replanted

Deforestation: Recent gains from reductions in deforestation at risk due to relaxed clearing laws

Afforestation: Very limited additional afforestation expected by 2019-20, delivering only 2% LCGP potential

Landfill waste: Current trends would lead to a 48% increase in methane abatement from landfill and wastewater gas, capturing more than the LCGP potential

Agriculture: Activity is increasing in some areas, but only 15% of LCGP potential would be captured without further incentives, research and development

Outlook to 2020

Share of available potential that current trend would deliver

- No abatement captured
- 1–25%
- 26%–50%
- 51%–75%
- 76%+
- Data unavailable

Legend

- Factor that could drive emissions reductions
- Factor that could impede emissions reductions

What's in the pipeline?	Key influencing factors	Case studies	
There is twice as much renewable energy capacity in the pipeline than what's needed to meet the Renewable Energy Target There is no prospect of lock-in from new major coal projects before 2019-20	Renewable Energy Target, Carbon price Electricity demand remaining soft Possible gas price increases Planning regulations limiting wind development	Coal generator Delta Electricity is starting to consider the quality of black coal in its purchasing decisions, aiming to prioritise coal with a higher energy to emissions ratio, which will impact on future coal supply contracts.	POWER
Projects that have been awarded CTIP grants will be able to save up to 75 PJ of energy, equivalent to 8 $MtCO_2e$ of abatement N_2O abatement technology likely to be installed in all ammonium nitrate plants	Energy price rises incentivising energy efficiency activity Carbon price, CTIP grants and EEO Increased company capability Possible gas price rise could incentivise fuel shift to coal	As a result of an increased focus on energy management from senior executives, CSR has been able to take advantage of the CTIP grants announced in 2012 by the Australian Government. Carlton & United Breweries has now signed onto its parent company SAB Miller's world wide targets on energy and greenhouse gas reduction which will further incentivised energy reductions.	INDUSTRY
Almost all office buildings under construction in major capital cities are Green Star registered Current trends would lead to a three fold increase of solar generation by 2020 Greener Government building program could deliver 1.2 $MtCO_2e$ of abatement by 2019-20	Further increases in electricity prices Improved information New technologies Regulatory uncertainty	A 2MW tri-generation plant at Central Park, a new precinct in Sydney's CBD, will save 7,600 tonnes of CO_2 per year once the entire system comes online which equates to 190,000 tonnes of emissions reductions over its 25 year design life. Once complete, the Barangaroo precinct in Sydney will source all of its electricity from on and offsite solar panels with excess generation returned to the grid.	BUILDINGS
45 MW of landfill gas generation capacity is currently in development with a further 18 MW under evaluation Adoption of methane capture at piggeries is expected to increase to cover 30% of Australia's pig herd by 2019-20	Potential changes to land clearing regulations could lead to more deforestation Carbon revenue uncertainty Investment in research could increase adoption	With help from the North Australian Indigenous Land and Sea Management Alliance (NAILSMA), local communities are reducing emissions from fires in northern Australia, and receiving credits under the CFI.	LAND-USE AND WASTE

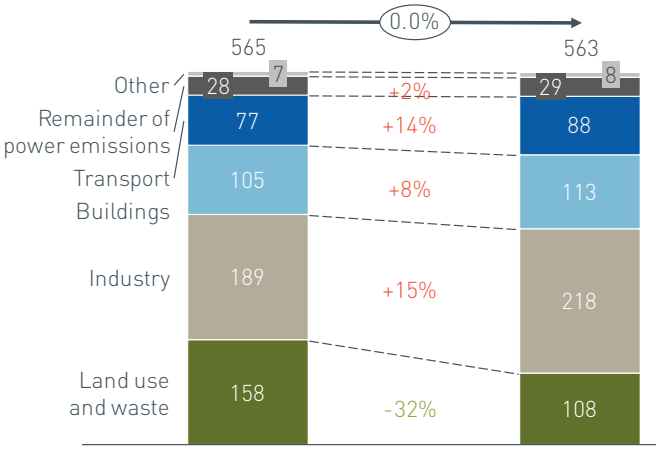
1.3 Overview of activity by sector

1.3.1 Recent progress

Strong reductions in deforestation combined with increases in afforestation have contributed a large portion of the emissions reductions in the last decade. In addition, there has been a strong increase in renewable energy generation and industrial energy efficiency.

Australia's economy has grown strongly between 2002-03 and 2010-11, particularly in mining and resources. However, emissions over that period have remained stable (see Exhibit 1.4 below), with Australia's total emissions in 2010-11 almost the same (563 $MtCO_2e$ in 2010-11) as a decade ago (565 $MtCO_2e$ in 2002-03). Early estimates of 2011-12 emissions (566 $MtCO_2e$) (DIICCSRTE 2013b) suggest that growth in emissions has been limited since 2010-11.

Exhibit 1.4: Recent changes in Australian emissions, MtCO2e (DIICCSRTE 2013a)



Australia's economy now emits more than 20 per cent fewer greenhouse gas emissions for each dollar of GDP than it did a decade ago. The 'carbon emissions intensity' of the Australian economy has improved over the decade to 2011-12 from 0.51 kilograms of CO_2e per dollar of GDP in 2002-03 to an estimated 0.39 kilograms of CO_2e per unit of GDP in 2011-12.

Many other factors have influenced the average emissions intensity of the economy. In particular, changes to the economic mix are likely to have played a significant role. The Prime Minister's Task Group on Energy Efficiency suggested that a structural shift from manufacturing to a services-based economy may account for a proportion of the improvements seen in Australia's overall energy intensity (PMTGEE 2010).

Growth in highly emissions intensive sectors such as the resources sector may have the opposite effect, contributing to an increase in emissions intensity. While macroeconomic factors have been considered in this analysis, the focus has been on the changes in emissions reduction activity, and on the impact that these changes are likely to have had on the emissions and emissions intensity of each sector analysed.

POWER

The emissions intensity[2] of Australia's grid-supplied electricity generation has decreased, with strong reductions in coal generation. Total emissions have decreased by 13 per cent since its peak in 2008-09 to 2012-13.

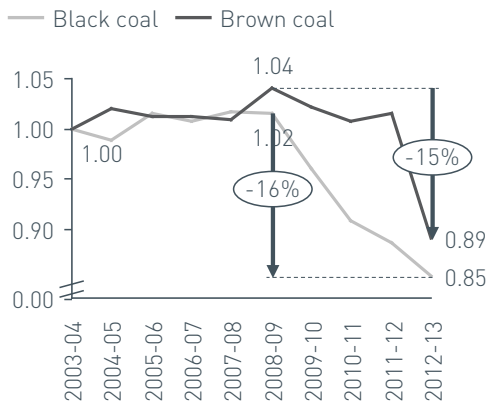
Demand: Australia's electricity demand reduced by 5 per cent between 2009-10 and 2012-13, contrary to previous expectations of continued growth in demand. This reduction of about 12,000 GWh is equivalent to eliminating Tasmania's annual electricity use in recent years. Reductions in electricity demand have come primarily from a reduction in manufacturing output, increased uptake of distributed energy particularly solar PV, milder weather in the last 4 years leading to less heating and cooling, and improvements in energy efficiency in industry and buildings[3].

Renewables: Generation of electricity from large-scale renewables grew by 62 per cent between 2003-04[4] and 2012-13, led mostly by wind and a post-drought recovery in hydro. Renewables now generate 12 per cent of all electricity in Australia, up from 7 per cent a decade ago.

The Large-scale Renewable Energy Target (LRET) legislation requires that Australia generate 20 per cent or 41,000 GWh of large-scale renewable energy by 2020. It has driven a surge in investment in wind power, with generation from wind energy growing from 214 GWh in 2003-04 to 7,744 GWh in 2012-13.

Fossil fuels: Electricity generation from coal decreased by 14 per cent between 2003-04 and 2012-13. This shift has been driven by a combination of the LRET, the carbon price, increased gas generation and a reduction in demand for grid-supplied electricity. The reduction has been most pronounced in the last 4 years.

Exhibit 1.5: Generation of black and brown coal 2003-04 to 2012-13, index (ESAA 2005-2012, AEMO 2013)[5]



What's driving down coal generation?

The reduction in coal generation has been most pronounced in the last 4 years. Since 2008-09, total coal generation has decreased by 16 per cent, mostly driven by a 16 per cent reduction in black coal generation, as well as a 15 per cent reduction in brown coal generation.

While black coal generation has been steadily declining since 2008-09, brown coal generation remained relatively stable until 2011-12. A sharp decrease (12 per cent) in brown coal generation was seen from 2011-12 to 2012-13.

Many factors contributed to this decrease, including flooding and industrial action at Yallourn, the introduction of the carbon price in July 2012 (which is expected to have affected brown coal generators the most given their high emissions intensity), and continued reductions in electricity demand.

The steady decrease in black coal generation, however, suggests that black coal generators have been more heavily affected by the softening demand for grid-supplied electricity and the increase in renewable generation.

When demand for electricity drops, some power stations must reduce the amount of electricity produced. Renewables such as wind farms have a very low marginal cost (the cost to produce one unit of electricity, once the station is built), as they do not require fuel inputs which means they often take precedence over fossil fuel power stations.

The historic growth in total emissions from electricity generation has stalled. While emissions from the sector grew steadily from 2003-04 and peaked in 2008-09 at 7 per cent above 2003-04 levels, this trend has since reversed, with a sharp fall in emissions of 13 per cent between 2008-09 and 2012-13. Emissions from the sector are now almost 3 per cent lower than they were in 2002-03, after having increased steadily between 2002-03 and 2008-09.

2 The volume of greenhouse gases emitted for each unit of electricity produced, e.g. tCO_2 / MWh of electricity produced.
3 More details on analysis in the industry and buildings sectors are in Reports 3 and 4 of the Tracking Progress series.
4 Data for this sector was not available for 2002-03.
5 2012-13 data is based on estimates using National Electricity Market (NEM) data

Latest data suggests that recent reductions in demand for grid-supplied electricity have been primarily from decreases in industrial production, as well as from reductions in auxiliary consumption by coal power plants, a stabilisation in buildings electricity consumption and strong uptake of residential solar PV.

Demand for grid-supplied electricity consumption comes from Buildings, Industry, Agriculture, Transport, losses occurring during the transmission and distribution of electricity from power stations to the locations where it is used, and auxiliary consumption of electricity for the operation of power stations themselves.

While there is data showing the total amount of demand for grid-supplied electricity, there is only incomplete data available on how each of these components that make up this total demand have changed between 2010-11 and 2012-13. We have attempted to estimate the changes, building upon our analysis of the Power, Industry and Buildings sectors. These are the sectors in which demand is expected to have changed significantly over this period.

Auxiliary consumption and transmission and distribution losses: There is comprehensive data on grid-supplied electricity generation by fuel type, which allowed an estimate to be made of auxiliary consumption from power generation plants. This data suggests that strong decreases in black and especially brown coal generation have resulted in an 8 per cent decrease in auxiliary consumption. Coal generation accounted for more than 90 per cent of all auxiliary consumption in 2010-11. Data on grid-supplied electricity generation was also used to estimate transmission and distribution losses, which have been decreasing in line with total grid-supplied electricity consumed.[7]

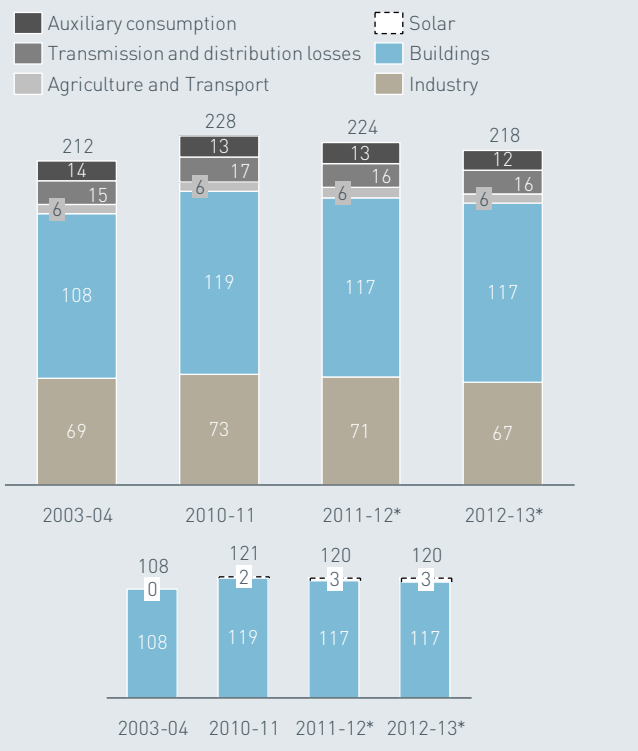
Industry demand for grid-supplied electricity: There is also some data available on the changes in demand for grid-supplied electricity from industrial companies. In order to estimate grid-supplied electricity demand in 2011-12, the 2010-11 data was adjusted to account for changes in grid-supplied electricity use that were reported through the NGERS program and for known changes in manufacuring output in some sectors. In order to obtain 2012-13 estimates, the reduction in grid-electricity use from the closure of the Kurri Kurri Aluminium smelter, which occurred in June 2012 and was estimated to account for 9 per cent of total electricity use in aluminium smelters in 2010-11 (DCCEE 2012, Australian Aluminium Council 2012), was subtracted from the 2011-12 estimates. We also assumed that observed reductions in grid-supplied electricity demand between 2011-12 and 2012-13 that the data does not otherwise explain were from the Industry sector (which corresponds to 0.3 TWh). The resulting estimates suggest that a decrease in industrial output could account for about a 7 per cent reduction in grid-supplied electricity use, or a 5 TWh reduction in two years, which would make up most of the total reduction observed between 2010-11 and 2012-13.

Agriculture and Transport: Consumption for Agriculture and Transport in 2011-12 were taken from the recent BREE energy statistics (BREE 2013), and were assumed to remain constant between 2011-12 and 2012-13.

Buildings demand for grid-supplied electricity: The sector with the least data is Buildings. The estimated buildings grid-supplied electricity usage in 2011-12 was obtained by subtracting the other sectors consumption from total grid-supplied electricity generation. Using the assumptions for other sectors, the analysis suggests that total electricity consumption from buildings has remained relatively stable between 2011-12 and 2012-13, with increased solar PV uptake leading to a slight decrease in demand for grid-supplied electricity. There is a high level of uncertainty on these findings, especially as the data used to estimate industrial electricity use is only partial - the actual saving could have been greater than estimated. However, this preliminary result supports the assumption made in this report that the historical trend of steady growth in buildings electricity use is likely to have started to reverse, at least in the residential buildings sector.

This analysis is preliminary only. Further research would be needed to establish the exact contribution of each sector to the recent changes in demand.

Exhibit 1.6: Estimated grid-supplied electricity use distribution, TWh (BREE 2012, ClimateWorks team analysis)



* Estimates based on data available

7 We have assumed that the rate of auxiliary consumption by fuel type, and the amount of electricity lost in transmission and distribution networks as a proportion of the amount of electricity sent-out into the grid remain constant past 2010-11.

INDUSTRY

Industrial emissions intensity[8] has been improving in recent years, driven in part by a large increase in energy efficiency activity, more self-generation of electricity using gas, and improvement in the emissions intensity of processes in the aluminium and cement industries.

Energy efficiency: Energy use accounts for the largest share of industrial emissions. Between 2007-08 and 2009-10, the annual rate of improvement in energy efficiency across the sector as a whole has been 1.3 per cent of energy use per year. This compares with the most rapid energy efficiency improvement rates internationally, although Australia started from a low base compared to other OECD countries due to historically low energy prices and is now catching up. These improvements have helped reduce the growth in industrial energy consumption, but were offset by strong production growth amounting to a 25 per cent increase in industrial value added[9] between 2002-03 and 2011-12[10].

How companies are improving energy efficiency

Companies interviewed for the Special Report on factors influencing large industrial energy efficiency listed numerous energy efficiency projects delivered in recent years, including:

- Improving cooling tower operational control
- Upgrading boilers (including changing fuels)
- Waste heat and steam capture and re-use projects
- Upgrading lighting
- Installing co-generation plants
- Improving crushing and grinding on Mining sites
- Improving compressed air processes
- Installing variable speed drives on conveyors.

Changes in energy mix: The emissions intensity of industrial energy consumption[11] improved by almost 5 per cent between 2002-03 and 2011-12. Industrial use of grid-supplied electricity has decreased by 8 per cent between 2008-09 and 2011-12 while self-generated electricity and other off-grid electricity use increased by 58 per cent from 2008-09 to 2011-12. Most self-generated electricity uses gas as its fuel input and is less emissions-intensive than grid-supplied electricity. It is mostly associated with growth in the resources sector, often in remote areas. The emissions-intensity of grid-supplied electricity has also declined[12], which has helped to reduce overall emissions intensity of industrial energy consumption.

Industrial processes: Greenhouse gases released as a result of industrial processes (also referred to as process emissions in this report) accounted for 15 per cent of all industrial emissions in 2010-11. The aluminium, iron and steel and cement industries have driven a 10 per cent reduction in their average emissions intensity between 2002-03 and 2011-12 through strong decreases in perfluocarbon (PFC) emissions in the aluminium industry and the use of supplementary materials to replace clinker in cement making.

Reducing aluminium process emissions

Significant effort has been made by aluminium producers to improve the operation of smelters since 1990, resulting in a 95 per cent reduction in perfluorocarbons (PFCs) produced. PFCs are powerful greenhouse gases with over 7,000 times the 100-year global warming potential of carbon dioxide.

The emissions intensity of ammonium nitrate production (used in fertilisers and explosives) has started to decrease in the last few years through the piloting of technologies which transform the nitrous oxide produced in the process into nitrogen gas. Nitrous oxide is responsible for nearly half of all industrial process emissions in the Chemical industry.

Transforming nitrous oxide into thin air

Nitrous oxide (N_2O) has a global warming effect around 300 times greater than carbon dioxide, attracting a high carbon liability.

Chemicals producers are using catalysts to convert nitrous oxide into nitrogen and oxygen, the main components of the atmosphere. This technology can reduce N_2O from chemicals production by up to 85 per cent.

Fugitive emissions: Fugitive emissions released during the extraction, transportation and handling of coal, oil and gas accounted for 19 per cent of total industrial emissions in 2010-11. Improved flaring and venting practices in oil and gas production has reduced the growth in fugitive emissions resulting from substantial production increases in the sector.

8 Emissions intensity has been defined as the amount of emissions produced for each unit of output or other metric, e.g tonnes of CO_2e per $m value added

9 'Value added' refers to the total value of goods and services produced by an industry, after deducting the cost of goods and services used in the process of production (ABS 2013)

10 2011-12 data in this report has been estimated based on recent trends in industrial output and available public data.

11 The amount of emissions produced for each unit of energy consumed

12 See report 2: Power of the Tracking Progress report series for further details

Several projects have been implemented to capture waste coal mine methane for electricity generation, driven by government incentives for carbon abatement. However carbon price uncertainty has restricted the pipeline to only a few projects. The reduction in emissions achieved through improvements in waste methane capture appear to have been offset by an increase in the average emissions intensity of coal production due to increased coal mining in regions with particularly 'gassy' geology.

Combined, the activities described above have helped to decrease the overall emissions intensity of Australia's industrial output by an estimated 10 per cent between 2002-03 and 2011-12. In other words, despite strong growth over this period (in particular in mining and resources) which saw industrial value added grow by 25 per cent, emissions from the sector are estimated to have grown by only 13 per cent.

Boral ENVISIA™ concrete reduces carbon by over 40%

Boral is one of Australia's largest manufacturers of concrete, cement, bricks and other construction and building materials.

Clinker is the main ingredient used to make cement. Approximately half of Boral's cement emissions in any year are from emissions released during production of clinker.

Boral has recently developed a technology (ZEP™) which can reduce the overall embedded carbon of the final ENVISIA™ concrete product by well over 40 per cent. The emissions reduction is achieved without affecting the strength or durability of the concrete product.

Full case study available in Report 3: Industry of the *Tracking Progress* report series.

Drivers of industrial energy efficiency

In-depth interviews with energy or environmental managers (or similar role) from large industrial companies indicate that a range of factors have led to increases in energy efficiency activity.

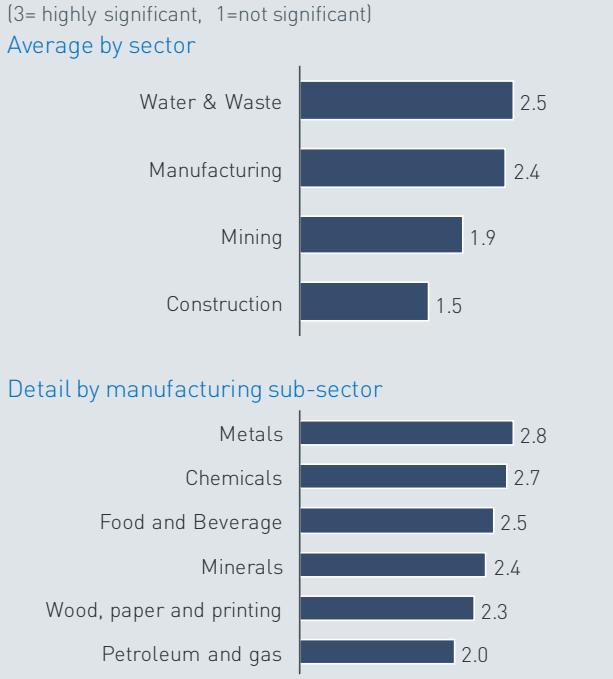
The most significant influencing factor mentioned by companies interviewed was energy price rises. Other factors cited as significant included the carbon price and Energy Efficiency Opportunities (EEO) program.

Eighty two per cent of respondents indicated that the carbon price has had a highly or moderately significant impact on their energy efficiency activity, with 41 per cent stating it has had a highly significant impact.

Among respondents, the carbon price impact appeared to differ by sector (see Exhibit 1.7), but the most significant impact was to increase senior management focus and attention devoted to managing current and future carbon risks and liabilities.

See Report 6: Special report on factors influencing large industrial energy efficiency) of the *Tracking Progress* report series for further detail.

Exhibit 1.7: Average reported impact of carbon price on improving energy efficiency by industry sector and manufacturing sub-sector (ClimateWorks team analysis)



BUILDINGS

The energy intensity of Australia's buildings has decreased by 3 per cent between 2002-03 and 2010-11, led by improvements in the operation of buildings, improved energy efficiency standards, more efficient appliances and distributed energy.

New commercial buildings: New building standards are estimated to have delivered about a 32 per cent reduction in emissions from office base buildings. This comprises heating, cooling, ventilation, common area lighting and elevators but only accounts for around 12 per cent of commercial building energy use. Lack of data prevents accurate estimates of recent changes in office tenancies and other commercial building types.

Existing commercial buildings: Energy intensity of the building stock overall has improved slightly (2 per cent) over the last 10 years, driven by a small number of market leaders and capture of 'low hanging fruit' in other buildings.

Other than in large offices, activity has been patchy and fragmented and often linked to government incentives and white certificate schemes.

Expanding the base of market leaders

Rating tools, predominantly Green Star and NABERS, have helped reduce the emissions intensity of commercial buildings.

The Green Star tool provides a framework for the design and construction of high performing buildings, with the lowest rating requiring best practices to be demonstrated. The tool provides a rating based on the building's design in a number of areas of environmental impact, focusing on minimising energy and emissions. On average, Green Star office buildings emit 45 per cent fewer emissions than new office buildings built to current efficiency standards.

The NABERS rating tool is predominantly used to assess the emissions intensity of building operations. Since its inception in 1998 participation has increased, with two thirds of Australia's commercial office building stock rated in 2011-12. Large institutional property owners have led the uptake of NABERS, using the tool to assess their premises and re-rate following building upgrades. In 2010 the proportion of buildings performing at or above best practice was so high that the NABERS scale was extended to 6 stars to diversify the market leaders.

Today, these tools are supporting significant improvements in high-end commercial offices, driven by competition for tenants. Penetration in other building types is increasing but still only a small proportion in most sub-sectors.

Buildings using energy more efficiently

Buildings can generally improve energy efficiency by:

- Upgrading appliances and equipment such as lights and heating and cooling systems
- Retrofitting the building fabric to improve its ability to retain heat in winter and prevent or slow heating in summer, for example by installing double glazed windows or insulation
- Using building control systems which ensure that heating and cooling systems are only operated at the level required to meet demand in the building, or engaging staff and tenants to avoid energy waste, for example by switching off computers at night.

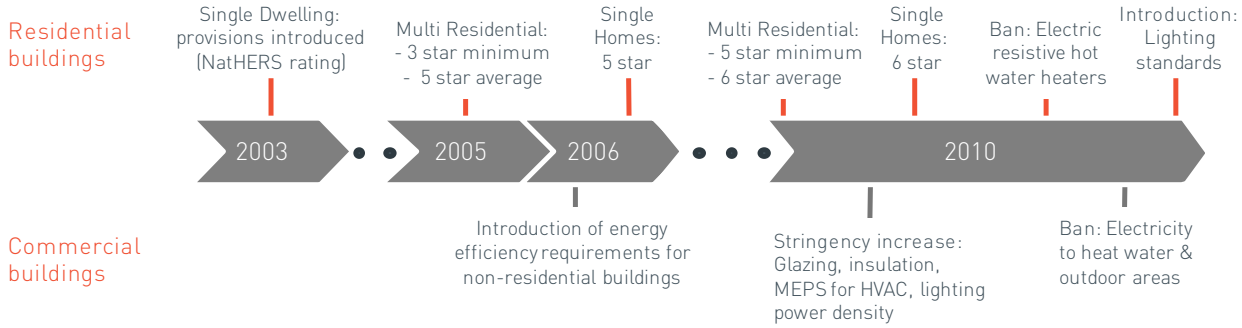
New residential buildings: The maximum allowable energy intensity for heating and cooling has decreased on average by 17 per cent since 2009-10 when building fabric standards were increased.

Existing residential buildings: Across the residential building stock as a whole there has been a slight (2 per cent) decrease in energy intensity, due mostly to improvements in appliance efficiency, hot water and lighting.

Distributed energy: The rapid uptake of small scale solar has contributed to slowing down demand for grid-supplied electricity from homes. More than one million Australian homes now have a solar PV system installed, representing a five-fold increase from 2008-09 to 2011-12. In 2012 Australia had the highest number of residential solar installations in the world. Commercial buildings have had strong uptake of co- and tri-generation, however no comprehensive dataset exists.

These activities, combined with the decrease in the emissions intensity of grid-supplied electricity (see Power section above), have helped to slow the growth in emissions resulting from additional new buildings, and increased ownership of appliances. Between 2002-03 and 2010-11, commercial building floor space increased by about 17 per cent and the number of households by 12 per cent, but over the same period total emissions from buildings increased by only 8 per cent.

Exhibit 1.8: Timeline of energy efficiency measures as added to the Building Code of Australia (ABCB 2010, Wilkenfeld & Associates 2007, Lighting, Art + Science 2009)



Standards as a tool to improve energy efficiency

In 2010, there were strong improvements in the energy efficiency standards for both residential and commercial buildings. These changes have helped to reduce the amount of heating and cooling required, improve lighting efficiency by reducing lighting power density, and eliminate new electric hot water heaters. States and territories choose whether to adopt the changes, which are set by the Australian Building Codes Board (ABCB).

The National Construction Code (NCC) now contains a range of energy efficiency requirements, including requirements relating to the building itself – such as glazing, insulation and draught proofing – as well as major energy using equipment such as heating and cooling systems, water heating and lighting.

However, there is some concern that there is insufficient post-construction verification to ensure compliance. Research by QUT (Queensland University of Technology) demonstrates that many homes are not performing as expected.

Minimum Energy Performance Standards (MEPS) are mandatory minimum standards that a range of appliances must meet in order to be sold in Australia. Appliances that are currently covered by MEPS include refrigerators, motors, water heaters, air-conditioners and a range of lighting products.

The rise of solar PV

Solar photovoltaic (PV) panels have become extremely popular for Australian homes, incentivised through government programs such as the Small Scale Renewable Energy Scheme (SRES) and feed-in tariffs (which guarantee that solar panel owners will be paid a certain price for excess electricity generated by their systems and fed back to the grid), as well as rising electricity prices.

Solar panel technology allows the conversion of sunlight into electricity, which is either directly used in the home or exported to the grid to be used by neighbouring homes and businesses.

The technology has rapidly improved over the decade. The average 1.5 kW sized system now costs around a quarter of what a similar system would have cost in 2003[13].

There have been fewer solar PV installations on commercial buildings, but some companies are predicting strong growth in the future as building owners hedge against rising electricity costs.

13 At June 2013, average price including installation across Australia from market data (Solar Choice 2013) was $3,700 whereas it was approximately $15,000 in 2003 (Watt 2012)

LAND-USE AND WASTE

Reforestation and large reductions in deforestation have led a 32 per cent reduction in emissions from Land-use and Waste over the last decade.

Deforestation: The annual deforestation rate fell by more than half from 2003 to 2011[14]. This reduction was mostly driven by state land clearing regulations in New South Wales and Queensland and poorer economic outlook for farmers which reduced the incentive to clear land. The reduction in deforestation resulted in a decrease in emissions of 60 $MtCO_2e$ in 2011 compared to a peak in emissions in 2005. This emissions reduction is equivalent to eliminating around 80 per cent of emissions from brown coal generation in Australia from 2010-11.

Reforestation: Significant areas of plantation forest were established over the decade in response to investment incentives, which, combined with plantings from the previous decade, doubled carbon sequestration from forests.

However, the rate of new plantations has decreased since 2008 and now represents less than 3 per cent of the rate at the peak. In 2012, the area of plantation forests cleared exceeded new plantings, resulting in a reduction in the total plantation estate for the year.

Waste: Emissions from waste treatment facilities such as landfills and wastewater treatment account for 12 per cent of total emissions from Land-use and Waste. The combustion of waste gases from these facilities through flaring or for power generation has reduced overall emissions, despite an increase in the volume of methane produced from these sites.

Between 2002-03 and 2010-11, there has been a 60 per cent increase in abatement of captured waste gas, which is used to generate enough energy to power over 200,000 homes each year.

Methane capture and combustion

Methane is produced by many activities in Land-use and Waste including agricultural manure and landfills. Methane is a greenhouse gas with more than 20 times the global warming potential of carbon dioxide.

These gases can be captured by covering landfills or animal waste collection ponds. The gas is then burnt which converts methane into carbon dioxide and water. This reaction produces heat which can be used to generate electricity, while reducing the global warming potential of the gases.

Agriculture: Emissions from livestock such as cattle, sheep and pigs account for slightly more than half of emissions from Land-use and Waste.

The majority of these emissions are from cattle, produced during digestion (the enteric fermentation process) and belched into the atmosphere or emitted from manure.

A reduction in the number of sheep in the last decade due to the prolonged drought conditions led to a reduction in emissions from livestock over this period.

While methodologies have been developed to reduce enteric emissions, there has been limited uptake to date due to cost and technological uncertainty.

There has been greater adoption of projects to destroy gas produced by manure, particularly at piggeries which are now beginning to capture this waste methane to use as a direct fuel for electricity generation.

Overall, emissions from forestry, agriculture and waste fell by 32 per cent from 2003 to 2011, offsetting growth in emissions from all other sectors of the economy.

Pork power – When a pig farm becomes a power station

Blantyre Farms near Young in New South Wales was the first piggery in Australia to secure approval to participate in the Carbon Farming Initiative (CFI) scheme through capturing and destroying methane from effluent ponds to generate energy.

Michael and Edwina Beveridge, who own and operate the farm, covered effluent ponds so that gases produced could be collected and used to power a biogas system to generate electricity from manure.

The biogas system features three 80 kW generators with an integrated heat exchanger that can be used to provide warmth for piglets in winter.

The system has not only eliminated the farm's $15,000 a month electricity and gas bill but actually earns $5,000 a month from electricity sold back to the grid. This removes the risk of rising energy prices eating away at the farm's profit margins.

The upgrades to the farm have already been credited with reducing emissions by 8,000 tCO_2e under the CFI.

The Beveridges expect to earn $175,000 per year from the sale of carbon credits. Along with revenue from energy generated, they are expecting to return their investment within two years.

14 Note that forestry emissions are reported per calendar year, whereas emissions for the rest of the inventory are calculated by financial year

1.3.2 Outlook to 2020

Without any further actions to reduce emissions, economic growth between 2010-11 and 2019-20 would drive a 29 per cent increase in emissions (162 $MtCO_2e$) over this period[15].

This growth would mostly come from:

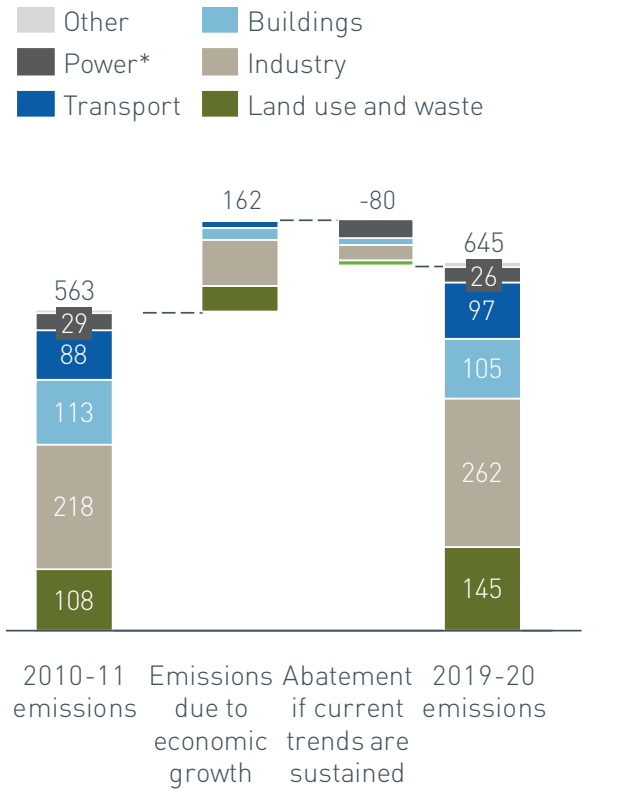
- a 30 per cent (44 $MtCO_2e$) increase in emissions from industrial energy use, particularly associated with growth in coal mining (44 per cent) and metal ore mining (98 per cent), and LNG production (256 per cent)[16]
- an increase in fugitive emissions associated with increased coal mining and oil and gas extraction (29 $MtCO_2e$)
- harvesting (and not replanting) of plantation forests.

However, if recent levels of emission reduction activity are sustained, Australia's emissions would be reduced by 80 MtCO2e to be 645 MtCO2e in 2019-20.17 This would get Australia over 40 per cent of the way towards the minimum 5 per cent emissions reduction target by 2019-20 through domestic action.

Around 73 per cent of the opportunity identified in the *Low Carbon Growth Plan for Australia* would remain uncaptured, and the remaining years from now to 2019-20 provide time to identify increased incentives that could help capture these opportunities for local action, which could deliver a 25 per cent reduction in our national emissions compared to 2000 levels (equivalent to 424 $MtCO_2e$ total national emissions in 2019-20). This is in line with what IPCC scientists have recommended for developed nations. Between now and 2019-20, there also remains time to consider the role of international offsets in achieving our national targets, and to consider increasing the current minimum 5 per cent target (equivalent to 527 $MtCO_2e$ national emissions in 2019-20).

Whether recent trends can be sustained or increased is dependent on a range of factors including future electricity and fuel prices (particularly gas prices), technological improvements, sustaining current levels of regulatory support and incentives, and resolution of regulatory barriers and policy uncertainties (see section 1.4.7 below for further detail on the key areas of uncertainty that could influence future trends).

Exhibit 1.9: Australian emissions, $MtCO_2e$ (DIICCSRTE 2013a, ClimateWorks team analysis)



* Represents the remainder of Power emissions (after emissions from grid-supplied electricity have been attributed to Industry and Buildings) and all abatement achieved through power generation

15 Please note that this differs from estimates of emissions growth under a business-as-usual scenario such as the estimates in the Australian Government's emissions projections reports. A detailed description of the differences between the approach taken in the Tracking Progress report series and the government's projections is presented in section 1.4.8.
16 Despite no assumed growth in manufacturing.
17 This estimate is based on current expectations of future economic activity, as well as the current policy environment continuing as it is today.

POWER

Assuming the Renewable Energy Target is met, and if other abatement trends in the power sector are sustained, power sector emissions would continue to fall slightly to 2019-20 with new renewables supplying more than the additional demand for grid-supplied electricity.

Without any further emissions reduction activity in the Industry and Buildings sectors, higher demand for grid-supplied electricity from more industrial activity, growth in total building stock and increased use of appliances would put upward pressure on power sector emissions between now and 2019-20. In this case, if the emissions intensity of grid-supplied electricity were to remain constant at 2009-10 levels, emissions from the Power sector would grow by 32 $MtCO_2e$ between 2010-11 and 2019-20.

However, a range of factors are expected to see the power sector reduce its overall emissions from 173 $MtCO_2e$ in 2012-13 to 171 $MtCO_2e$ by 2019-20, leading to a 11 per cent decrease in emissions intensity of grid-supplied electricity from 2012-13 to 2019-20.

Demand: Existing policies and trends in the Buildings and Industry sectors are expected to keep demand for grid-supplied electricity low, with a net increase of 6 per cent in grid-supplied electricity demand expected between 2010-11 and 2019-20 (compared to 2012 forecasts of around 14% growth over the same period).

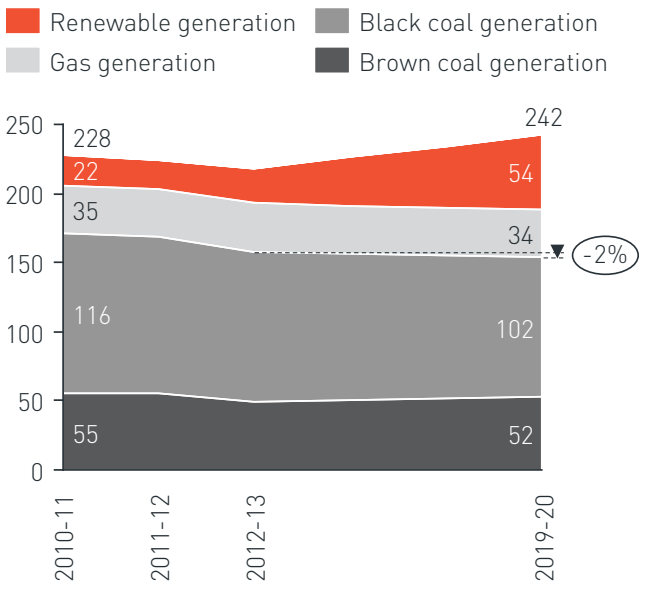
Renewables: The LRET is expected to continue to drive new renewable energy projects. Fewer than half of the projects currently in the pipeline would be required to meet the LRET, although implementing the projects needed to meet the LRET would require a significant increase in the rate of construction of renewable generation assets.

Fossil fuels: An increase in renewables and soft demand for grid-supplied electricity are expected to lead to a decrease in generation from coal and gas. If recent trends are sustained, generation from existing coal assets would further decrease by 2 per cent from 2012-13 to 2019-20 (see Exhibit 1.10).

If recent trends in abatement activity are sustained, around 32 per cent of the abatement potential identified in the *Low Carbon Growth Plan for Australia* for this sector would be captured by 2019-20.

Future demand for grid-supplied electricity, the availability of renewable technologies at reasonable cost, the carbon price and future fuel prices – in particular gas prices – are the key influencing factors that will determine whether current trends are sustained or can be increased.

Exhibit 1.10: Outlook for generation mix to 2019-20, TWh (ESAA 2005-2012, AEMO 2013, ClimateWorks team analysis)



Future changes in technology costs

Relative costs of generation technologies will be influenced by a number of factors, in particular:

- **Gas prices**. The rapid development of Australia's gas resources and export market is widely expected to drive up domestic gas prices, as they move closer to the higher international prices. The Grattan Institute estimates that domestic gas prices will likely rise by more than 80 per cent (Grattan Institute 2013). With this kind of increase in gas prices, the business case for new gas power plants could be undermined, and the costs for existing gas power plants could increase.
- **Renewables technology costs**. Wind and hydro are likely to remain the cheapest renewable technologies to 2019-20, with the cost of wind generation expected to fall below $100/MWh by 2019-20. Further funding assistance from the Australian Government could further reduce the cost of implementation locally, increasing the attractiveness of renewable generation.
- **Carbon price**. Further carbon price increases would reduce the competitiveness of black and brown coal generators relative to lower emissions technologies, including gas and renewables. For example, with a carbon price of $\$50/tCO_2e$, wind generation becomes more attractive than black and brown coal generation. More certainty around the carbon price, however, will be required to drive long term investment decisions.

INDUSTRY

If recent trends in the improvement of industrial emissions intensity continue, this would offset a portion of the strong expected growth in emissions that could result from increasing industrial production.[18]

Australia's Industry sector is expected to continue to grow strongly between 2010-11 and 2019-20, despite no growth assumed in manufacturing. Growth is expected to be particularly strong in LNG production (256 per cent), coal mining (44 per cent), metal ore mining (98 per cent) and alumina production (50 per cent).

Without any further emissions reduction activity, this growth would drive an increase in total emissions from the industrial sector of 37 per cent by 2019-20, making industry the largest contributor to Australia's emissions growth between now and 2019-20. If recent trends in abatement activity are sustained, this growth in emissions would be reduced from 37 per cent to 20 per cent.

Energy efficiency: Continuation of the recent high levels of industrial energy efficiency improvement is possible, and would lead to a 9 per cent improvement in energy intensity between 2010-11 and 2019-20. Recent trends have been driven by a combination of factors including electricity price rises and government policies which have also led to improvements in energy management skills. Future trends in these areas, as well as future technological improvements and other macroeconomic factors, will determine whether these rates of energy efficiency improvement can be sustained.

How will Australia's industrial mix evolve?

Future industrial emissions are highly dependent on future industrial activity and production. In order to estimate future activity, ClimateWorks has adjusted the Australian Treasury's *Strong Growth, Low Pollution* forecast based on the most recent Australian Government emissions projections, and consultation with experts.

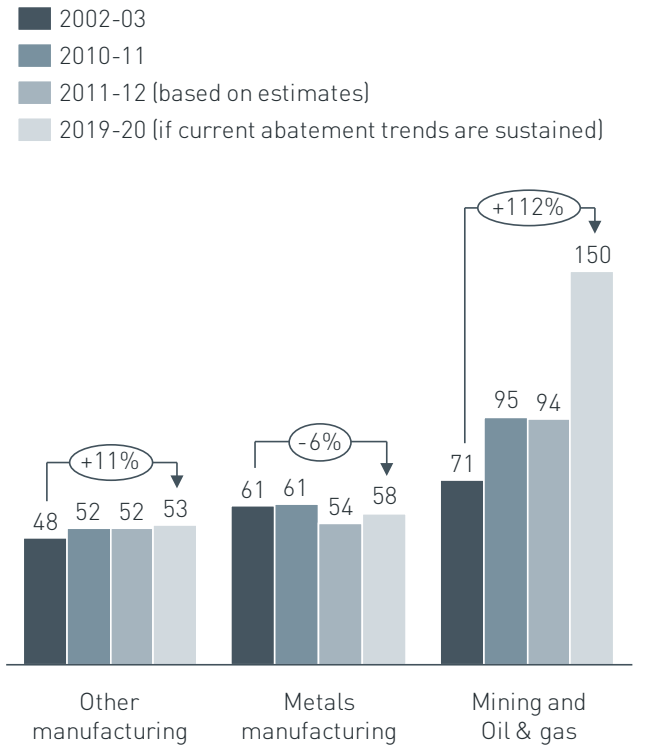
Our best estimate indicates a reduction in manufacturing activity (except alumina production), especially in the most energy-intensive sub-sectors, in contrast with growth in the resources sector particularly in gas production (driven by LNG exports), metal ore and coal mining.

LNG (liquefied natural gas) production in particular is expected to experience a boom in coming years. LNG is natural gas that has been compressed and converted to a liquid in order to allow it to be transported, which may be required where it is not feasible or economic to build a pipeline. Global demand for gas is rapidly increasing, with the International Energy Agency forecasting a doubling of gas consumption between 1990 and 2020[18]. As a result, Australia's vast reserves of conventional and coal seam gas are currently being rapidly developed and converted to LNG for export.

Exhibit 1.11 shows the expected impact of these structural changes on industrial emissions.

There is a high level of uncertainty around the future direction of some sub-sectors, in particular LNG production and some mining sub-sectors. Future production levels in these sub-sectors will be strongly driven by commodity and resource prices.

Exhibit 1.11: Emissions from industrial subsectors, $MtCO_2e$ (DIICCSRTE 2013a, BREE 2012, ClimateWorks team analysis)



Changes in energy mix: Overall, the shift towards self-generated electricity and lower emissions fuel sources (mainly gas) is expected to continue, driven by developments in remote areas and increased production of LNG which is primarily powered by gas. However, if gas prices increase significantly, this may trigger a return to more emissions intensive coal in some sub-sectors that are highly sensitive to energy costs.

Industrial processes: The emissions intensity of process emissions is on track to improve markedly, with cement and chemicals process improvements likely to drive a 12 per cent improvement in industrial process emissions intensity overall between 2010-

18 IEA 2012.

11 and 2019-20. The cement industry is on track to reach best practice in terms of use of supplementary materials by 2019-20, and nitrous oxide abatement technology is likely to be used in all ammonium nitrate production sites by 2019-20. Reductions in emissions as a result of reduced production of iron and steel and aluminium are also expected. These are expected to be counterbalanced by emissions from refrigerant gases, as a greater proportion of refrigerants are captured in Australia's emissions inventory.

Fugitive emissions: If current trends are sustained, continued reductions in fugitive emissions from conventional oil and gas production are expected, while carbon capture and storage is planned at the new Gorgon gas project which will further reduce growth in vented carbon dioxide. Policy and economic uncertainty are expected to limit uptake of future waste coal mine gas abatement projects. Fugitive emissions from coal seam gas production are particularly uncertain and the methodologies to estimate fugitive emissions from coal seam gas are currently under review.

If recent trends in these emissions reduction activities are sustained, around 57 per cent of the abatement potential identified in the *Low Carbon Growth Plan for Australia* for this sector would be captured by 2019-20.

The importance of policy certainty for waste coal mine gas capture

The release of Waste Coal Mine Gas (WCMG) is a potentially hazardous and particularly greenhouse intensive part of the coal mining process. The gas, which is composed mostly of methane can be collected and burned to produce electricity, turning it into much less potent CO_2 and reducing emissions from consumption of grid-supplied electricity.

Clean energy company Energy Developments Ltd (EDL) developed the first large scale WCMG facility in 1996, and its latest project at Anglo American's Moranbah North mine displaces around 1.3 million tCO_2e per year and produces enough energy to power around 48,000 homes.

Waste coal mine gas generation is not generally feasible without carbon revenue. Investment in this technology is therefore dependent on policy certainty ensuing that this revenue is available for the life of the project. Relative policy certainty under the NSW Greenhouse Gas Reduction Scheme (GGAS) facilitated the progress of 5 major WCMG power projects leading to the delivery of about 110 MW of new clean energy capacity.

The full case study is available in Report 3: Industry of the *Tracking Progress* report series.

Unlocking further industrial energy savings

Of the industrial companies interviewed, those that identified and implemented the most energy savings saved three times more energy than average companies and ten times more than those who identified and implemented the least. This suggests that there remains considerable scope for additional energy savings within the industrial sector.

A number of energy management practices were reported to be particularly effective in helping companies achieve energy savings.

Respondents that reported a high score for *Regular analysis of energy data*, *Energy included in policies and operational guides*, and *Senior management oversight of energy* achieved three times more energy savings than companies that reported a low score for those practices.

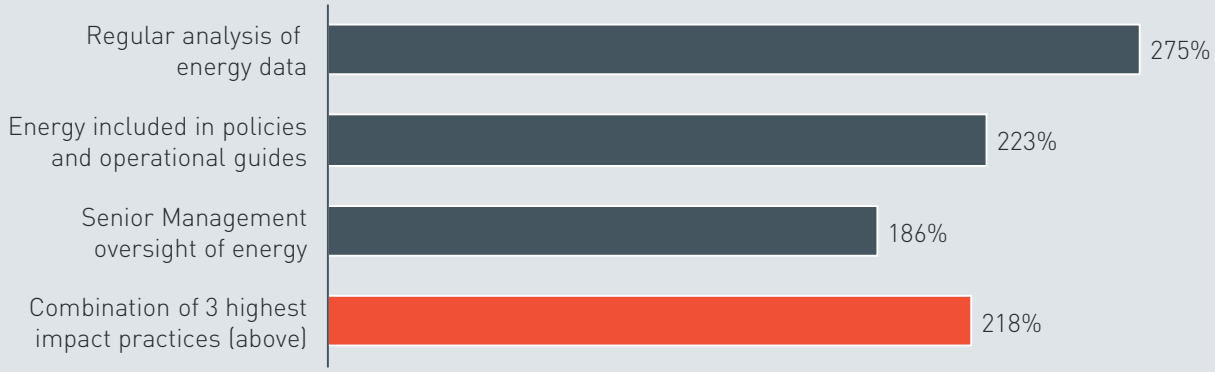
Wider adoption of these practices could help other companies to increase energy savings.

Preliminary findings of ClimateWorks' research for the Industrial Energy Efficiency Data Analysis Project (IEEDAP, available at www.climateworksaustralia.org/industrial-energy-efficiency-data-analysis) found that companies have not yet implemented about 60 per cent of savings identified and reported through government programs such as EEO.

In interviews for the Tracking Progress report series, companies regarded access to internal capital, the payback period of energy efficiency projects, opportunity cost and operational risk as key reasons those savings are not being implemented.

See Report 6: Special report on factors influencing large industrial energy efficiency in the *Tracking Progress* report series for further detail.

Exhibit 1.12: Percentage of additional savings achieved for companies with a high score for the practice compared to companies with a low score , % of energy use (DRET 2008-2011, ClimateWorks team analysis)



BUILDINGS

Despite strong expected growth in the number of homes and commercial buildings, a continuation of recent trends in emissions reduction activities would drive a 7 per cent reduction in buildings emissions between 2010-11 and 2019-20.

Without further activity to reduce emissions, building emissions would be expected to increase by almost 19 per cent to 2019-20, from 113 $MtCO_2e$ in 2010-11 to 135 $MtCO_2e$ in 2019-20. The rise would come mostly from an increase in the number of new homes and commercial floor space. Continuation of recent trends in emissions reduction activity would more than offset this growth, resulting in a net 7 per cent reduction in emissions between 2010-11 and 2019-20.

New commercial buildings: Buildings constructed between 2012-13 and 2019-20 will make up 23 per cent of all commercial floor space by 2019-20. These buildings will be constructed to meet NCC 2010 standards (to date no further increases to standards have been proposed). Current registrations of Green Star projects suggests that Green Star rated offices will represent 50 per cent of all new offices built between 2013 and 2017. A growing number of other buildings (e.g. education) are also using Green Star.

Existing commercial buildings: The energy intensity of the commercial building stock would improve by 3 per cent by 2019-20 if recent trends of 0.3 per cent annual improvement are sustained. Key factors that will influence the level of future activity include improved building monitoring and automation, upgrades to lighting and improvements to heating, cooling and ventilation systems. Flexible financing, government grants and white certificate incentives could drive further improvements.

New residential buildings: Between 2011-12 and 2019-20 the number of households is expected to increase by 0.9 million. These homes will be constructed to meet NCC 2010 standards. Recent adoption of increased standards in NSW and Tasmania would provide an additional 8 per cent reduction in the maximum allowable energy intensity for heating and cooling from 2010-11. Further abatement could be realised by providing information on low emissions homes to home buyers and tenants.

Existing residential buildings: The strongest improvements in buildings could come from reduced residential elecricity demand. The latest national statistics are from 2010-11, and they show a slight increase in electricity use per household up until that year. More recent data[19] suggests this trend is reversing, due the 2010 building standard improvements and improved MEPS for refrigerators, televisions, stand-by power, computers and monitors.

Distributed energy: The uptake of distributed energy is expected to remain strong despite recent regulation changes including the removal of feed in tariffs, and amendments to NABERS regulations for co-generation. If current trends continue residential solar would more than triple by 2019-20. Commercial solar installations have taken longer to gain traction however the business case is becoming more attractive as electricity prices continue to rise and businesses focus on reducing emissions. Further uptake of co- and tri-generation is expected to be encouraged through Green Star ratings and the Greener Government Buildings program.

Building energy performance disclosure

Building energy performance disclosure schemes are aimed at providing prospective building purchasers and tenants with the information required to assess the energy performance, and therefore the probable energy costs of running a building.

The introduction of energy performance disclosure for large commercial buildings in 2010 has revealed both a growing group of market leaders and a large group of buildings that have been slow to act. Of all buildings assessed, 39 per cent exhibited better emissions intensity than new builds (at or above a 4 stars NABERS rating). However, 11 per cent of buildings had a rating of 0 star. These buildings consumed over twice as much energy per square metre as market leaders, which would lead to significant differences in energy bills.

The Australian Capital Territory's House Energy Rating Scheme requires building owners to obtain a rating which must be provided to prospective buyers or tenants when the building is being leased or sold. It is currently the only residential building disclosure scheme in Australia. Results from the scheme demonstrate that there have been financial benefits for home owners who improve the energy performance of their homes. .

19 Further detail is presented in the full Buildings sector report, report 4 of the Tracking Progress series

Bringing low emission homes into the mainstream

Positive Footprints is a Victorian-based company that designs and builds affordable low emission homes. The company has standard designs for 9 Star NatHERS rated homes which need only one third of the energy for heating and cooling of standard 6 star homes.

Common design features include passive solar design, a high degree of insulation, tight building fabric to prevent air leakage, excellent ventilation, reversible ceiling fans for cooling, high efficiency LED and compact fluorescent lighting, solar PV system, solar hot water with gas booster, and Green Switches to eliminate standby power when appliances are not in use. Penola house (above right) is one such example.

Greener Victorian Government Buildings

Buildings account for 70 per cent of the Victorian Government's energy use. The Department of Treasury and Finance initiated the Greener Government Buildings program to reduce emissions from government owned assets through the use of energy performance contracts.

As at July 2013, facilities representing 24 per cent of the Victorian Government's total energy use had projects implemented or in progress. These 33 projects are forecast to deliver a net financial benefit of over $400 million and a greenhouse gas savings representing 9 per cent of the Victorian Government's footprint. The 5 projects completed to date have delivered an average 36 per cent emissions reduction. Almost 50 per cent of projects include co- or tri-generation.

"Never before has the Victorian Government, or any property owner that I'm aware of, delivered such substantial energy and greenhouse gas savings, and such significant financial returns, at such low risk." Sam Burke, Program Manager.

Australia's first Zero Carbon Precinct

Barangaroo South is Australia's first large scale carbon neutral precinct. It is a mixed use redevelopment of the southern 7.5 hectares of a former container wharf in Sydney's CBD.

The project integrates sustainability into its design, including the adoption of a neighbourhood scale, shared infrastructure approach to services benefiting the wider Sydney community.

Design features include best practice design for buildings utilising Green Star, NABERS and BASIX rating tools, promotion of energy efficienct appliances, on-site solar generation, and investment in offsite renewable energy.

The site is predicted to contribute approximately 50,000 tonnes of CO_2e abatement annually, equivalent to taking more than 12,000 cars off the road. as well as generating more renewable energy than it uses.

LAND-USE AND WASTE

Under current economic and policy conditions, limited emissions reduction activities in Land-use and Waste are being implemented. Without a change in these conditions emissions would increase over the next decade, as plantation forests are harvested and agricultural production recovers after a prolonged period of drought.

If recent trends in emissions reduction activity continue, only a small number of projects would be implemented between now and 2019-20.

This abatement would not be sufficient to offset the strong expected growth in emissions, resulting from a reduction in carbon sequestered by plantation forests (due to a significant reduction in plantation rates and expected conversion of forests deemed unviable for replanting after harvest) and a recovery in agricultural production after the prolonged recent drought. In this scenario, emissions would increase by 42 per cent, from 108 $MtCO_2e$ to 153 $MtCO_2e$. If recent trends continue, emissions would be reduced to 145 $MtCO_2e$.

Deforestation: There are no significant projects currently observed to reduce deforestation emissions, and changes to land clearing regulations in Queensland could actually increase the rate of deforestation between now and 2020.

Avoided deforestation has recently become eligible for credits under the Carbon Farming Initiative (CFI), but the extent of abatement from this activity will depend on the future price of carbon.

Afforestation: While some forms of reforestation can earn revenue under the CFI, there is still very limited reforestation activity expected to take place under current settings due to expectations of low future carbon prices and policy uncertainty.

Reforestation projects rely on long-term revenue from government incentives such as the CFI and the carbon price in order to make them profitable, and as such there is a need for long-term certainty around the existence of these policies, and around the future price of carbon.

Waste: Continued implementation of landfill and wastewater gas capture and combustion projects in line with recent trends would increase abatement from these projects by 48 per cent between 2010-11 and 2019-20.

There are already 45 MW of new electricity generation projects from landfill gas in development, with a further 18 MW under assessment. Recent increases were particularly strong in wastewater treatment plants, and if recent trends were sustained, then on average plants in Australia would abate 60 per cent of their waste methane by 2019-20, which corresponds to best practice today.

Talent to burn: using indigeneous knowledge to better manage savanna landscapes

For hundreds of generations, Indigenous people have been using fire in the landscape. This traditional knowledge may prove key to sustainable management of Australia's northern landscapes. Burning was done to encourage new growth, to help with hunting, and for ceremonial purposes. It also helped to protect important places and resources from destructive and unmanaged late dry season wildfires.

Currently, fires across northern Australia produce around 3 per cent of Australia's total emissions, including through the release of methane and nitrous oxide. Traditional burning practices can reduce these emissions by reducing the intensity of late season fires.

Through partnerships with local communities and scientists, NAILSMA are demonstrating how traditional burning of northern savanna landscapes reduces wildfires, creates a patchwork of habitats for plants and animals, and reduces greenhouse gas emissions from fires.

Current projects using these enhanced fire management methods already contribute 110,000 tCO_2e of abatement per year, equivalent to removing almost 30,000 cars from the road. The development of a methodology in the CFI means that these abatement methods can be used to earn revenue which can help fund further projects.

The full case study is available in report 5: Land-use and Waste from the *Tracking Progress* report series.

Agriculture: projects such as savanna fire management and piggery methane destruction could deliver 1.1 $MtCO_2e$ of abatement per year by 2019-20.

Enhanced vegetation through improved management of rangelands has the potential to contribute a further 2.6 $MtCO_2e$ of abatement if projects identified in the pipeline are realised. The delivery of this abatement is contingent on the ongoing business viability of projects.

If recent trends are sustained, only around 8 per cent of the abatement potential identified in the *Low Carbon Growth Plan for Australia* for Land-use and Waste would be captured.

1.3.3 How do different sectors compare?

The emissions reduction activities that have grown most strongly between 2002-03 and 2012-13 are:

- A strong decrease in the annual rate of deforestation and an increase in afforestation have allowed net forestry emissions to decrease by 80 per cent while emissions from all other sectors of the economy were increasing. As a result, **forestry emissions accounted for just 2 per cent of Australian emissions in 2010-11, whereas they represented 10 per cent of emissions in 2002-03.** Overall, the reduction in Land-use and Waste emissions has counterbalanced the increase in emissions from all other sectors between 2002-03 and 2010-11.
- **Renewable energy generation has increased very significantly** since 2003-04, in particular due to the strong emergence of wind and solar PV generation. Emissions from electricity generation account for more than a third of Australia's emissions, and they have for the first time started to decrease in the past few years, as a result of both a slow down in demand for grid-supplied electricity, and a shift towards cleaner electricity generation.
- **There has been a three-fold increase in the amount of annual energy savings in Industry.** Industrial energy use accounts for about a quarter of Australian emissions, and has been the largest contributor to Australian emissions growth between 2002-03 and 2010-11 following strong growth in industrial production. Improvements in energy efficiency mean that in the future the emissions from industrial energy use will grow more slowly than industrial production.

Looking forward to 2019-20, if recent trends are sustained:

- **The largest emissions savings would come from the Power sector** (32 $MtCO_2e$), where a strong increase in renewable generation (driven by the large-scale Renewable Energy Target) combined with a continued slow down in demand for grid-supplied electricity would reduce generation from fossil fuels and in particular black coal.
- The second largest emissions savings would come from the Industrial sector (27 $MtCO_2e$), with **strong emissions reductions from a sustained high level of implementation of energy efficiency**, as well as an expected step change in industrial process emissions from the chemical sector (thanks to nitrous oxide abatement technology).
- Nearly half that amount again (12 $MtCO_2e$) would come from emissions reduction activities in buildings, and in particular in residential buildings where **recent data suggests that the historical increase in electricity use per household is likely to reverse**, driven by improvements in the efficiency of new builds and appliances as well as behaviour change in response to increased electricity prices. In addition, solar PV installations are expected to continue to increase strongly in the next few years.
- **A small amount (8 $MtCO_2e$) would come from the land sector**, where policy uncertainty and low expected carbon revenues are expected to limit abatement activity. Changes in deforestation regulations may also result in emissions significantly higher than government forecasts.

This activity would offset a portion of the growth in emissions expected from economic growth between 2010-11 and 2019-20, led by strong growth (81 $MtCO_2e$) in industrial emissions, particularly from LNG production, and mining.

- **The expected growth in industrial emissions with no further abatement activity to 2019-20 is equivalent to the total emissions reductions that would be achieved if recent trends in all sectors were sustained** (80 $MtCO_2e$), and is equivalent to more than 70 per cent of the total emissions from buildings (113 $MtCO_2e$ in 2011).
- After a long period of decrease, emissions from forestry are also expected to increase strongly (36 $MtCO_2e$) as plantation forests are harvested and not replanted, with expected emissions in 2020 (46 $MtCO_2e$) more than quadrupling compared to 2011 levels, and nearly going back to 2003 levels (55 $MtCO_2e$).

1.3.4 What more could be done?

Each sector has the potential to contribute additional emissions reductions by 2019-20. This potential was outlined in ClimateWorks' *Low Carbon Growth Plan for Australia*.

That research, published in 2010 and updated in 2011, provides an indication of the scale of emissions reduction potential available in Australia without changes to the business mix of our economy or to our lifestyles. It also provides details of the activities that can deliver these emissions reductions.

The *Low Carbon Growth Plan for Australia* found that there is enough abatement potential to achieve a 25 per cent emissions reduction target in Australia, using technologies and practices already available. However further policy or economic incentives would be required to drive the uptake of those activities.

Exhibit 1.13 below compares the abatement observed in the economy to date as shown in this *Tracking Progress* report series with the potential described in the *Low Carbon Growth Plan for Australia*, noting that total abatement figures per sector do not align exactly due to the different methodologies used for the two reports and changes in the economic context between 2011 and today[20].

Exhibit 1.13 shows that despite the progress already observed, there is substantial further potential to reduce emissions in each sector.

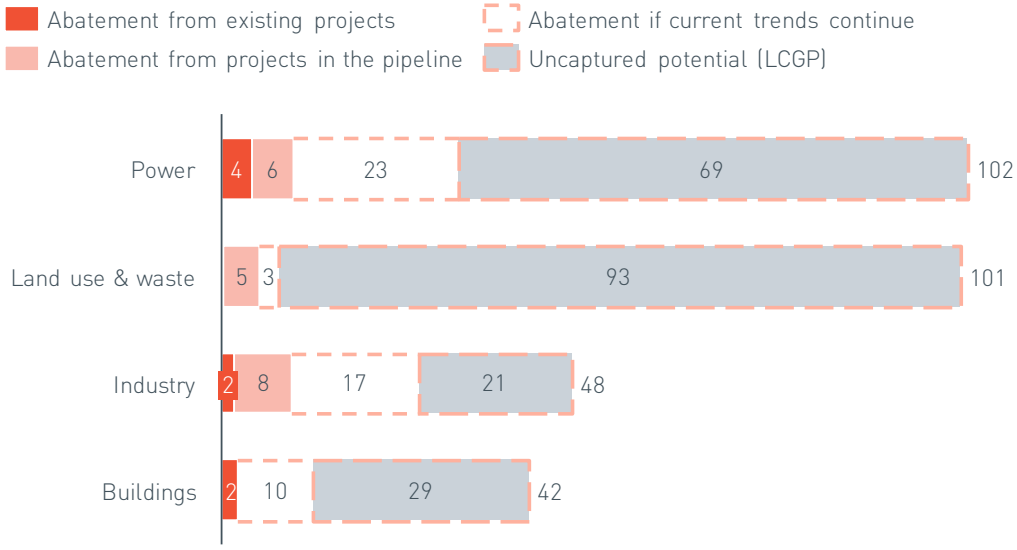
The sectors with the most estimated remaining potential to reduce emissions are Land-use and Waste (93 $MtCO_2e$) and Power (69 $MtCO_2e$), followed by Buildings (29 $MtCO_2e$) and then Industry (21 $MtCO_2e$).

These estimates are based on the potential to reduce emissions in each sector identified in the *Low Carbon Growth Plan for Australia*. It is important to note that this potential needs further incentive to be implemented, either through changed economic circumstances, increased policy support or regulation.

Key activities that could be undertaken to further reduce emissions include:

- **Power**: Further shift from coal generation through increased large-scale renewable energy (including above RET target of 41,000 GWh by 2020), increased gas generation, and further demand reduction in other sectors.
- **Land**: Significant remaining opportunities across the range of Land-use and Waste activities, particularly in avoided deforestation and afforestation.
- **Industry**: Increased uptake of energy efficiency, and decrease in fugitive emission from coal mines through ventilated air methane oxidation.
- **Buildings**: Improved building standards and operational performance for all buildings, and increase in retrofitting opportunities for existing residential and especially commercial buildings.

Exhibit 1.13: Relative share of emissions reduction potential by sector, $MtCO_2e$ [ClimateWorks 2011, ClimateWorks team analysis]



20 The *Low Carbon Growth Plan for Australia* (LCGP) is used only as a benchmark indication of how much potential remains available. The numbers presented in this report differ from the numbers presented in the LCGP given that those two analyses have slightly different scopes: the LCGP assessed abatement potential above the Australian Government's business-as-usual emissions projection, whereas this *Tracking Progress* study reports on all abatement activity undertaken, including abatement that would have been regarded as part of business-as-usual by government projections. For example, installation of new renewable capacity to meet the Renewable Energy Target was included in the Government's business-as-usual projection, but has been included in our abatement calculation in this report. This means that the 'total potential' referenced in this report appears larger than what was reported in the LCGP.

1.3.5 What lessons can we learn from these results to inform Australia's ongoing efforts to reduce emissions?

This research analyses emissions reduction activity across the economy in different sectors and many categories of abatement within each sector. The evidence reveals a mix of activity levels, some strong and some less strong. The cause of variation in activity is generally a combination of multiple factors including macroeconomic factors as well as the impact of policy and regulatory programs.

Within this context, some common themes in the results suggest the following lessons for maintaining and increasing the implementation of low carbon activity in Australia:

PRICE SIGNALS ARE POWERFUL — Activity trends are strong in sectors that can respond easily to effective price signals.

Energy efficiency in large industrial companies has accelerated in recent years in response to energy price rises and the introduction of the carbon price. Skills and information developed in this time, including through the Energy Efficiency Opportunities program, are contributing to ongoing sustained improvement rates in energy efficiency.

Sectors facing a multiplier of the carbon price (due to greenhouse gases produced with higher global warming potential than carbon dioxide) – sometimes in combination with other factors such as electricity price rises – have seen particularly strong uptake of new technology to reduce emissions.

Examples include producers of explosives reducing nitrous oxide emissions, cement manufacturers reducing their use of clinker, water utilities reducing methane emissions escaping from wastewater treatment plants, and piggeries reducing methane emissions from manure pits.

The Renewable Energy Target supports the development of new renewable energy capacity by requiring electricity retailers to purchase or generate an increasing volume of renewable energy certificates each year, or pay a set penalty. Revenue from certificates covers the difference in generation costs for renewable operators compared to fossil fuel power plants. This operates as a price signal in the electricity market, and is playing a major role in increasing renewable generation, so that the emissions intensity of the grid continues to improve over the decade.

Funding support is another financial incentive that has also stimulated activity in companies and households.

Grants for industrial equipment upgrades, feed-in-tariffs for solar PV, and white certificate scheme credits for energy efficient appliances in buildings have contributed to noticeable increases in installation of these technologies. Market growth in these areas has contributed to falling technology prices and greater awareness amongst consumers, such that uptake continues beyond those eligible for the initial funding support.

UNCERTAINTY IS A DRAG — There is less evidence that activities to reduce emissions will take place in the future in areas that have higher upfront costs and rely on an expectation of stable and sufficient policy drivers or incentives over the longer term for their financial return on investment.

One example of the impact of uncertainty is in the uptake of technology to capture fugitive emissions from coal mines to generate electricity. In coal mines where fugitive gases are not already captured for safety reasons, a carbon price or other incentive is needed to trigger investment in the equipment. Given the uncertainty over the future carbon price and limited availability of other incentives, it has been difficult for companies to commit at this stage to implementing the technology.

Forestry activities for carbon sequestration are a long-term investment decision. Forestry activities have high initial capital costs and often do not begin to sequester significant amounts of carbon for a number of years. They require a price level greater than the current expectations of future carbon prices, and reasonable certainty that the price will continue at a sufficient level over the life of the investment. There is little evidence yet of investment in the large-scale potential for afforestation. The *Low Carbon Growth Plan for Australia* found that an investor carbon price of around $25 was necessary for most carbon forestry to deliver a return on investment.

Other carbon farming activities also need additional revenue over the life of the activity than is currently expected, and so activity levels are yet to increase.

The uptake of technologies in the early stage of development such as large-scale geothermal, wave power generation and carbon capture and storage remains uncertain, given the high cost of technological development and commercialisation.

REGULATION IS RELIABLE — Where regulation sets a minimum standard or requirement, there is clear evidence of steady, ongoing abatement activity.

Six star standards for new homes, increased standards for new commercial buildings – both have led to over 10 per cent improvement in emissions performance in new buildings, which improves the overall performance of Australia's building stock and contributes to reduced emissions from the Buildings sector.

State regulations on land clearing rules have very effectively reduced deforestation emissions by 60 $MtCO_2e$ between 2006 and 2011, offsetting Australia's emissions growth in the last decade.

Verification is often required to ensure that regulations are working as intended. For example, research suggests that in order to ensure energy efficiency design standards for buildings are properly implemented, post-construction verification that buildings are constructed in accordance with the design is required.

MACROECONOMIC FACTORS CAN STILL THROW A CURVE BALL — Some of the largest changes in emissions per sector are linked to macroeconomic factors. Changes in these factors can outweigh or weaken the momentum from emissions reductions activities.

For example, high growth in resources production creates more emissions despite increases in low carbon activity; slowing growth in manufacturing lessens demand for electricity and therefore reduces emissions without an increase in low emissions activity; European economic downturn is keeping the international carbon price low.

While industrial energy efficiency activity has grown substantially, current incentives do not appear to be sufficient to stimulate activity within less profitable companies which have limited access to resources and capital, suggesting that further support may be required to unlock the energy efficiency available to those companies.

1.4 Context and Technical Material

1.4.1 About the *Tracking Progress* project

Tracking Progress is the first national index of Australia's progress towards a low carbon economy.

With increasing business and community focus on how best to transition to a low carbon future, it is critical to have a robust measurement and evaluation framework for low carbon activity.

In order to understand how Australia is progressing towards our national emissions reduction targets, a good understanding of this activity – and the factors that are supporting or impeding it – is required. Building this evidence is critical for achieving an efficient, least-cost transition while maintaining our economic growth, competitiveness and prosperity.

The reports that make up this project provide an assessment of activity occurring across the Australian economy that reduces or avoids greenhouse gas emissions, pulling together all the available information and data across key sectors. We have tracked and reported progress through our national progress report series covering Power, Industry, Buildings and Land-Use & Waste[21]. In addition we have produced a Special Report on factors influencing large industrial energy efficiency.

No other research provides a national aggregation of data on the underlying investments and activity that lead to future abatement. National measurements currently focus on actual emissions and energy use each year. This only reveals 'the tip of the iceberg' of abatement activity.

This report reveals the hidden part of the story including:

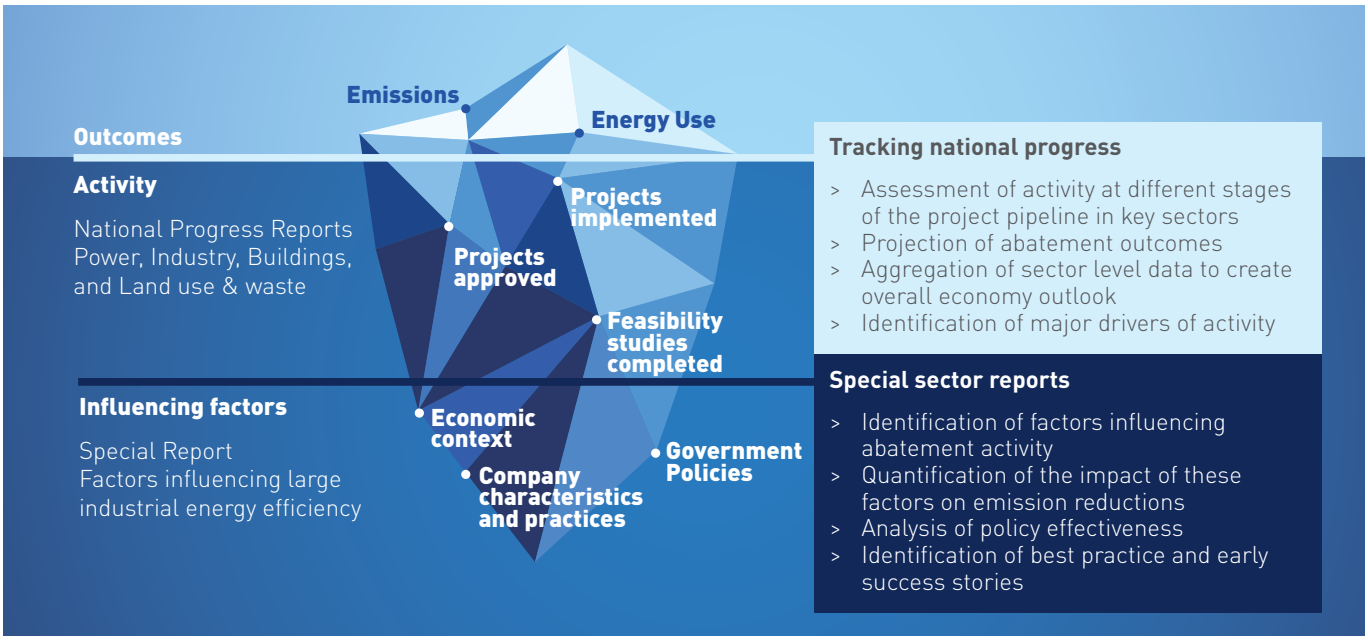
LEVEL OF CURRENT ACTIVITY across key sectors of the economy. This includes activities that will deliver emissions savings in the future, some of which do not yet appear in national energy and emissions metrics but which are sufficiently advanced to make a known contribution to reducing future emissions.

FUTURE ABATEMENT that can be achieved if recent trends in abatement activity are sustained to 2019-20

FACTORS INFLUENCING EMISSIONS REDUCTION ACTIVITY for large industrial energy efficiency – from broad economic influences to company specific factors – including an understanding of the common qualities of companies that achieve the most emissions reductions.

21 The Transport sector has not been assessed in the 2013 Tracking Progress report series but will be addressed in a future report series.

Exhibit 1.14: The hidden factors that influence emissions outcomes [ClimateWorks team analysis]



1.4.2 Sectors covered in this report

This *Tracking Progress* report series is comprised of four Sector Reports assessing progress in Industry, Power, Buildings and Land-use and Waste, a Special Report on factors influencing large industrial energy efficiency, and this National Progress Report aggregating the results and comparing the progress in the sectors with Australia's national emissions reduction targets.

Power generation

Power generation in this report includes generation from large-scale grid-connected fossil fuel and renewable energy generation. It also examines electricity transmission and distribution networks across Australia. Small-scale solar power, other forms of distributed energy generation and most off-grid electricity generation are addressed in Report 3: Industry and Report 4: Buildings.

Abatement arising from activities that reduce electricity demand from industry and buildings is attributed to the Industry or Buildings sectors in this report series.

However, these activities may also have an impact on the relative proportions of coal, gas and renewables generating electricity, and therefore an impact on the emissions intensity of the grid as a whole. This abatement is attributed to the Power sector.

Further information on the interactions between the Power sector and other sectors can be found in section 1.4.4.

Industry

Industrial sectors covered by this report are mining, manufacturing and construction (as well as gas transmission and distribution networks for fugitive emissions). The report investigates improvements in industrial energy efficiency, changes in the type of fuels used to produce energy for industrial uses, improvements in fugitive emissions from industrial activities and in emissions from industrial processes.

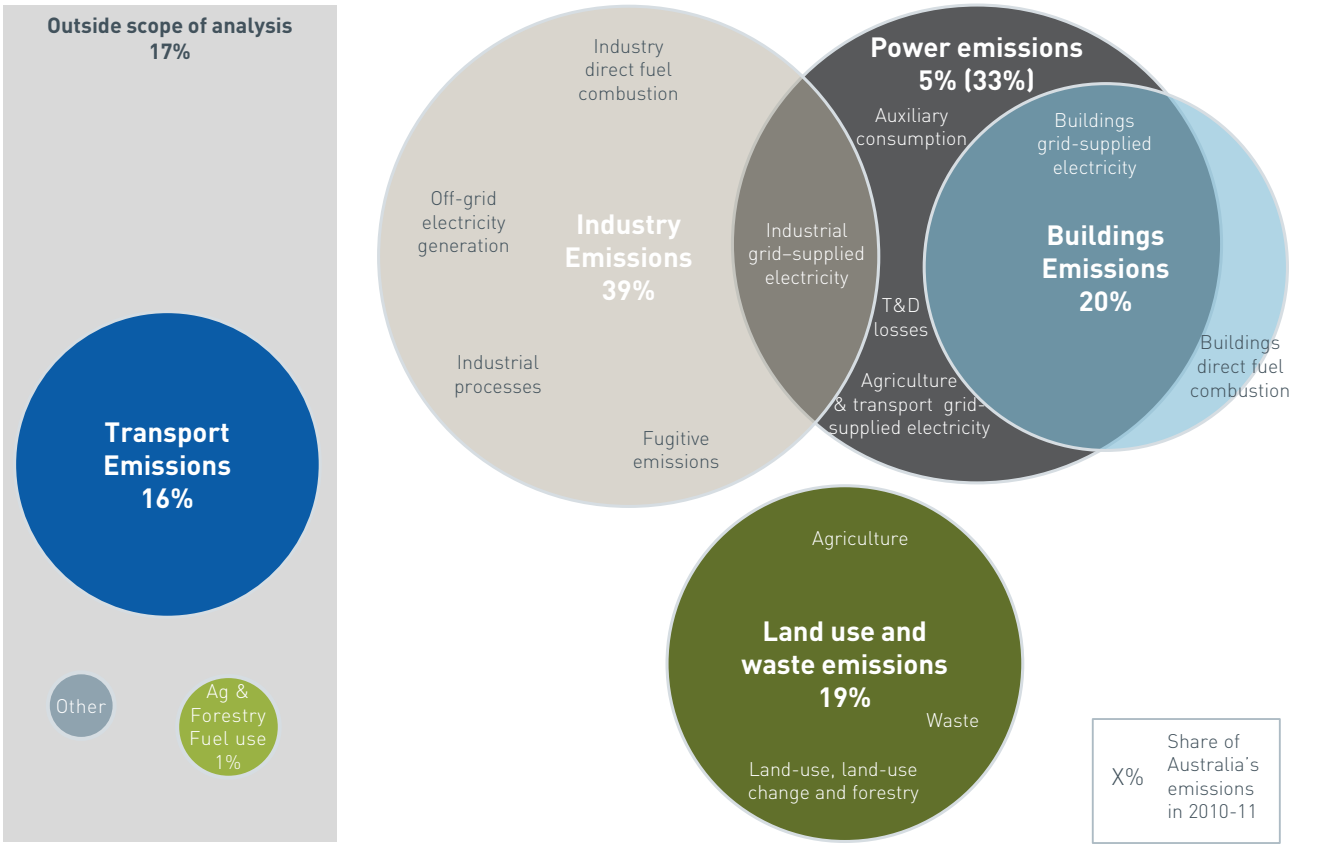
Buildings

The Buildings sector analysis includes existing commercial and residential building stock, new buildings, and small to medium-scale distributed energy generation including solar PV and co-generation.

Land-use and Waste

The 'Land-use and Waste' report investigates emissions reduction activities from non-energy related emissions from agriculture, forestry and waste. This includes emissions from livestock, agricultural soils, savanna fire management, clearing of forests, and gases released from solid and liquid waste.

Exhibit 1.15: Scope of the Tracking Progress report series (the size of the bubbles illustrates the volume of emissions from each sector) (DIICCSRTE 2013a, ClimateWorks team analysis)



Sequestration activities that remove greenhouse gasses from the atmosphere such as afforestation (establishing a forest on cleared land), reforestation (re-establishment of an existing forest), and revegetation are also included.

Transport

This report does not currently include an analysis of emissions reduction activity in the transport sector. Where necessary we use the former Australian Department of Climate Change and Energy Efficiency projections figures for transport emissions for summaries of total national emissions (DCCEE 2012).

Special report on factors influencing large industrial energy efficiency

ClimateWorks conducted in-depth interviews between January and April 2013 with energy or environment managers (or similar role) in large industrial companies that control over 70 per cent of industrial sector energy use. These 47 companies in the manufacturing, mining, water, waste and construction sectors are participants in the Australian Government's Energy Efficiency Opportunities (EEO) program.

The interviews focused on the factors influencing companies to address energy efficiency and company practices used in implementing energy efficiency activities.

The analysis in the Special Report examines the reasons why companies have implemented opportunities, and the reasons why other opportunities are not implemented. Additional quantitative analysis drawing on Energy Efficiency Opportunities (EEO) data and public data on company characteristics was also undertaken to identify the common characteristics of companies that achieve more energy savings.

Throughout these reports, we attribute emissions to end use sectors. Exhibit 1.16 opposite summarises the link between the source of emissions and their end use. Most government reporting on emissions categorises emissions according to the source of emissions.

This causes particular difficulties when trying to separate out emissions from grid-supplied electricity into their different end uses in Buildings or Industry, which we have done in Exhibit 1.16.

Section 1.4.4 of this report provides further details of the interactions that exist between grid-supplied electricity emissions and the Buildings and Industry sectors.

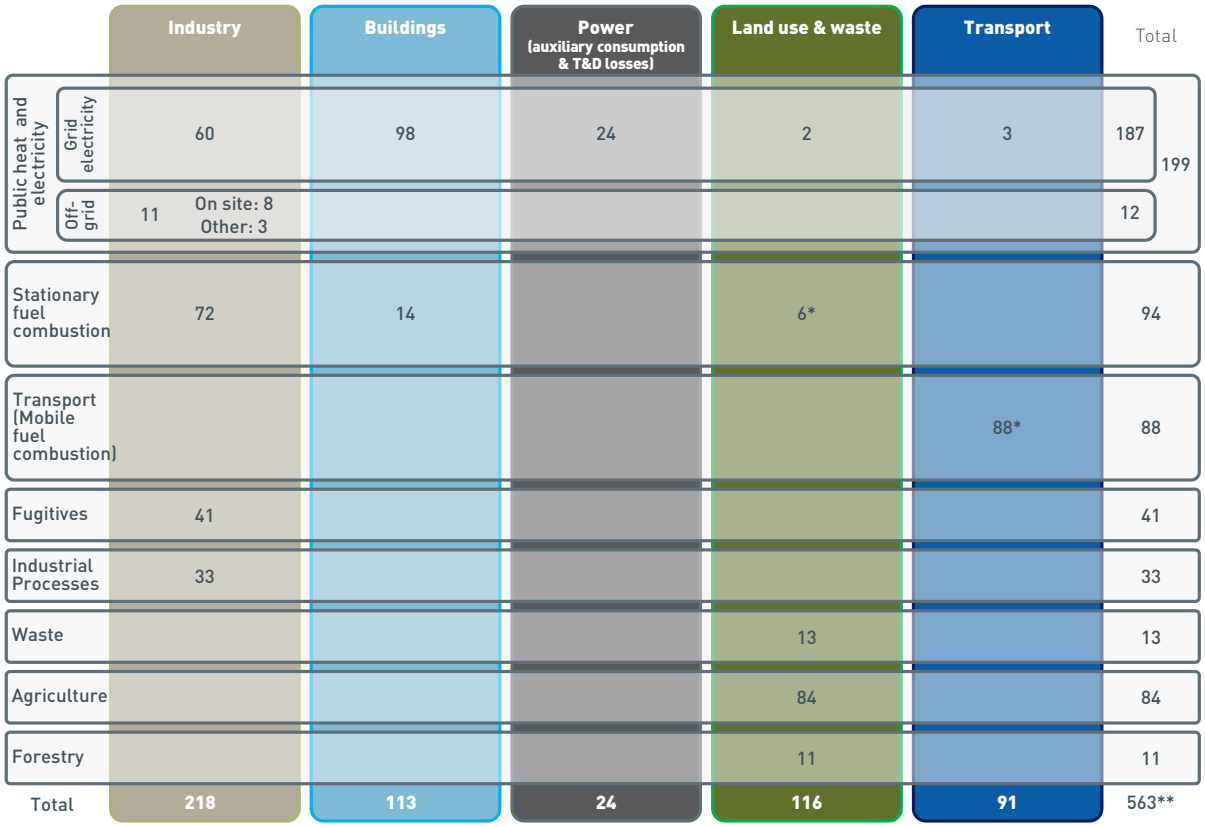
This is the first time that available data on the underlying activity that reduces emissions has been pulled together from across almost the whole Australian economy and compared.

Energy efficiency and emissions management are emerging areas of national policy focus, and the data remains highly fragmented, coming from multiple sources, with varying scopes and different time frames (see section 1.4.10 below for further detail on data gaps and limitations).

However, the data collected is sufficient to build a picture of the activity taking place across our economy.

As Australia continues its transition to a low carbon economy, collecting more comprehensive and consistent data will allow for more informed and effective decisions to be made by businesses and government.

Exhibit 1.16: Matrix of emissions by sector (DIICCSRTE 2013a, ClimateWorks team analysis]



* Outside scope of analysis

** Also includes 2 $MtCO_2e$ of other stationary fuel combustion emissions; totals may not add up due to rounding.

1.4.3 Australia's emissions over time

Exhibit 1.17 below shows the breakdown of Australia's emissions by the sectors covered in this report, and how they have changed from 1989-90 (the base year for the Kyoto Protocol) and 2002-03 (the start of the analysis period for this report, being ten years ago).

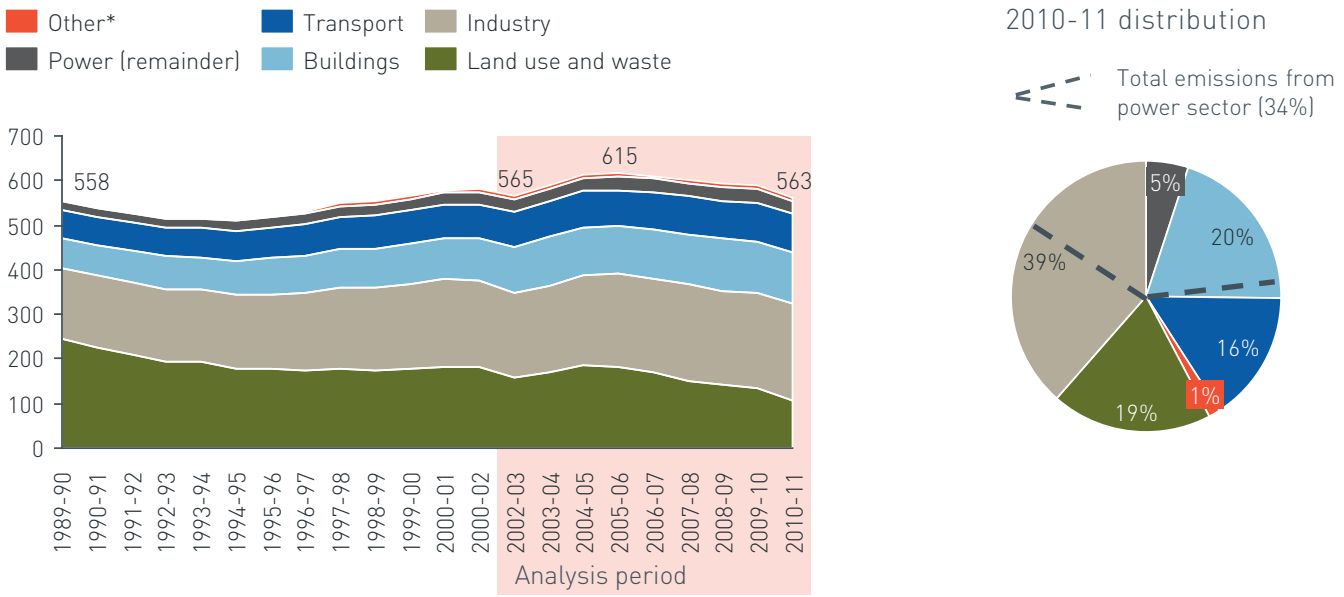
Australia's emissions have historically been dominated by agricultural and industrial emissions, reflecting the nation's extensive agricultural land, abundant mineral resources and historically low electricity prices.

In 1989-90, emissions from industry accounted for 29 per cent of total emissions, and have grown over the two decades to 2002-03 (the beginning of the analysis period for this report) to be 33 per cent of total emissions.

Emissions from Land-use and Waste represented 44 per cent of emissions in 1989-90, but have declined significantly primarily as a result of reduced deforestation, and in 2002-03 accounted for 28 per cent of total emissions.

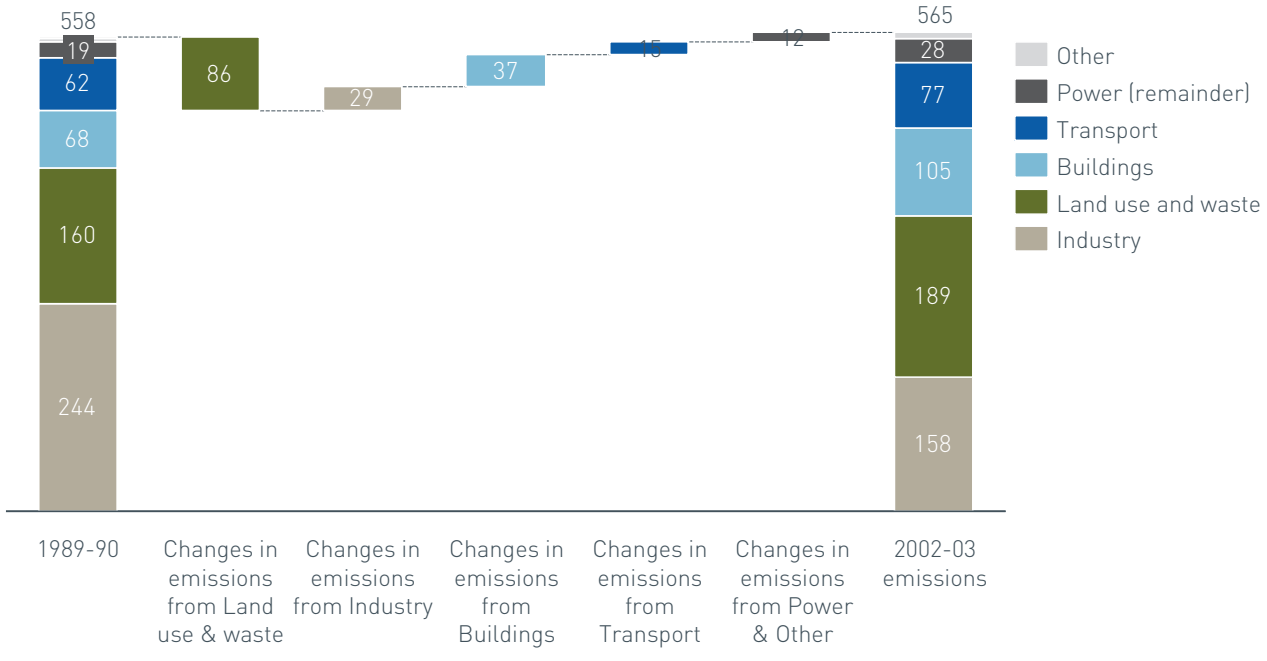
Emissions from Buildings and Transport accounted for most of the remaining emissions, and have grown from less than a quarter of total emissions in 1989-90 to nearly a third by 2002-03.

Exhibit 1.17: Trend in Australian emissions, $MtCO_2e$ (DIICCSRTE 2013a)



*Other includes emissions from stationary fuel combustion in the Agriculture and Forestry sector, as well as in other sectors

Exhibit 1.18: Changes in Australia's emissions between 1989-90 and 2002-03 (DIICCSRTE 2013a)



1.4.4 Interactions between power and other sectors

Emissions from grid-supplied electricity generation are mostly attributable to end-use demand for electricity from industrial activity and from commercial and residential buildings. Together, these account for almost 85 per cent of grid-supplied electricity use in 2010-11.

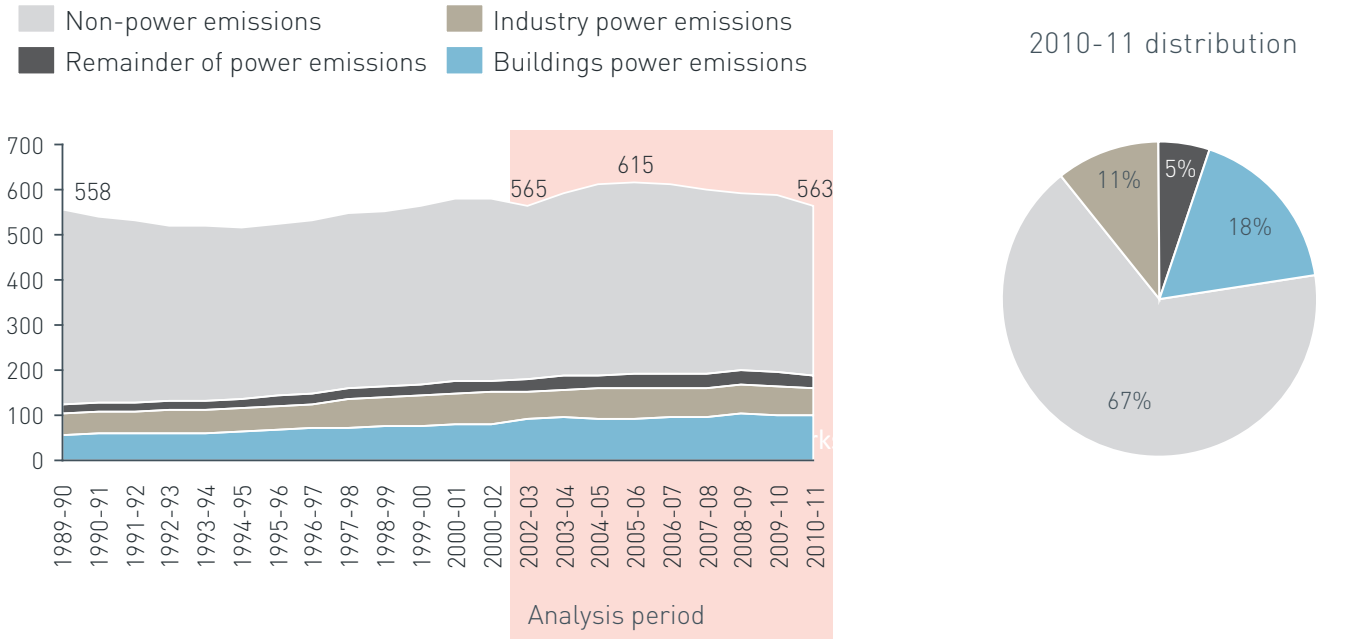
The rest of grid-supplied electricity generation is attributable to transmission and distribution losses in electricity networks (7 per cent in 2010-11), auxiliary consumption by power generators (6 per cent), transport electricity use (2 per cent) and agricultural electricity use (1 per cent). The associated emissions are referred to as 'Remainder of power emissions' in Exhibit 1.19 below.

In 2010-11, most of the emissions from Buildings, and more than a quarter of the emissions from Industry, came from centralised power generation, mostly fuelled by black and brown coal. These fuels are extremely abundant in Australia but have a high emissions intensity, amplifying the emissions impact of electricity used in Buildings and Industry.

This shows how closely linked Buildings and Industry emissions and Power sector emissions are. The emissions in those sectors will be strongly affected by changes in the emissions intensity of grid-supplied electricity. This is particularly true in the Buildings sector where grid-supplied electricity emissions represented 87 per cent of total emissions in 2010-11.

In addition, the emissions intensity of grid-supplied electricity generation will be strongly affected by changes in electricity demand from the Buildings and Industry sectors, both in terms of volume and shape throughout the day and the year. These factors will influence which types of power generation plants are used to generate electricity.

Exhibit 1.19: Trend in Australian emissions, $MtCO_2e$ (DIICCSRTE 2013a, ClimateWorks team analysis)



1.4.5 How Australia can reduce its emissions

ClimateWorks' *Low Carbon Growth Plan for Australia*, released in March 2010, outlined a comprehensive economy-wide blueprint for how Australia could achieve an ambitious reduction in greenhouse gas emissions, while building a robust low-carbon economy. It identified the least-cost opportunities across the economy that would achieve a 25 per cent reduction in Australia's emissions below 2000 levels (see Exhibit 1.20 on next page).

The Plan won the highly regarded Eureka Prize for Innovative Solutions to Climate Change and the Ethical Investor Award for Sustainability Research in 2010. ClimateWorks updated this analysis in 2011 to take into account changes since 2010.

Based on detailed economic and policy analysis, the *Low Carbon Growth Plan for Australia* identified the actions required to reduce emissions, the barriers to their implementation, and their relative cost in six key sectors – Power, Forestry, Industry, Buildings, Agriculture and Transport.

The modelling excluded opportunities that would require a significant change to the business mix of our economy, or changes to our lifestyles, as well as opportunities with a high degree of speculation or technological uncertainty.

Energy efficiency opportunities in the Building and Industry sectors were found to be the cheapest form of abatement, often delivering a financial return over their lifetime. Combined with abatement from fuel mix changes in those sectors, these opportunities represented 29 per cent of the total abatement identified.

Opportunities in Land and Power were generally found to require a carbon price or other support to be cost effective, requiring further incentives to attract investment. These opportunities represented 64 per cent of the total abatement identified.

While there have been changes in economic and policy factors since the publication of the *Low Carbon Growth Plan for Australia*, the overall findings summarised above remain valid.

The exact size of each abatement opportunity may be different but the range of opportunities and their cost relative to other opportunities remain similar.

How to read the greenhouse gas emissions reduction cost curve

The greenhouse gas emissions reduction cost curve, also known as a marginal abatement cost curve (MACC), summarises our estimate of the realistic volume and costs of opportunities to reduce greenhouse gas emissions in Australia.

Each box on the curve represents a different opportunity to reduce greenhouse gas emissions.

The width of each box represents the emissions reduction potential that opportunity can deliver in 2020 compared to business-as-usual.

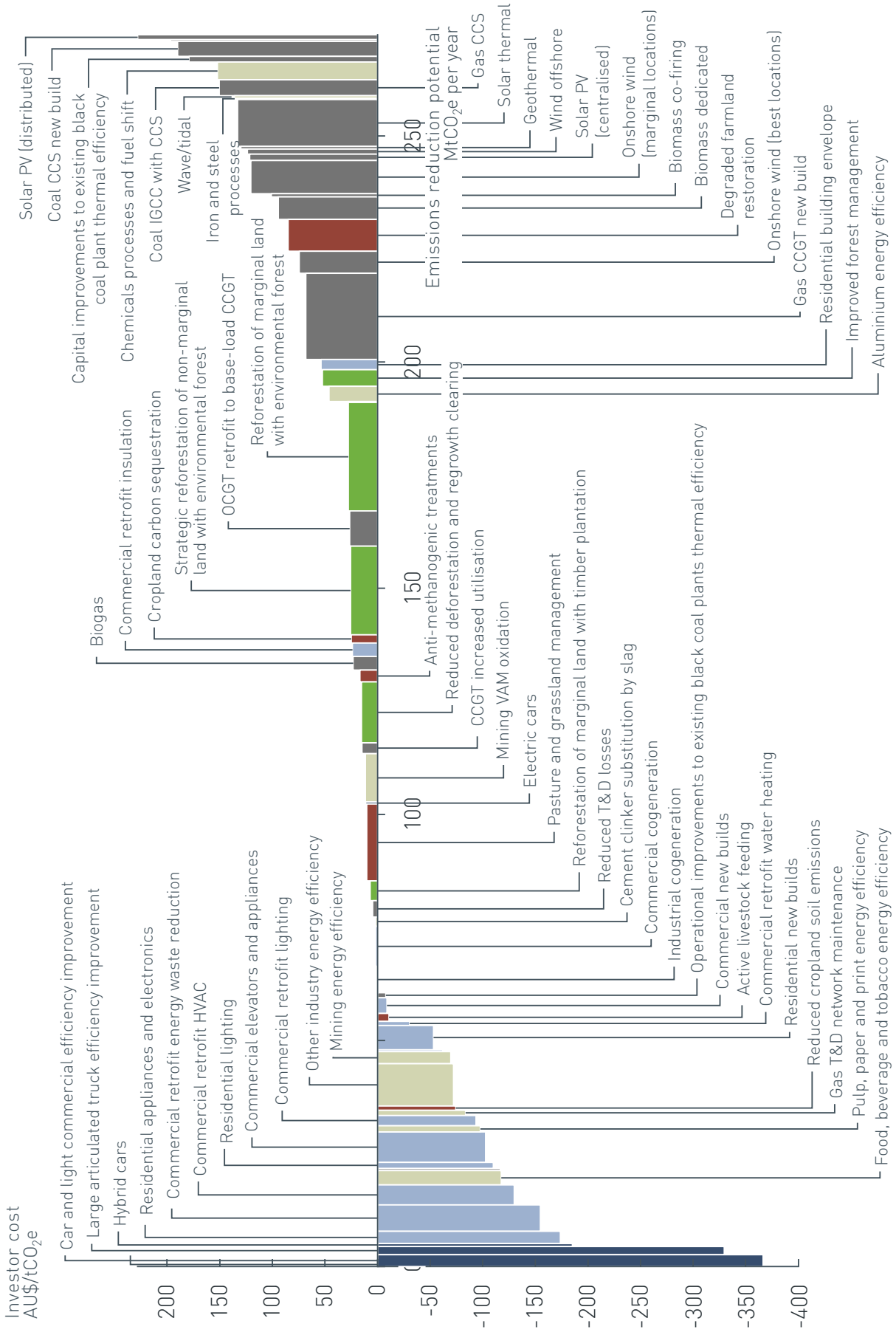
The height of each box represents the average net cost of abating one tonne of CO_2e (carbon dioxide equivalent) through that activity.

The graph is ordered left to right from the lowest cost to the highest cost opportunities.

Those opportunities that appear below the horizontal axis offer the potential for financial savings even after the upfront costs of capturing them have been factored in.

Opportunities that appear above the horizontal axis are expected to come at a net cost.

Exhibit 1.20: National investor abatement cost curve from the *Low Carbon Growth Plan for Australia, 2011 update* (ClimateWorks Australia 2011)



1.4.6 Methodology overview

This first *Tracking Progress* report series provides an assessment of Australia's progress in reducing emissions over the last decade (since 2002-03), and looking forward to 2019-20.

For each of the economic sectors included in the report series, we have undertaken an assessment of what activity is taking place to reduce emissions.

For each sector, we also provide analysis of the key drivers of activity based on interviews with relevant experts.

For the Special Report on large industrial energy efficiency, we combined qualitative information from an extensive interview survey with 47 companies with quantitative analysis of activity data to develop a deeper understanding of the drivers of energy efficiency activity in those companies. Similar analyses could be completed for other sectors in the future.

In each sector, abatement activity is measured over time using the following measures:

- **Emissions intensity**, namely the emissions in tonnes of CO_2e (carbon dioxide equivalent) per unit of output or other metric, for example emissions per ton of metal produced, or per dollar of GDP.
- **Energy intensity**, namely the amount of energy used per unit of output or other metric, for example energy per square metre of commercial building floor space. This measure was in particular used in the Buildings and Industry sectors to separate the impact of activities undertaken within the sector to reduce energy consumption, from the impact of changes in grid-supplied electricity intensity (which results from activity in the Power sector) on the overall sectoral emissions. Energy intensity can be equal to energy efficiency, or it can be a combination of energy efficiency and other factors.
- **Energy efficiency** refers to improvements in energy intensity from internal processes and operations. For example, the energy intensity of mining operations is influenced by the energy efficiency of the internal processes involved such as extraction and processing of ore, as well as external factors such as the grade of the ore and the depth at which it sits. Energy efficiency activity is regarded as any activity to identify, investigate or implement actions that reduce the amount of energy required to complete internal processes and operations.
- **Total emissions**, namely the total emissions in each sector and sub-sector in tonnes of CO_2e. Changes in total emissions result from changes in emissions intensity (which can be driven by abatement activity or structural factors), changes in underlying economic activity (e.g. changes in the level of economic activity, or changes in the structure of the economy such as a decline in manufacturing and a growth in mining).

This report series focuses on quantifying future emissions reduction activity based on observable abatement, rather than modelling or projections. This restricts its analysis to abatement from:

- Projects that have been implemented since 2009-10;
- Projects or activity underway in a sufficiently advanced stage such that emissions reductions in the future can be calculated from the planned volume of implementation; and
- Continuation of recent trends in abatement activity. In most sectors, the observable pipeline of activity does not yet extend to 2019-20 (e.g. investment pipelines are known to 2014-15 but not beyond). Accordingly, we have estimated the additional abatement that would occur between now and 2019-20 if the same rate of implementation of activity seen over recent years continued to 2019-20. This excludes possible new abatement from improved rates of penetration of activity or technological advancement. It restricts abatement levels to only that which would occur if the same rate of implementation observed in the past decade continued. It also implicitly assumes that similar amounts of attractive abatement opportunity could be found in the future compared to what was identified in the past. The implementation rate may be adjusted if there has been a clear directional shift in the trend in more recent years, or if the impact of changes such as new regulations that have been implemented is sufficiently certain but has yet to be reflected in observable trends (e.g. the Renewable Energy Target, which would require a significant increase in installation of new renewables in order to be met).
- This demonstrates how much abatement would be delivered by 2019-20 if current trends continued, and provides an indication of how much activity levels would need to increase in order to meet current or future national emissions reduction targets.

Exhibit 1.21 opposite illustrates this as steps 2, 3 and 4. To compare the abatement observed with what is needed to achieve Australia's minimum national 5 per cent emission reduction target, the abatement is deducted from where emissions would have been if there was no abatement but simply the economic growth continued and the level of abatement remained at pre-2009-10 levels (e.g. emissions intensity does not improve). This is represented by Step 1 in the chart below. The 2009-10 reference year was chosen to allow a comparison of abatement activity with the opportunities to reduce emissions identified in the *Low Carbon Growth Plan for Australia.*

The resulting estimate of emissions in 2019-20 represents the volume of emissions that would occur if the economic and policy conditions that are observable today stay the same until 2019-20, and the rate of abatement continues at the same level (adjusted as described above).

At a whole-of-economy level, this National Progress Report brings together the results from each sector to provide an assessment of current progress towards meeting the current national bi-partisan minimum emissions reduction target of a 5 per cent reduction on 2000 levels by 2020.

At a sectoral level, the Tracking Progress report series assesses each sector's progress towards implementing the opportunities for emissions reduction identified in ClimateWorks' *Low Carbon Growth Plan for Australia* (see section 1.4.5), which would deliver a 25 per cent emissions reduction target domestically (427 $MtCO_2e$). This 25 per cent target aligns with the minimum target recommended by IPCC scientists for developed countries (IPCC 2007).

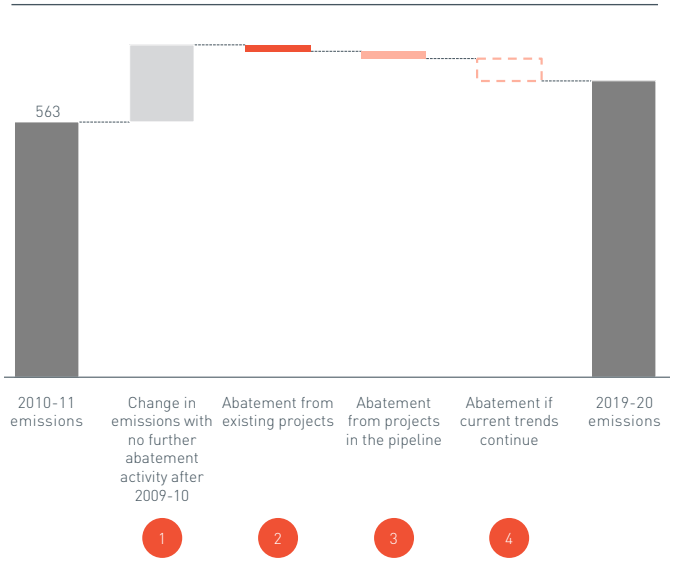
The assessment of progress includes:

1. Recent progress
    a. Analysis of emissions reduction activity between 2002-03 and 2012-13 (or latest year with available data)
    b. Calculating a rating for each sector or activity. The rating is based on the degree to which activity to reduce emissions has increased or improved since 2002-03. We take into account the specific context of each sector – a 1 per cent growth in one sector or activity may be rated the same as a 10 per cent growth in another, depending on the opportunities available and other factors influencing activity. We also consider the change in total emissions for the sector, and reduce the rating if emissions have increased significantly despite improvement in emissions reduction activity.
2. Outlook to 2020
    a. Quantitative assessment of emissions reductions that will be achieved by 2019-20 from projects implemented since 2009-10
    b. Estimate of emissions reductions expected by 2019-20 from projects currently under way
    c. Estimate of emissions reductions that would be achieved by 2019-20 if recent trends in emissions reduction activity were to continue
    d. Rating of this future outlook according to how far (a), (b), and (c) gets each sector towards reaching the full available emissions reductions identified for each sector in the *Low Carbon Growth Plan for Australia* by 2019-20.
3. Comparison to targets and potential
    a. For the Overview Report, calculation of Australia's emissions in 2019-20 after subtracting all the emissions reductions identified in each sector report (including those already implemented, those expected from projects under way, and those that would be achieved by 2019-20 with recent trends). This number is then compared to 537 $MtCO_2e$, which represents Australia's 5 per cent emissions reduction target.
    b. Estimate of how much more emissions reduction potential is available by 2019-20, by reference to the opportunities identified in the *Low Carbon Growth Plan for Australia* which assessed the least cost approach to achieving a 25 per cent reduction in Australia.

Data used in this report to aggregate emissions across the Australian economy are drawn from the annual publication of the National Greenhouse Gas Inventory (NGGI). The most recent report contains national greenhouse gas emission estimates for the period 1989-90 to 2010-11, compiled under the rules for reporting applicable to the United Nations Framework Convention on Climate Change (UNFCCC).

Where more recent data is available, this has been included in the relevant sector chapter. The recent data is not comprehensive enough to allow all sectors to be updated beyond 2010-11 so we have used the 2010-11 year as a common comparison point for all sectors.

Exhibit 1.21: 4 steps followed to estimate the potential impact of abatement activity by 2019-20 (ClimateWorks team analysis)



1.4.7 Key areas of uncertainty

Economic conditions, policy settings, fuel prices and other external factors can have a significant impact on emissions and abatement levels.

The results presented in this report would change if the prevailing conditions change from what is currently expected. Some of the parameters around which there is considerable uncertainty are:

- Future energy use, and in particular electricity demand
- Future level of coal-fired electricity generation
- Future levels of deforestation and afforestation.

Future energy use in Australia will be affected by many factors, in particular the level of manufacturing and mining production, the carbon price and electricity use in buildings.

The strongest influence on future energy use in Australia is likely to be the future levels of production in the manufacturing and mining sectors.

Experts currently expect to see strong growth in coal and metal ore mining, as well as in gas production for LNG exports. This could change, for example, if international agreement were reached sooner than expected to reduce coal combustion to contain greenhouse gas emissions growth, or if international gas prices dropped following strong increases in hydraulic fracturing ('fracking') gas production elsewhere in the world. Production levels in coal mining and oil and gas extraction also have a strong impact on fugitive emissions.

While mining and resources are expected to grow, experts are currently not expecting that the manufacturing sector will experience significant growth by 2019-20. Our analysis therefore assumes that manufacturing energy use (outside of LNG production) would stay stable between 2010-11 and 2019-20.

If instead production increased – for example following a significant drop in the Australian dollar – or decreased, the total energy use in Australia in 2019-20 could change significantly. In particular, any change in output from the most energy intensive sectors would have strong impacts on overall energy usage. For example, a further decrease in Aluminium production would have a very strong impact on Australia's grid-supplied electricity demand.

The carbon price could also have a strong impact on future energy use. A high carbon price could increase the financial attractiveness of many energy efficiency, self-generation or waste gas capture opportunities, and could incentivise a shift in activity and investment.

Another key factor will be future electricity usage in buildings. Buildings are now responsible for more than half of the grid-supplied electricity consumption in Australia, with about a quarter due to residential buildings and a quarter to commercial buildings.

Contrary to historical trends, recent data suggests that electricity use per household has started to decrease. If that was not the case (for example if the rebound effect counterbalanced improvements in energy efficiency), or if that decrease was very strong (for example through stronger responses to increased electricity prices than was expected, or through new technology developments), then this would have an impact on overall grid-supplied electricity usage in Australia.

Another factor that will impact on the grid-supplied electricity demand from buildings is the uptake of distributed electricity generation. This report assesses emissions levels that would result if solar PV uptake followed recent trends to 2019-20. However, installation rates could either slow (for example, if the maturing solar PV market led to a contraction in the number of PV installers this could increase prices of solar PV systems) or increase further (for example, if the commercial and industrial sectors experienced a boom similar to what has been seen in the residential sector in recent years).

In addition, the future of co-generation is quite uncertain, and linked closely to future changes in regulations (to facilitate the grid-connection process) and to future gas prices (currently the high risk of strong increases in gas prices in the future is preventing many co-generation projects from proceeding).

The future level of coal-fired electricity generation will be influenced by future demand for grid-supplied electricity, as well as by future carbon and gas prices.

In the past few years, coal-fired electricity generation has decreased as grid-supplied electricity demand contracted and renewable energy and gas generation increased. Its future levels are likely to be closely linked to the future evolution of these factors.

As the Renewable Energy Target requires (in legislation) that 41,000 GWh of renewable energy must be generated from renewables in 2019-20, coal generation is likely to be constrained if electricity demand falls, which would have a very significant impact on overall emissions.

There is currently a high level of uncertainty around future grid-supplied electricity demand, including those related to future energy use which are mentioned above. Another factor is whether the new LNG production plants which are expected to be developed in Queensland will connect to the grid.

These plants would require a significant amount

of electricity each year, equivalent to about 3% of Queensland's annual electricity use today.

Other factors that will have a strong impact on future levels of coal-fired electricity generation are future carbon and gas prices. Combined, these determine the "merit order" of the various electricity generation plants in Australia – plants that have the lowest cost of production are likely to provide higher volumes of electricity to the grid. High gas prices and low carbon prices would favour coal over gas, whereas low gas prices and high carbon prices would favour gas over coal.

Future levels of deforestation are highly dependent on changes in deforestation levels that may flow following recent changes to land clearing rules in Queensland, and future levels of afforestation will depend on the future carbon price levels and certainty.

Since 1999, the *Vegetation Management Act 1999* (Qld) and reduced agricultural commodity prices have led to a reduction in land clearing of 80 per cent in Queensland. This was the main driver of the strong reductions in deforestation emissions in Australia over the last decade.

The *Vegetation Management Framework Amendment Act 2013* (Qld) which was passed by the Queensland Government in May 2013 removes many of the restrictions on clearing of forest regrowth in the Vegetation Management Act. Regrowth clearing in Queensland decreased by 68 per cent from its peak in 2006 to 2011.

This contributed a quarter of the total reduction in deforestation that occurred in Australia during this period. The removal of these protections places significant areas of forest at risk, which could significantly increase future deforestation rates and counterbalance many of the emission reductions achieved in the other sectors of the economy.

For afforestation activity, new plantations have high upfront establishment costs and long project lives. They rely on revenues generated through the creation of carbon credits, making them highly sensitive to regulatory uncertainty and market risks.

In many cases, these projects have a long payback period as it can take several years before forests reach their peak sequestration rate and begin generating significant carbon revenues.

At the moment, very few projects are likely to be implemented, whereas if a sufficient and certain carbon price was in place, there is potential to sequester large amounts of carbon through afforestation in Australia.

The *Low Carbon Growth Plan for Australia* identified more than 50 $MtCO_2e$ of potential by 2020 in reforestation activities.

1.4.8 Differences with Australian Government projections

The former Australian Department Climate Change and Energy Efficiency (now Department of Innovation, Industry, Climate Change, Science and Tertiary Education (DIICCSRTE) produces projections of future emissions.

The Department's projections estimate what Australia's expected emissions would be in 2019-20, using models to assess future economic activity, as well as expected emissions reduction activities. In particular, the Department uses marginal abatement cost curves, in conjunction with CGE (computable general equilibrum) modelling and sectoral modelling, to work out the level of emissions that would occur in the economy with and without a carbon price.

The Department's latest projections were released in 2012, and estimated that with the carbon pricing mechanism and complementary programs (including the Carbon Farming Initiative) in place, Australia's domestic emissions in 2019-20 would be 637 $MtCO_2e$. Without the carbon pricing mechanism and Carbon Farming Initiative, their projections estimated that Australia's domestic emissions in 2019-20 would be 693 $MtCO_2e$.

ClimateWorks' approach differs significantly from the Department's projections' methodology. This report looks at what would happen if recent abatement activity trends continued at a similar pace until 2019-20.

This is not a modelling or projection exercise, and does not correspond to a "business-as-usual" scenario, as the report does not model any increase or decrease in abatement activity resulting from potential future changes to the current economic or policy context between today and 2019-20.

Instead, ClimateWorks' approach provides an indication of how much abatement would occur between now and 2019-20 if current levels of abatement activity are sustained, and if so which sectors could experience high levels of activity, and which sectors may require additional support or incentives to unlock additional emissions reductions.

These two analyses are different in both approach and aim, and are therefore not directly comparable.

However, our estimate is that that emissions in 2019-20 would be 645 $MtCO_2e$, which is about 1 per cent higher than the 637 $MtCO_2e$ expected emissions in the Department's projections. This indicates that Australia will need to sustain recent improvement rates in abatement in order to reduce domestic emissions to the level projected by the Department under the 'with a carbon price and CFI' scenario in 2019-20.

In addition, this project has a different scope from the Department's projections: this project does not cover abatement activity from the Transport sector, or from agriculture or forestry fuel use.

These sectors represent about 17% of Australia's emissions in 2010-11 but only a small share of the abatement opportunity identified in the *Low Carbon Growth Plan for Australia*, and so are not expected to have a large impact on overall abatement activity estimates.

We have used the Department's projections for Transport emissions without a carbon price to estimate conservatively what this sector's emissions could amount to by 2019-20.

We have also assumed that emissions from fuel use in Agriculture and Forestry would grow in line with Agriculture and Forestry activity forecasts from the Treasury's *Strong Growth, Low Pollution* (Australian Government 2011) modelling (12 per cent between 2010-11 and 2019-20).

1.4.9 Impact of changes to Kyoto Protocol accounting

Australia has recently updated its reporting methodologies for the second commitment period of the Kyoto Protocol. These changes include updating the Global Warming Potential (GWP) of greenhouse gases, including changes in emissions from forest management and including net emissions from cropland management, grazing land management and revegetation activities in the land sector[22].

We have not included these changes in our analysis due to the proximity of the change to our publication date and because reliable historical data reflecting these changes is not available in emissions inventories. The transition to the new arrangements will take place progressively over the next three years through government and company reporting.

22 Full detail on these changes is available via www.climatechange.gov.au/international/negotiations/history-negotiations/kyoto-protocol/impact-kyoto-accounting-changes-qelro-and-targets

1.4.10 Data gaps and limitations

In attempting to collect evidence of emissions reduction activity across the Australian economy, ClimateWorks has encountered a range of data challenges. A list of these data issues is provided below in Exhibit 1.22, and indicates areas where data improvements would enable more robust and useful analysis of Australian emissions and abatement activities to be undertaken.

Exhibit 1.22: Data issues and limitations (ClimateWorks team analysis)

Sector	Comment
Power	> It is hard to reconcile comprehensive national datasets on electricity generation and consumption between themselves and with electricity market datasets (e.g. the National Electricity Market or NEM) – both in terms of scope and timeframes > Little data is available on smaller electricity markets (other than the NEM) and off-grid electricity generation
Industry	> There is a long lag (about 2 years) in data availability for energy use, emissions and energy savings > Available data on both industrial energy use and emissions is only provided at a high level of aggregation, and the aggregation methodology varies between sources > Very little data exists on off-grid electricity consumption > No public data exists on energy efficiency activity undertaken by smaller energy users or by the owners and operators of new developments > Many sources of fugitive emissions are estimated using emissions factors applied to production rather than measured (e.g. coal seam gas and surface coal mining) > Most data on emissions from industrial processes in the Chemicals sector is confidential and cannot be reported publicly > Emissions from refrigerant gases covered under the Montreal Protocol are not included in Australia's emissions inventory and stocks of these gases are difficult to measure
Buildings	> Many data gaps exist in relation to commercial building energy usage, in particular: energy used by the tenants of buildings, energy use in smaller buildings, self-generated electricity by technology, performance of existing non-office buildings, comprehensive data on the amount of commercial building floor space > In the residential sector, little public data exists on actual energy use in residential buildings by technology (most data is based on modelling), and no data exists on the performance of existing appliances or the ratings of bought appliances (the Australian Government has recently established regulations allowing for the collection of data on ratings of bought appliances) > No data exists on energy use in multi-residential buildings
Land-use & Waste	> There is very limited available data on emissions and abatement potential from activities that fell outside emissions reporting for the first commitment period of the Kyoto Protocol, but which have now been included in the second commitment period. This includes emissions from cropland management, grazing land management, forest management and revegetation > Data on forestry emissions does not provide detail on the carbon content of forests that are removed or planted

1.4.11 Results summary table

	2002-03 emissions (MtCO2e)	2002-03 to 2010-11 change (%)			2010-11 emissions (MtCO2e)	Economic growth impact (MtCO2e) ***	Abatement from 2009-10 to 2019-20 (MtCO2e)				2010-11 to 2019-20 change (%)			2019-20 emissions (MtCO2e)	Un-captured potential (MtCO2e)
		Output	Emissions intensity	Emissions			Recent	Pipeline	Future trends	Total	Output	Emissions intensity	Emissions		
Total	565	+27%	-21%	-0%	563	+162	-8.5	-18.2	-53.2	-80.0	+29%	-11%	+14%	645	-212
Power	179	+12%	-7%	+4%	187	+17	-4.2	-5.7	-22.6	-32.5	+6%	-14%	-9%	171	-69
Industry	189	+21%	-5%	+15%	218	+71	-1.8	-7.8	-17.5	-27.0	+33%	-9%	+20%	262	-21
Energy use	127	+27%	-11%	+13%	143	+34	-1.0	-2.5	-11.8	-15.4	+33%	-15%	+13%	162	-12
Grid electricity use	56	N/A	N/A	+7%	60	-0	-0.3	-0.8	-3.6	-4.7	-1%	-8%	-8%	55	N/A
Off-grid electricity generation	6	N/A	N/A	+95%	12	+6	-0.1	-0.2	-1.1	-1.5	+52%	-8%	+40%	17	N/A
Direct fuel combustion	61	N/A	N/A	+18%	72	+28	-0.6	-1.5	-7.1	-9.2	+38%	-9%	+26%	90	N/A
Industrial processes	29	N/A	N/A	+17%	33	+8	-0.8	-2.6	-2.3	-5.7	+24%	-14%	+7%	35.72	-1
Aluminium	4	+4%	-26%	-23%	3	-0	-	-	-	-	-9%	+0%	-9%	3.16	N/A
Iron and Steel	9	-2%	+0%	-2%	9	-2	-	-	-	-	-29%	+0%	-29%	6.10	N/A
Mineral products	7	+10%	-9%	+0%	7	+1	-	-	-1.3	-1.3	+20%	-17%	-0%	6.53	N/A
Chemicals	5	N/A	N/A	+22%	6	+6	-0.8	-2.6	-1.0	-4.4	+95%	-37%	+23%	7.41	N/A
Regrigerants	3	N/A	N/A	+144%	8	+4	-	-	-	-	+49%	+0%	+49%	11.63	N/A
Other	1	N/A	N/A	+34%	1	-	-	-	-	-	+0%	+0%	+0%	0.89	N/A
Fugitive emissions	34	+22%	+0%	+22%	41	+29	+0.0	-2.7	-3.3	-6.0	+70%	-9%	+56%	64	-8
Oil & gas flaring and venting	8	+20%	-23%	-7%	7	+11	-	-2.7	-1.2	-3.9	+134%	-12%	+105%	14	N/A
Oil & gas distribution	3	+44%	-6%	+35%	4	+3	-	-	-	-	+68%	-1%	+67%	7	N/A
Coal mining	21	+26%	+7%	+34%	28	+14	-	-	-2.1	-2.1	+50%	-5%	+42%	40	N/A
Other	2	N/A	N/A	-9%	2	+1	-	-	-	-	+50%	-	+50%	3	N/A
Buildings	105	+14%	-6%	+8%	113	+5	-2.5	-	-10.0	-12.5	+16%	-20%	-7%	105	-29
Residential buildings	56	+12%	-4%	+8%	60	+3	-1.5	-	-8.8	-10.3	+15%	-24%	-13%	53	0
Residential energy use	56	+12%	-1%	+11%	62	+1	-	-	-4.0	-4.0	+15%	-17%	-5%	59	-6
All electricity use*	53	+12%	-12%	-1%	53	-1	-	-	-3.0	-3.0	+15%	-19%	-7%	49	N/A
Fuel combustion (gas, wood)	9	+12%	-6%	+6%	10	+2	-	-	-1.0	-1.0	+15%	-7%	+6%	10	N/A
Solar PV generation**	0	N/A	N/A	N/A	-2	+2	-1.5	-	-4.8	-6.3	N/A	N/A	+253%	-7	6
Commercial buildings	49	+17%	-8%	+8%	53	+2	-1.0	-	-1.2	-2.2	+18%	-16%	-1%	53	-29
Electricity use*	45	+17%	-8%	+8%	48	+1	-0.9	-	-1.1	-2.0	+18%	-17%	-2%	48	N/A
Direct fuel combustion	4	+17%	-9%	+7%	5	+1	-0.1	-	-0.2	-0.3	+18%	-4%	+13%	5	N/A
Land use & Waste	158	N/A	N/A	-32%	108	+46	-0.3	-4.7	-2.9	-7.9	+42%	-5%	+35%	145	-93
Agriculture	90	N/A	N/A	-6%	84	+8	-0.1	-2.7	-0.9	-3.7	+10%	-4%	+6%	89	-26
Forestry	55	N/A	N/A	-80%	11	+36	-0.2	-	-0.6	-0.8	N/A	N/A	+321%	46	-69
Deforestation	68	N/A	N/A	-45%	38	+14	-	-	-	-	+37%	+0%	+37%	51	N/A
Afforestation	-13	N/A	N/A	+102%	-27	+22	-0.2	-	-0.6	-0.8	-82%	+17%	-79%	-6	N/A
Waste	13	+6%	-10%	-4%	13	+1	-0.0	-2.0	-1.4	-3.5	+11%	-24%	-16%	11	2

* "All electricity use" corresponds to the emissions that would happen if all residential electricity use was from grid-supplied electricity. The impact of solar PV on emissions is shown separately under "Solar PV generation".

** All solar PV generation has been attributed to residential buildings for simplicity (currently 96% of solar capacity installed is in the residential sector)

*** Emissions due to economic growth if no further abatement activity happened in that sector past 2009-10 (this corresponds to the total emissions due to economic growth in each sector minus the abatement allocated to other sectors).

1.5 Glossary

ABCB, Australian Building Codes Board

CCA, Climate Change Authority

CFI, Carbon Farming Initiative

CO_2, carbon dioxide

CO_2e, carbon dioxide equivalent (used to describe how much global warming a given type and amount of greenhouse gas may cause, using the functionally equivalent amount or concentration of carbon dioxide as the reference)

CTIP, Clean Technology Investment Program

DIICCSRTE, Commonwealth Department of Innovation, Industry, Climate Change, Science, Research and Tertiary Education

DRET, Commonwealth Department of Resources, Energy and Tourism

EEO, Energy Efficiency Opportunities program

Emissions intensity, the amount of emissions produced for each unit of output or other metric

Energy efficiency, improvements in energy intensity from internal processes and operations.

Energy efficiency activity, any activity to identify, investigate or implement actions that reduce the amount of energy required to complete internal processes and operations.

Energy intensity, the amount of energy used per unit of output or other metric

GGAS, Greenhouse Gas Reduction Scheme

GHG, greenhouse gas (defined in the Kyoto Protocol to include four greenhouse gases (carbon dioxide, methane, nitrous oxide, sulphur hexafluoride) and two groups of gases (hydrofluorocarbons and perfluorocarbons)

GJ, giga joules

GW, giga watt (one billion watts)

Ha, hectare

kW, kilo watt (one thousand watts)

LNG, liquefied natural gas

LRET, Large-scale Renewable Energy Target

MEPS, Minimum Energy Performance Standards

Mt, mega tonne (one million tonnes)

$MtCO_2e$, million tonnes of carbon dioxide equivalent

MW, mega watt (one million watts)

MWh, mega watt hour, a unit of energy in particular electricity, equivalent to the work done by one million watts for one hour

N_20, nitrous oxide

NABERS, National Australian Built Environment Rating System

NCC, National Construction Code

OECD, Organisation for Economic Co-operation and Development

PJ, peta joules (one million giga joules)

PFC, perfluorocarbon

RET, Renewable Energy Target

Solar PV, solar photovoltaic

SRES, Small-scale Renewable Energy Scheme

SREC, Small-scale Renewable Energy Certificate

TWh, tera watt hour (one million mega watt hours)

Value added, the total value of goods and services produced by an industry, after deducting the cost of goods and services used in the process of production (ABS 2013)

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