

AUSTRALIA'S EMISSIONS OUTLOOK

11

Without strong policies to drive emissions reductions, and with strong projected population and economic growth, emissions from most sectors of the Australian economy are projected to rise. Total domestic emissions are projected to grow to 17 per cent above 2000 levels by 2020, and 37 per cent by 2030.

Even with incentives to reduce emissions, growth in export-oriented activity, such as liquefied natural gas (LNG) production and agriculture, is projected to increase emissions in those areas.

To meet its emissions reduction goals, Australia must capture the significant low-cost opportunities it has to reduce emissions, particularly in the electricity generation, industrial processes and fugitive emissions sectors. A set of stable, effective and complementary policies will be important to achieve goals at lowest cost, including targeted policies and regulations to address non-price barriers to reducing emissions.

If Australia is to reduce its emissions in the medium to longer term, effective policies need to be implemented now. Australia's current stock of emissions-intensive and energy-intensive buildings, electricity generators, industrial plants, infrastructure and vehicles will take decades to turn over. New infrastructure will affect Australia's efficiency and emissions levels, for better or worse, for many years. Australia needs clear and sustained policy signals in place as soon as possible to deliver substantial emissions reductions post-2020.

The electricity sector has the largest share of Australia's emissions and the largest emissions reduction potential. Investments in this sector are long-lived—failing to act in the near term to improve energy efficiency in industrial, commercial and residential sectors would make it harder to meet Australia's future emissions reduction goals. Longer term, reducing the emissions intensity of supply is vital. If electricity generation becomes considerably less emissions-intensive, electricity could be used to power other sectors, including transport and direct combustion, reducing domestic emissions.

Improving transport energy efficiency is a major opportunity for substantial low-cost emissions reductions. The Authority recommends the government investigate light vehicle CO₂ emission standards for introduction in Australia in the near term.

Chapter 11 describes Australia's emissions outlook in detail and highlights substantial opportunities to reduce emissions from energy supply, buildings, equipment and vehicles.

In this chapter, emissions reduction opportunities are identified relative to a counterfactual 'no price' scenario. This analysis is complemented by Appendix D, which presents a more detailed assessment of Australia's progress against emissions reduction goals and the outlook for emissions, relative to 2000 levels.

11.1 WHY ANALYSE AUSTRALIA'S EMISSIONS OUTLOOK?

Assessing Australia's emissions outlook can identify opportunities for economically efficient and environmentally effective emissions reductions, as well as uncertainties, data gaps and challenges to realising those opportunities. This information can contribute to effective policy development. It can also indicate whether Australia is on track to meet its emissions reduction goals and international commitments, and provide an early warning if efforts are falling short.

The Authority must review Australia's progress towards its emission reduction goals annually. The analysis of Australia's emissions outlook in this chapter, together with the analysis in chapters 5, 6 and 12 and Appendix D, fulfills the current legislative requirements for reporting on progress.

The following sections explore possible future trends in sectoral emissions and potential contributions to Australia's emissions reduction goals. They neither prescribe nor imply endorsement of specific outcomes, but instead identify potential paths for future emissions reductions.

11.2 MODELLING UNDERPINNING THE EMISSIONS OUTLOOK

The Authority has used economic modelling to explore a range of future scenarios for Australia's economy and emissions. The four core scenarios modelled by Treasury and DIICSRTE (2013) and described in Chapter 10 involve different levels of incentives for emissions reductions (Box 11.1). The no price scenario includes existing policies such as the RET, energy efficiency standards and land clearing controls, but excludes the carbon price and the CFI. The other three scenarios assume a low, medium and high carbon price, in addition to other existing policies and the CFI.

While the scenarios are largely based on the current legislative arrangements in the Clean Energy Act, the Authority considers the carbon price can be seen as a broad proxy for incentive-based measures. The results show the potential scale and source of emissions reductions available in Australia at different marginal costs (Table 11.1). These four scenarios inform the Authority's assessment of possible emissions outcomes in the remainder of this chapter and in Appendix D.

BOX 11.1: MODELLED EMISSIONS REDUCTIONS OPPORTUNITIES

The emissions reduction opportunities identified in the modelling reflect projected outcomes under different future carbon prices, relative to projected emissions without a carbon price. Depending on the design, the Authority considers other policies, including the Direct Action Plan, may mobilise similar emissions reductions opportunities. The Treasury and DIICCSRTE modelling reflects:

- Outcomes that might arise when entities subject to the carbon price pay for emissions. If carbon prices are passed through to downstream markets, it may prompt a reduction in demand, leading to lower production of emissions-intensive goods and services. This effect is included in the modelled outcomes.
- The coverage of the carbon price under the current legislation. The Direct Action Plan may cover a different set of activities. In the low, medium and high scenarios, a price incentive applies to all emissions sources except fuel use by light vehicles, decommissioned mines, synthetic gases imported prior to July 2012 and facilities below the coverage threshold (generally 25 kt CO₂-e per year). LULUCF, agriculture and waste deposited to landfill before 2012 can access a price incentive for emissions reductions through the CFI.

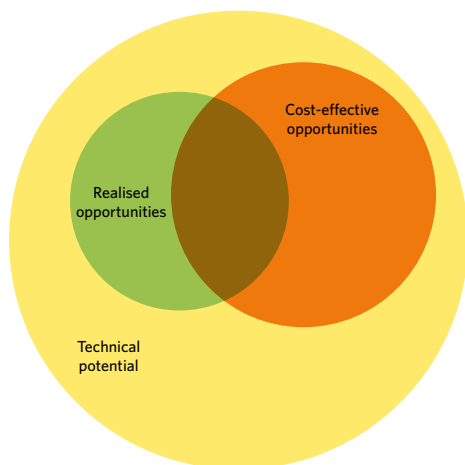
TABLE 11.1: MARGINAL EMISSIONS REDUCTION COST UNDER DIFFERENT SCENARIOS, 2020 AND 2030 (\$/t CO₂-e)

	2020	2030
No price scenario	0	0
Low scenario	\$6.30	\$54.50
Medium scenario	\$26.70	\$54.40
High scenario	\$65.20	\$134.90

Note: Real \$2012, rounded to nearest 10 cents. The marginal cost of emissions reductions in 2020 reflects the weighted average of the ACU and the Kyoto unit prices. In 2030, the marginal cost of emissions reduction is the ACU price.

Source: Treasury and DIICCSRTE 2013

The modelling provides a useful benchmark to assess the cost of achieving different targets and identifying emissions reduction opportunities in the domestic economy at different prices, given certain policy settings and assumptions. It does not give a complete picture of emissions reductions potential under all possible policies. The actual emissions reductions made in Australia in the future, and the associated economic cost, will depend on a range of factors, including the policies in place. Figure 11.1 explains the range of estimates for emissions reductions and Section 11.3.3 describes the factors influencing Australia’s emissions reduction outlook.

FIGURE 11.1: CATEGORIES OF EMISSIONS REDUCTION OPPORTUNITIES

There are different ways to consider emissions reduction opportunities:

- technical potential is that which is technically possible, though not necessarily at low cost
- cost-effective opportunities are those that can be realised up to a benchmark of acceptable cost, from either a societal or investor perspective
- realised opportunities are those that are taken up.

Policies can change the relative costs of reducing emissions and can make low-emissions activities and technologies competitive with conventional ones. An effective policy suite will align cost-effective opportunities with realised opportunities. Policy gaps mean that cost-effective opportunities are missed; inefficient policies realise opportunities that are not cost-effective.

Source: Climate Change Authority

Modelling, emissions projections and marginal abatement cost curves all make assumptions about technical, cost-effective and realised emissions reduction opportunities. They give a snapshot of potential outcomes at a point in time. Modelling results are significantly influenced by these assumptions and this is reflected in the wide range of emissions reduction estimates (Box 11.2).

The Treasury and DIICCSRTE modelling, for example, considers only a portion of the technical potential for emissions reductions. It focuses on the cost-effective opportunities for Australian emissions reductions in particular sectors at various marginal costs, which together meet a given emissions reduction goal.

BOX 11.2: WHY DO EMISSIONS REDUCTION ESTIMATES DIFFER?

The Treasury and DIICCSRTE modelling suggests total domestic emissions reductions in 2020 could be 35, 65 and 134 Mt CO₂-e in 2020 (relative to no price scenarios, in low, medium and high scenarios respectively). Only a portion of the technical potential for emissions reductions is realised.

Other studies suggest 2020 emissions reductions may be more or less. ClimateWorks (2010), for example, estimates 'realistic' emissions reduction potential in 2020 is 249 Mt CO₂-e, relative to business-as-usual (BAU). By contrast, in a later study, ClimateWorks (2013a) estimates 80 Mt CO₂-e of emissions reductions may be realised in 2020 if recent levels of emissions reduction activity are sustained (2013).

Differences between these studies explain the variability in their results, including assumptions in BAU and other scenarios about:

- Technologies and practices available to reduce emissions (this affects ‘technical potential’). For example, ClimateWorks (2010) assumed several carbon capture and storage (CCS) demonstration plants would be operating by 2020. By contrast, in the Treasury and DIICCSRE modelling CCS was found not to be economically viable before 2030.
- The costs of low-emissions technologies, including whether only private or also public or social costs are considered (this affects cost-effective opportunities). ClimateWorks assumed capital costs of low-emissions sources of electricity are generally lower than was assumed in the Treasury and DIICCSRE modelling. The modelling assumptions were based on ACIL Allen Consulting’s (2013) updates to technology costs from the 2012 Australian Energy Technology Assessment (BREE 2012).
- The anticipated consumer response and uptake of low-emissions options (this affects ‘realised opportunities’). ClimateWorks (2010 and 2013a) made more detailed and extensive assumptions about energy efficiency potential, and suggests large potential savings, than did the Treasury and DIICCSRE modelling.

Emissions accounting differences also alter results. The Authority, for example, incorporated updated global warming potentials from the IPCC’s Fourth Assessment Report (AR4) in its emission estimates, while ClimateWorks used the global warming potentials specified in the Second Assessment Report (AR2).

11.3 OUTLOOK FOR AUSTRALIA’S EMISSIONS

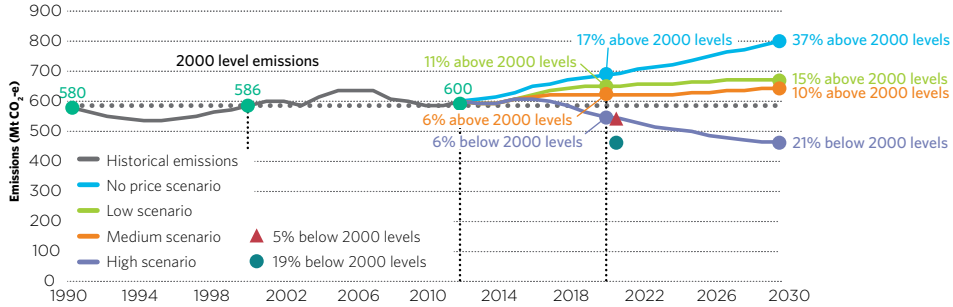
11.3.1 AUSTRALIA’S DOMESTIC EMISSIONS LEVELS

Australia’s emissions have remained relatively flat since 1990. As discussed in Chapter 6, most of the emissions reductions over that period are attributable to economic factors and policies enacted in the land sector. Between 2008 and 2012, electricity sector emissions have been falling by an average of about 0.8 per cent per year, due to lower demand growth and a shift towards less emissions-intensive generation (gas and renewables).

The current rate of reduction in emissions intensity from both policy and economic drivers is unlikely to reduce overall national emissions to 2020. Under the no price scenario, Australia’s emissions are projected to rise to 17 per cent above 2000 levels in 2020 and 37 per cent in 2030. Figure 11.2 shows that with price incentives emissions may fall—and the stronger the incentive, the greater the emissions reductions.

Only under the high scenario are Australia’s emissions projected to fall and stay below 2000 levels (Figure 11.2). The high scenario gets closest to the cumulative emissions reductions required to meet Australia’s minimum 5 per cent target.

FIGURE 11.2: AUSTRALIA'S PROJECTED EMISSIONS UNDER DIFFERENT SCENARIOS, 1990-2030



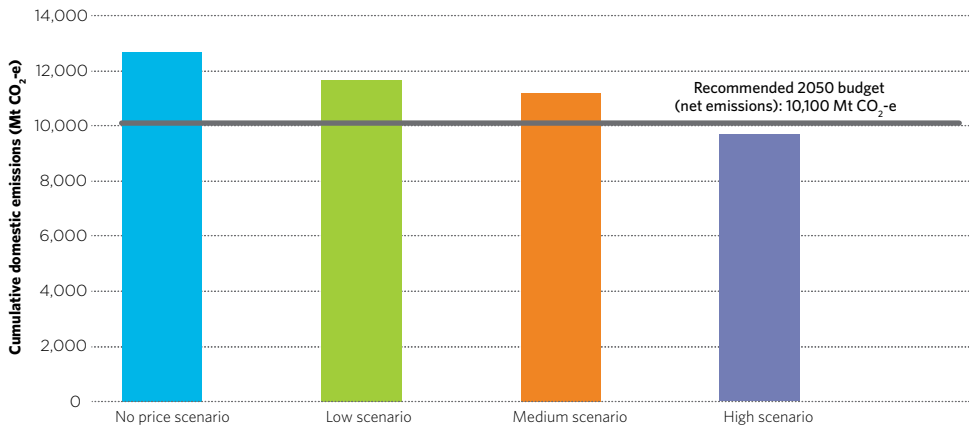
Source: Climate Change Authority calculations using results from Treasury and DIICCS RTE 2013

Part C recommends emissions reduction goals for Australia, including a budget for the period 2013-2050 of 10.1 Gt CO₂-e. These goals are expressed in net terms, consistent with Australia's international commitments to reduce emissions. To the extent that Australia's domestic emissions are higher than the levels specified in its international commitments, they must be offset by international emissions reductions.

Figure 11.3 shows Australia's projected cumulative emissions over the period 2013-2030, relative to its net emissions budget to 2050. This illustrates that, by 2030, Australia's emissions exceed the recommended budget under all of the modelled scenarios, except the high scenario. This suggests that to stay within the recommended budget, Australia will need to use international emissions reductions to complement domestic reductions.

The high scenario consumes the least of the Authority's recommended emissions budget; the low and medium scenarios use the budget more slowly than the no price scenario. This highlights the role of a strong incentive, or new policy, to reduce Australia's domestic emissions.

FIGURE 11.3: AUSTRALIA'S RECOMMENDED EMISSIONS BUDGET TO 2050 COMPARED WITH CUMULATIVE DOMESTIC EMISSIONS FROM 2013 TO 2030

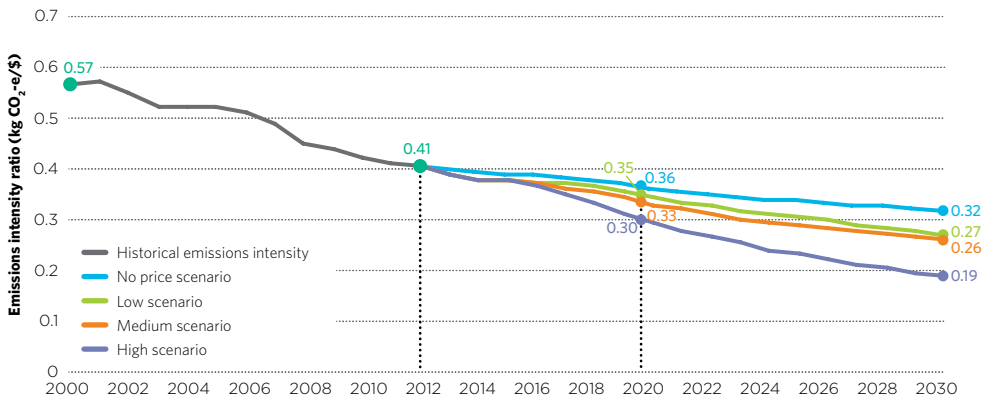


Source: Climate Change Authority calculations using results from Treasury and DIICCS RTE 2013

11.3.2 AUSTRALIA'S DOMESTIC EMISSIONS INTENSITY

The historical trend of falling emissions intensity of the economy, described in Chapter 6, is projected to continue under all scenarios as projected economic growth outpaces emissions growth (Figure 11.4). Economic growth is projected to increase at an average annual rate of about 3.1 per cent between 2013 and 2020, resulting in a similar average rate of emissions intensity reduction over the two decades since 1992.

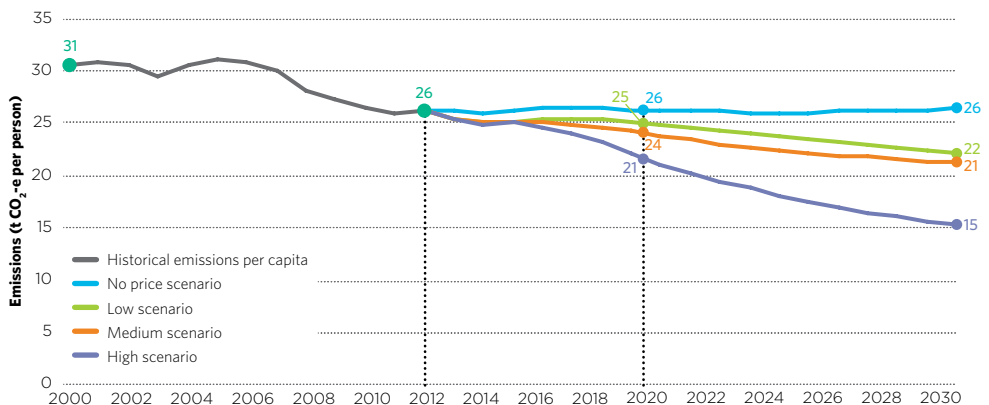
FIGURE 11.4: AUSTRALIA'S PROJECTED EMISSIONS PER DOLLAR GDP, 2000-2030



Source: Climate Change Authority calculations using results from Treasury and DIICCSRTE 2013

Emissions per person are also projected to fall in the low, medium and high scenarios, but rise slightly relative to current levels in the no price scenario (Figure 11.5). In the high scenario, emissions per person are approximately half 2000 levels by 2030.

FIGURE 11.5: AUSTRALIA'S PROJECTED EMISSIONS PER PERSON, 2000-2030



Source: Climate Change Authority calculations using results from Treasury and DIICCSRTE 2013

11.3.3 FACTORS INFLUENCING THE EMISSIONS OUTLOOK

Several factors will drive Australia's future emissions. Across all scenarios, irrespective of the choice of emissions reduction goals or the level of a price incentive, emissions will be influenced by:

- Broad trends in the macro-economy, such as exchange rates, commodity prices, interest rates, income levels, renewal of building stock and equipment, and population growth. Australia's population and economy are projected to grow and to place upwards pressure on emissions as a result.
- International demand for emissions-intensive commodities and resources, such as beef, LNG and coal. Projected growth in global demand is likely to increase Australian activity in these sectors and the associated emissions.

The type of emissions reductions and the rate at which they are achieved will also be affected by:

- technical progress over time, which can make low-emissions technologies or practices more feasible, and change their relative costs
- the diffusion rate of new technologies and practices, which depends on stock and fleet turnover rates, the timing of retrofit opportunities, and the lead time for training and skills development
- incentives and policies put in place to reduce emissions; for example, in the electricity sector, the RET is significant
- cultural norms and consumer behaviour.

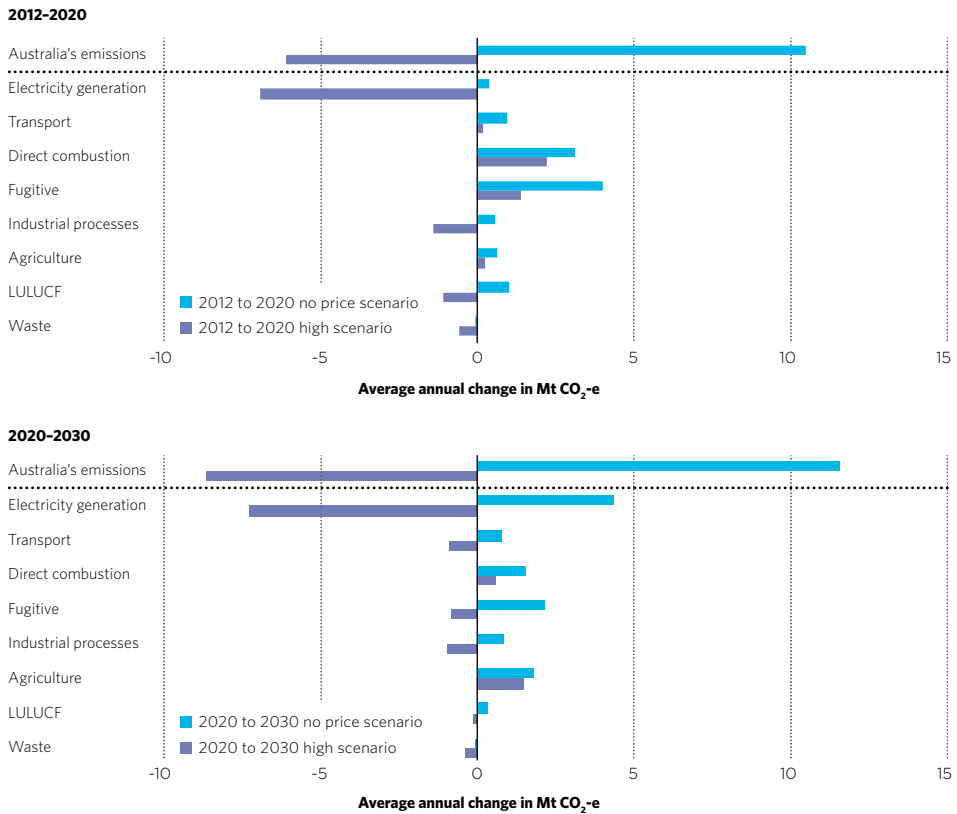
A range of assumptions and baselines are reflected in different estimates for emissions reductions (see Box 11.2). These estimates explore what might happen and where there could be variability, but do not necessarily assess likelihood.

11.3.4 SECTORAL OUTLOOK OVERVIEW

Emissions reduction opportunities vary considerably, depending on each sector's proportion of Australia's total emissions (Figure 6.2) and its responsiveness to incentives. For example, the Treasury and DIICSRTE (2013) suggest that growth in mining and LNG processing will lead to new sources of emissions. These would need to be offset by stronger reductions in other sectors to maintain the same overall pace of reduction.

Figure 11.6 shows the range in projected sectoral emissions outcomes across the modelled scenarios. Without additional policies (no price scenario), emissions in every sector except waste are projected to increase above 2012 levels. Specific sectoral emissions reduction opportunities are discussed further in Section 11.4 and Appendix D.

FIGURE 11.6: PROJECTED AVERAGE ANNUAL CHANGE IN EMISSIONS, BY SECTOR, 2012-2030



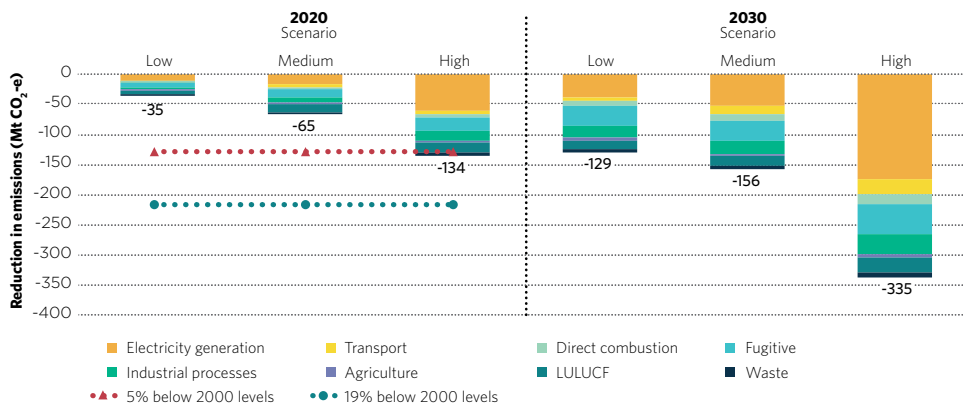
Source: Climate Change Authority calculations using results from Treasury and DIICSRTE 2013

Figure 11.7 and Table 11.2 provide an insight into the emissions reductions that a price incentive (or equivalent) could drive between now and 2030:

- Electricity remains the greatest single sectoral source of emissions under all scenarios. In a no price scenario, its emissions are set to rise from current levels, despite the RET. Electricity also offers the largest opportunity for emissions reductions in response to price incentives, through both a reduction in the emissions intensity of generation and energy efficiency.
- Sectors that are primarily driven by export demand—direct combustion, fugitives and agriculture—present the greatest challenge. Emissions growth is projected for these sectors under all scenarios, with the exception of fugitive emissions, which could fall during the 2020s with a sufficiently high price signal.
- Transport emissions reductions depend on the rate of uptake of fuel-efficient new vehicles and a switch to lower emissions fuels. Without policies to promote these opportunities, transport emissions will grow. Increasing activity in this sector, notably in aviation and road freight, is expected to place upwards pressure on emissions levels. So, too, would a possible move towards synthetic fuels derived from coal, gas and shale.
- Industrial process emissions are projected to be highly responsive to a price incentive and, under the high scenario, could be reduced by 58 per cent on 2000 levels by 2030.

- Greater reforestation and afforestation activities, avoided deforestation and improved land management could deliver emissions reductions from the land sector, especially with a high price incentive, to 2020.
- Waste emissions are projected to remain relatively stable without a price incentive. Emissions reductions are still available and could be realised with an appropriate price incentive.

FIGURE 11.7: PROJECTED EMISSIONS REDUCTIONS RELATIVE TO THE NO PRICE SCENARIO, 2020 AND 2030



Source: Climate Change Authority calculations using results from Treasury and DIICCS RTE 2013

TABLE 11.2: SECTORAL SHARES OF EMISSIONS REDUCTIONS RELATIVE TO THE NO PRICE SCENARIO, 2020 AND 2030 (PER CENT)

		ELECTRICITY	TRANSPORT	DIRECT COMBUSTION	FUGITIVES	INDUSTRIAL PROCESSES	AGRICULTURE	LULUCF	WASTE
2020	Low scenario	25.3	6.3	3.4	24.2	13.2	4.0	17.5	6.0
	Medium scenario	24.1	6.9	5.5	21.3	14.7	4.0	18.9	4.8
	High scenario	43.7	4.8	5.2	15.6	11.8	2.5	13.3	3.1
2030	Low scenario	28.3	5.4	6.8	24.4	16.2	3.2	11.0	4.7
	Medium scenario	32.7	9.4	6.0	21.1	14.5	3.0	9.1	4.1
	High scenario	51.9	6.9	5.0	15.2	10.1	1.9	6.7	2.4

Note: Rows may not total 100 per cent due to rounding.

Source: Climate Change Authority calculations using results from Treasury and DIICCS RTE 2013

11.4 SECTORAL OUTLOOK AND EMISSIONS REDUCTION OPPORTUNITIES

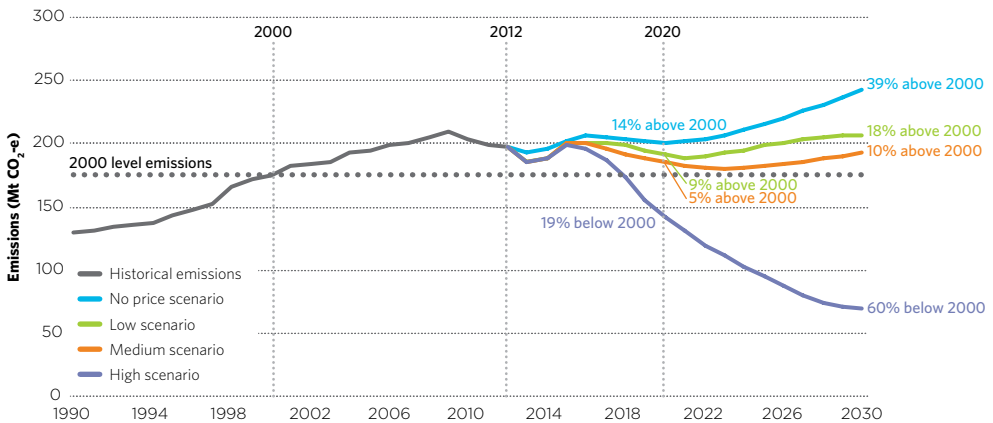
11.4.1 ELECTRICITY

Emissions in the electricity sector are released when fuels, such as coal, natural gas and oil, are combusted to generate electricity. This sector includes generation that is connected to electricity grids such as the NEM and generation for use on-site ('off-grid'). The electricity sector accounted for 33 per cent of national emissions in 2012 (Treasury and DIICSRTE 2013).

Emissions from electricity are projected to rise steadily in a no price scenario, underpinned by economic and population growth. With a price incentive, electricity emissions could stabilise and then fall significantly after 2030 (low and medium scenarios) or, with sufficient incentive, begin to fall in the nearer term (high scenario) (Figure 11.8).

The emissions reductions projected in the low, medium and high scenarios, relative to the no price scenario, reflect a shift towards lower emissions sources of generation and lower electricity demand. The relative costs of generating technologies and fuels, and mitigation policies that affect these costs, will largely determine the timing and magnitude of the shift towards low-emissions generation (ACIL Allen Consulting 2013; BREE 2012a; IEA 2012a).

FIGURE 11.8: ELECTRICITY EMISSIONS, HISTORICAL AND PROJECTED, 1990–2030



Source: Climate Change Authority calculations using results from Treasury and DIICSRTE 2013 and ACIL Allen Consulting 2013

OPPORTUNITIES TO REDUCE ELECTRICITY SECTOR EMISSIONS

Modelling and other analyses suggest that, with incentives in place, the electricity sector could be the single largest source of domestic emissions reductions over the next two decades. The Treasury and DIICSRTE modelling suggests about half of the domestic emissions reduction opportunities to reach Australia’s minimum 5 per cent target could be found in the electricity sector.

Compared to the no price scenario, the modelling suggests the electricity sector could reduce emissions by between 9 and 59 Mt CO₂-e in 2020 (in low and high scenarios, respectively) and by between 36 and 174 Mt CO₂-e in 2030. ClimateWorks (2010) estimates that the electricity sector has ‘realistic reduction’ potential of up to 77 Mt CO₂-e in 2020, compared to BAU, by reducing the emissions intensity of supply. These estimated emissions reductions are additional to the emissions reductions due to the RET.

The RET has a significant effect on emissions. At its currently legislated level, the RET is estimated to reduce emissions by 102 Mt CO₂-e over the period 2012–13 to 2020–21 (CCA 2012). If the RET is not met, or the level of the RET is lowered, this would increase projected emissions and the emissions reduction task to 2020 (see Chapter 9). AEMO's (2013a) forecasts also suggest the RET will play an important role in lowering the emissions intensity of electricity supply over the period to 2020. The Treasury and DIICCSRTE modelling projects that the RET is met, as legislated, in all scenarios.

Price incentives are important both in driving changes in the emissions intensity of supply and reducing demand (ClimateWorks 2013b; Garnaut 2008; IEA 2012a). Recently, emissions reductions have come from both, with estimates that about 40 per cent of the reduction in emissions from the NEM in the year to 2013 was due to lower electricity demand, and 60 per cent to the uptake of lower emissions electricity generation (Pitt & Sherry 2013).

In the near term, most of the electricity sector's emissions reductions are likely to come from reducing electricity demand, driven in part by energy efficiency measures. If barriers to energy efficiency (described below) are overcome, this could play an even larger role.

REDUCING EMISSIONS THROUGH LOWERING ELECTRICITY DEMAND

Despite declines in the past few years, Australia's per person electricity consumption is well above the OECD average and it lags on energy efficiency (IEA 2012b). Reducing electricity demand, particularly by taking up more efficient technologies and equipment, can:

- offer personal and societal financial savings
- make it easier and less costly to meet Australia's emissions reduction goals, particularly in the near term.

Several sources suggest that reducing electricity demand can reduce emissions at low cost, or even at a positive net present value (Prime Minister's Task Group on Energy Efficiency 2010; PC 2005; Climate Institute 2013). This could particularly benefit disadvantaged consumers, who have more energy-intensive appliances or houses and would be more likely to face the barriers of split incentives or capital constraints to investing in energy efficiency. Changing the profile or level of energy demand could also reduce consumers' electricity bills and offer economic benefits. For example, the AEMC (2012) estimates that reducing peak demand growth could cut system expenditure by at least \$4.3 billion over the next decade, mainly through avoided investment in the electricity transmission and distribution network.

Building and equipment choices lock in higher or lower emissions for many years. It may be decades before appliances are replaced or economic retrofits to buildings are possible. Policies targeting new assets will take several years—even decades—to significantly reduce aggregate emissions. The emissions reduced from buildings and appliances between 2020 and 2030 will depend on the policies and standards that are put in place in the next few years.

Evidence suggests that energy efficiency programs (primarily regulatory) have delivered large electricity demand reductions. According to Saddler (2013), these programs accounted for about a third of the observed reductions in demand growth in the NEM since 2006. AEMO reports that continuing the existing and planned building-related energy efficiency measures and minimum energy performance standards for electricity appliances could reduce electricity demand, in 2030, to a level that is about 17 per cent below projected national electricity demand in the Treasury and DIICCSRTE's no price scenario (AEMO 2013b). If such regulations were maintained and expanded, and complemented with some of the initiatives identified in previous reviews (see Table D.5 in Appendix D), it could increase the share of potential emissions reductions taken up.

All else being equal, lower-than-projected electricity demand can reduce emissions and make the emissions reduction task easier. Several downward revisions to demand projections in recent years illustrate this potential (for example, AEMO 2013a, 2013d). ClimateWorks (2013c) describes plausible scenarios for lower electricity demand from households, commercial buildings and industry, which could keep electricity demand at 2012–13 levels in 2020 and deliver up to 23 Mt CO₂-e emissions reductions in 2019–20. ACIL Allen Consulting (2013) modelled a low-electricity demand sensitivity, which suggested even larger potential emissions reductions.

REDUCING EMISSIONS INTENSITY OF ELECTRICITY SUPPLY

At present, Australia's electricity supply is among the most emissions-intensive in the developed world and, since 2007, has exceeded China's electricity emissions intensity (IEA 2013a).

To at least 2020, existing and committed electricity supply is expected to be adequate to meet demand in the NEM (AEMO 2013c). Over this period and into the decade beyond, the RET will play an important role in reducing the emissions-intensity of supply by supporting deployment of low-emissions technologies, including wind and solar. Over this period, the risk of locking in new emissions-intensive generation is relatively low. Longer term, however, clear policy and other signals must be in place to avoid deploying new emissions-intensive generation and to encourage major retrofits that reduce emissions from existing plants.

Additional opportunities to reduce the emissions intensity of the existing generation fleet, dominated by fossil fuel generators, may relate to:

- reducing output—with a price incentive, the recent trend towards mothballing and reducing output from coal-fired power could continue
- retrofitting—upgrading turbines, modifying boiler operations, retrofitting plants with new coal-drying technologies and co-firing with low-emissions fuels. Several Australian generators have suggested they may do so, in a scenario with a price incentive (DRET 2013).

Fuel prices will affect emissions from existing (and future) generators. Rising gas prices make it likely that gas-fired generation in the NEM will decline and remain below current levels until at least the early 2030s (AEMO 2013e). The Treasury and DIICCSRTE modelling projects that, in the no price scenario, the share of coal-fired generation does not change substantially in the period to 2030, and the declining share of gas generation is replaced by renewable sources. Some industry analysis suggests that gas could lose market share to coal-fired generation in the NEM instead of renewable sources (Reputex 2013).

Over time, with innovation and greater deployment, the costs of low-emissions technologies are likely to fall. This will improve their competitiveness and their share of generation. Depending on the relative costs and policy incentives, by the 2030s the growing share of low-emissions generation could include emerging technologies such as geothermal and CCS, which are currently relatively costly and facing other challenges to deployment (see below). Policies, including supporting research and development, could assist.

CHALLENGES TO REDUCING ELECTRICITY SECTOR EMISSIONS

Challenges to reducing electricity demand

There are several non-price barriers to reducing electricity demand, identified by the Productivity Commission (2005, 2013), Garnaut (2008), AEMC (2012) and others. There is also considerable consensus about solutions, including:

- electricity consumption information and prices that better reflect actual costs of supply and smart infrastructure to help consumers manage their use
- energy efficiency standards for electrical appliances and buildings. Standards help combat split or perverse incentives for investing in energy efficiency while still allowing consumers the same appliance functionality.

It is important to determine how energy efficiency opportunities can be cost-effectively pursued in the new policy environment. Particular initiatives that have been identified in previous reviews are discussed in Appendix D.

Challenges to reducing emissions intensity of electricity supply

Several sources of low-emissions electricity generation have already been deployed in Australia, including wind and solar PV. At present, new investments in low-emissions generation are not cost-competitive with existing generation (whose high initial capital costs are now sunk). This, combined with an overcapacity of supply in the NEM and barriers to exit for incumbent generators, means that existing generators could operate for some time. This means there is little incentive for investment in new lower emissions (or any other) electricity generation.

Policy is needed to reduce the emissions intensity of supply. The RET is accelerating deployment of renewable electricity generation; this could be further accelerated by policies that create an additional demand for low-emissions generation. It is important that policies and incentives are stable, given the long life of electricity generation assets.

The deployment of emerging low-emissions technologies, such as geothermal and CCS, is high-risk and capital-intensive. Public or policy support may be required to make deploying these technologies financially viable, unless an additional revenue stream is available. Further, technical, price and logistical challenges have slowed progress on these particular technologies in recent years. As a result, electricity sector experts generally do not expect them to contribute substantial emissions reductions in Australia until the 2030s, even if policy drivers exist to promote investments in lower emissions generation (ACIL Allen Consulting 2013; BREE 2012b).

Challenges to tracking progress in the electricity sector

Analysing the outlook for the electricity sector is hampered by data gaps. Policy-makers, investors, market participants and consumers could make better decisions if more information was available, including:

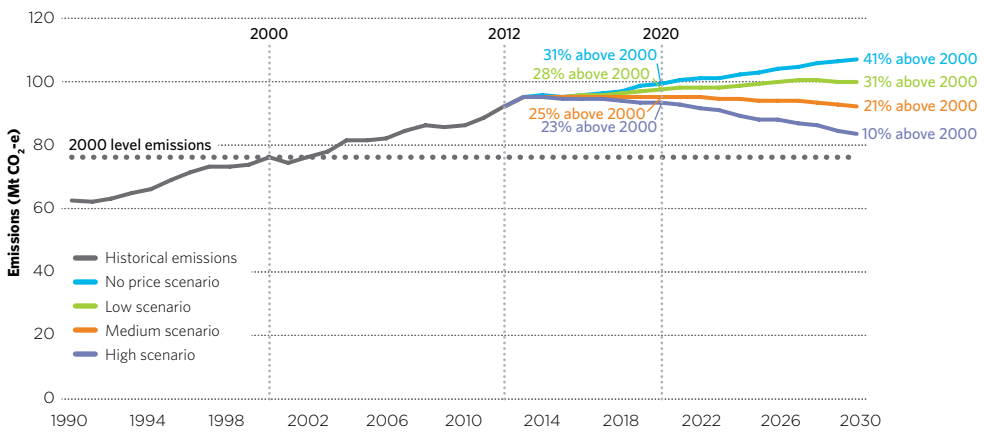
- consistent time series information on the location and time of end-use electricity consumption
- routine collection of granular information on the level and mix of off-grid generation
- earlier publication of the pipeline for grid-connected electricity generation assets, by AEMO and transmission companies.

A detailed analysis of progress in reducing electricity sector emissions is presented in Appendix D3.

11.4.2 TRANSPORT

Transport emissions are produced from vehicles combusting fuels to move people and freight, reported across four modes—road, rail, domestic aviation and domestic shipping. International aviation and shipping emissions are excluded from Australia’s emissions. Emissions associated with producing and refining liquid and gaseous fuels, as well as generating electricity, are attributed to stationary energy sectors. The transport sector accounted for approximately 15 per cent of Australia’s emissions in 2012.

FIGURE 11.9: TRANSPORT EMISSIONS, HISTORICAL AND PROJECTED, 1990–2030



Source: Climate Change Authority calculations using results from Treasury and DIICCSRTE 2013 and Reedman and Graham 2013

Transport sector emissions have increased by 29 Mt CO₂-e (46 per cent) since 1990. The Treasury and DIICCSRTE modelling projects that, under all scenarios, transport demand will continue to grow. Under the low, medium and high scenarios, emissions dip or level out to the mid 2030s, due to reduced emissions intensity of passenger and road freight transport (Figure 11.9). After 2030, emissions are projected to increase again as road transport activity continues to grow and price-driven emissions reduction opportunities are exhausted.

OPPORTUNITIES TO REDUCE TRANSPORT EMISSIONS

Broadly, transport emissions can be reduced in three ways:

- increasing the efficiency of vehicles, through technology improvements in internal combustion engines and rollout of alternative drivetrain vehicles in the case of road vehicles
- reduced emissions intensity of fuels, through low-emissions alternatives to conventional fuels such as biofuels and natural gas
- more efficient demand management—through mode shift from road freight to rail or shipping, and from private vehicles to public and active transport—as well as improved urban planning, transport infrastructure, traffic management and intelligent transport systems.

There are emissions reduction opportunities in all forms of transport. The Treasury and DIICCSRTE modelling suggests that price incentives may be effective in reducing emissions from some sources in the medium to long term, with emissions lower by 23 Mt CO₂-e in 2030 under the high scenario relative to the no price scenario.

In this modelling, most of the projected transport emissions reductions due to price incentives result from reduced emissions intensity of heavy vehicles through gains in efficiency and increasing consumption of biofuels in place of liquid fossil fuels. Biofuels could play the largest role in reducing aviation emissions, which could offset strong increases in demand.

Light vehicles are responsible for almost 10 per cent of Australia's total emissions. As mass-produced, dispersed emissions sources, light vehicle emissions reductions may be more effectively realised using efficiency standards (discussed below). Emissions reductions possible through such standards were not included in the modelling presented in Figure 11.9.

Emissions reduction benefits from better managed demand are not modelled; however, several studies (Graham et al. 2012) have identified significant emissions reduction potential for a range of approaches.

CHALLENGES TO REDUCING TRANSPORT EMISSIONS

Under any scenario, emissions reductions might be slowed or prevented by:

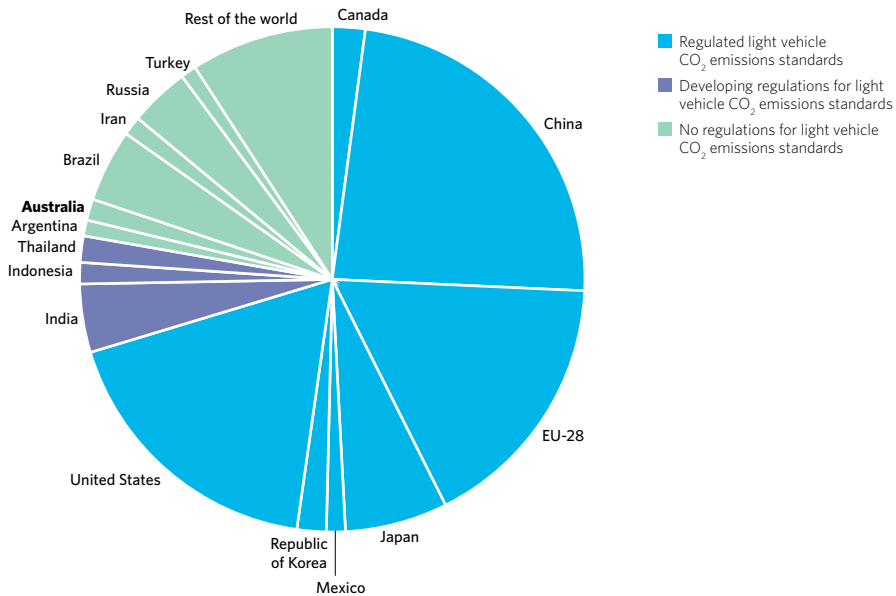
- The rate of turnover of the vehicle fleet—in 2013, the average age of all road vehicles registered in Australia was 10 years (ABS 2013), and trains, aircraft and ships may remain in service for several decades. Transport infrastructure, too, is designed and built for many decades of use.
- The cost of alternative fuels and emerging vehicle technologies—biofuels are currently expensive to produce compared to liquid fossil fuels, and if oil prices are lower than projected this may delay uptake of low-emissions alternatives. The current high purchase price and limited driving range of electric vehicles, for example, relative to internal combustion engine vehicles, is a hurdle to widespread adoption.
- Supply constraints in alternative fuels—the increased production of sustainable biofuels could be limited by a lack of available land and competing food uses for the biofuel crops, though next-generation biofuels may ameliorate this issue.
- The emissions intensity of new energy sources—if the emissions intensity of Australia's electricity supply remains high, it is possible that vehicle electrification could result in a net emissions increase compared with continued use of conventional light vehicles. Emissions could increase if higher emission alternative fuels, such as those derived from gas-, coal- and shale-to-liquid methods, gain market share at the expense of lower emissions fuels.
- The level and cost of infrastructure needed to encourage lower emissions alternative freight and passenger travel—for example, the low population density of Australia's cities (relative to European and Asian standards) presents a challenge to investing in and using alternatives to light vehicles for urban passenger movement.

A ROLE FOR FLEET-AVERAGE LIGHT VEHICLE CO₂ EMISSIONS STANDARDS FOR AUSTRALIA?

Despite having reduced their emissions intensity by 21 per cent over the past decade (NTC 2013), Australia's light vehicles remain among the most emissions-intensive in the world. The Treasury and DIICSRTE modelling does not include any price incentive or policies targeting vehicle efficiency.

Light vehicle emissions reductions can be realised through fleet-average CO₂ emissions standards (or, equivalently, fuel economy standards). Australia considered such standards in 2010 (DIT 2011) but they have not progressed. Over 70 per cent of light vehicles produced in the world today are subject to mandatory CO₂ emissions standards, including those sold in the EU, the US, Canada, China, Japan and South Korea (Figure 11.10). Similar standards are under investigation in emerging auto markets such as India, Indonesia and Thailand. Australia's light vehicle fleet is unlikely to maximise available fuel efficiency opportunities if suppliers prioritise auto markets with mandatory standards in place for their more efficient models and variants. Nevertheless, Australia is likely to gain some fuel efficiency benefits as a flow-on effect from standards applied in other auto markets.

FIGURE 11.10: SHARE OF GLOBAL VEHICLE MARKETS COVERED BY MANDATORY CO₂ EMISSIONS STANDARDS



Source: Climate Change Authority calculations based on The International Council on Clean Transportation 2013, Transport Policy.net 2013 (for standards coverage), and OICA 2012 (for vehicle numbers)

The Authority commissioned CSIRO to model the emissions reduction potential of Australia adopting fleet-average CO₂ emissions standards that drive a rate of efficiency improvement comparable to that of the EU and US. This modelling showed that up to 14 Mt CO₂-e per annum (13 per cent of total transport emissions) could be avoided by 2030 using fleet-average emissions standards introduced from 2018. By 2030, about half of the light vehicle fleet would have been subject to standards. For the entire modelled period (from now to 2050), introducing relatively lenient standards earlier (in 2018) was projected to achieve greater emissions reductions than introducing more stringent standards later (in 2025), emphasising the importance of early action. This is discussed in more detail in Appendix D4.

In overseas markets, fleet-average CO₂ standards deliver emissions reductions at a net private saving—the additional vehicle cost is more than offset by fuel savings over the life of the vehicle. Given the global market for automobiles, the cost of efficiency improvements is likely to be broadly comparable across markets (Reedman and Graham 2013). Studies have shown that the cost of the EU’s standards to 2020 (95 gCO₂/km by 2020) are likely to increase the average vehicle purchase price by about €1,000–1,100 per vehicle (Cambridge Econometrics and Ricardo-AEA 2013). Similarly, in the US, which has enacted standards with a similar rate of efficiency improvement, the increased purchase cost per vehicle in 2020, compared to a baseline year of 2010, is estimated at US\$762 (NHTSA 2012).

The CSIRO modelling shows that standards that require the same rate of efficiency improvement in Australia as under EU and US standards—about 5 per cent per annum—would reduce fleet-average fuel consumption by as much as 23 per cent by 2030, offering commensurate reductions in fuel cost and improvements in productivity, all else being equal. This is for the average of all in-service vehicles, not just newer vehicles subject to the standards. Standards could offer a total fleet-average fuel savings of about 3 cents per kilometre by 2030, which equates to \$450 per year for a vehicle travelling a typical 15,000 km per year. The savings would be higher for the average newer vehicle subject to the standards.

The CSIRO modelling projects light vehicle fuel consumption could be 12–24 per cent lower in 2030 with standards, which could help drive improvements in transport sector productivity. The modelling also shows that alternative drivetrain vehicles, notably plug-in hybrid electric vehicles and fully electric vehicles, are likely to be deployed sooner if light vehicle CO₂ standards are implemented. When operating in electric mode, these vehicles are quiet and have no drive-time emissions. Their deployment will help reduce Australians' exposure to noise and air toxic emissions, with associated health and amenity benefits.

Light vehicle CO₂ emissions standards appear to offer significant, low-cost emissions reductions, with potential co-benefits. Fuel savings alone are likely to provide a private payback of just a few years. Implementing light vehicle emissions standards deserves further investigation for Australia.

The emissions reduction potential of Australian light vehicle fleet-average CO₂ standards is discussed further in Appendix D.

RECOMMENDATION

R.10 The government investigate the near-term introduction of fleet-average CO₂ emissions standards for light vehicles in Australia as a way to secure significant, cost-effective emissions reductions and related co-benefits.

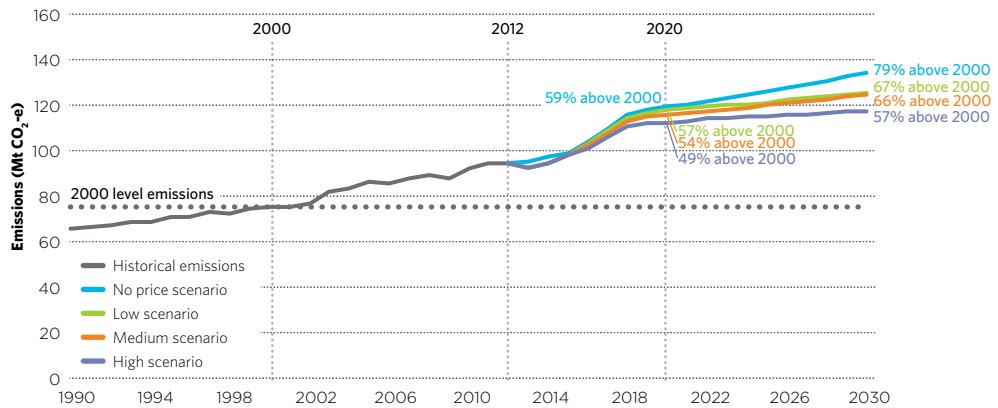
11.4.3 DIRECT COMBUSTION

Direct combustion emissions occur when fuels are combusted for stationary energy purposes, such as generating heat, steam or pressure (excluding electricity generation). These emissions are released by large industrial users and small, dispersed residential and commercial consumers. Emissions from direct combustion accounted for 16 per cent of national emissions in 2012 (Treasury and DIICCS RTE 2013).

In each modelled scenario, direct combustion emissions are projected to rise strongly from current levels through to 2030 (Figure 11.11). In absolute terms, under all but the no price scenario, direct combustion emissions increase more than any sector of the Australian economy. This increase is driven by growth in energy extraction industries, including more than 15 LNG production projects in operation, under construction or at initial stages (BREE 2013a).

Price incentives could slow growth to some extent by encouraging greater uptake of low-emissions technologies.

FIGURE 11.11: DIRECT COMBUSTION EMISSIONS, HISTORICAL AND PROJECTED, 1990-2030



Source: Climate Change Authority calculations using results from Treasury and DIICCS RTE 2013

OPPORTUNITIES TO REDUCE DIRECT COMBUSTION EMISSIONS

With strong growth projected in energy resources extraction, emissions intensity improvements are unlikely to be enough to reduce overall emissions from the sector. The Treasury and DIICCS RTE modelling suggests price incentives will have a relatively limited effect on direct combustion emissions; much of the growth relates to LNG exports under long-term supply contracts. Even under the high scenario, the sector is expected to reduce emissions by only about 6 per cent (7 Mt CO₂-e) in 2020 and 12 per cent (17 Mt CO₂-e) in 2030, compared with a no price scenario.

The manufacturing and mining industries produce about three-quarters of direct combustion emissions. Mining activity is projected to grow, even with strong global action on climate change. Emissions reductions could come from improvements in emissions intensity, such as making gas turbines and machinery more efficient, or capturing and using heat from gas turbine exhaust. With a price incentive, new investments could increasingly incorporate low-emissions technologies that could deliver greater emissions reductions in the longer term (Treasury and DIICCS RTE 2013).

The growth in residential and commercial direct combustion emissions, mainly from gas use, could be constrained through more efficient water and space heating appliances and more thermally efficient buildings. George Wilkenfeld & Associates (2009) suggest that ongoing and expanded mandatory efficiency standards for buildings and gas appliances, such as water heaters, could reduce cumulative emissions from residential gas use by 4.5 Mt CO₂-e between 2000 and 2020, though households shifting from electric to gas appliances may offset these emission reductions.

Beyond efficiency improvements, the main opportunity to reduce direct combustion emissions could be to substitute alternative lower emissions energy sources, such as biofuels. If the emissions intensity of electricity generation falls, as projected with incentives in place, then moving from direct fuel combustion to electricity could, in the medium to longer term, significantly reduce emissions from residential, commercial and industrial consumers.

CHALLENGES TO REDUCING DIRECT COMBUSTION EMISSIONS

The challenges to reducing emissions from direct combustion include:

- long-term energy supply contracts in the LNG industry
- investments in long-lived, high-value assets, including plant, equipment and buildings

- barriers to the take-up of energy efficiency, including lack of information on energy consumption and split or perverse incentives for investing in energy efficiency. Standards for gas appliances and buildings, and information provision, have been used to help overcome these non-price barriers.

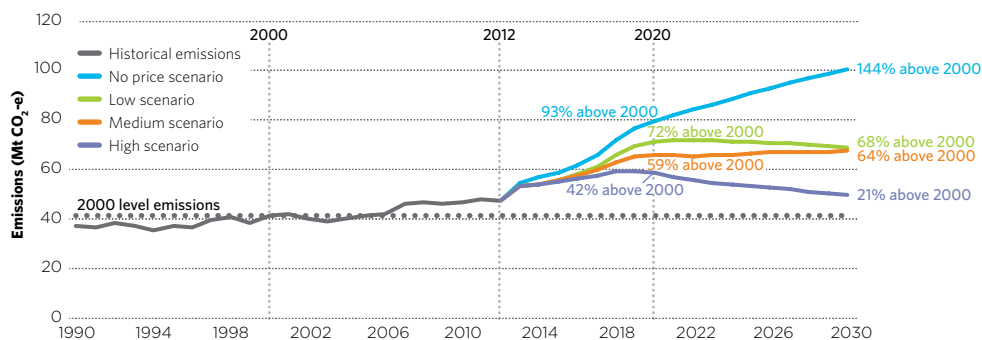
A detailed analysis of progress in reducing direct combustion emissions is presented in Appendix D5.

11.4.4 FUGITIVES

Fugitive emissions are greenhouse gases emitted during the extraction, production, processing, storage, transmission and distribution of fossil fuels such as coal, oil and gas. Fugitive emissions accounted for 8 per cent of national emissions in 2012 (Treasury and DIICCS RTE 2013).

Without price incentives, fugitive emissions could rise rapidly, driven largely by strong export demand for LNG and coal (Figure 11.12). Substantial emissions reduction opportunities exist, however. In the modelled scenarios, the fugitive sector is projected to be the second largest source of emissions reductions over the period to 2030, providing 15–24 per cent of total expected emissions reductions, relative to the no price scenario (Treasury and DIICCS RTE 2013).

FIGURE 11.12: FUGITIVE EMISSIONS, HISTORICAL AND PROJECTED, 1990–2030



Source: Climate Change Authority calculations using results from Treasury and DIICCS RTE 2013

OPPORTUNITIES TO REDUCE FUGITIVE EMISSIONS

In the no price scenario, fugitive emissions could more than double, from 48 Mt CO₂-e in 2012 to 100 Mt CO₂-e in 2030. In low and high scenarios, the modelling shows that the fugitives sector could reduce emissions by 8 and 21 Mt CO₂-e in 2020, respectively, compared to the no price scenario. In 2030, the fugitives sector could contribute between 31 and 51 Mt CO₂-e emissions reductions.

Despite increased coal and gas production, improvements in emissions intensity could result in fugitive emissions approaching current levels by 2030. Coal mines are responsible for about three-quarters of fugitive emissions; a number of technologies are available to reduce emissions, including pre-draining to capture methane (which is a mature technology) and the oxidation of ventilation air methane (which is at an early stage of development). With incentives, these technologies may be increasingly deployed after 2020 (ClimateWorks 2013a). In the short term, a price incentive to reduce emissions could encourage the relative expansion of lower emissions mines. It could also drive the deployment of additional pre- and post-mine drainage, where gas could either be flared or used to generate electricity.

CCS in the oil and gas sectors could significantly reduce fugitive emissions, though it is not widespread today. The IEA (2013b) highlights this potential at a global scale. The Gorgon LNG project in Western Australia is expected to capture and inject at least 3 Mt of CO₂ annually by 2015 (Chevron 2013). Incentives may encourage deployment of CCS technologies in new projects near geologically suitable injection sites. Recently announced Queensland LNG projects are not expected to use CCS.

Other opportunities to reduce fugitive emissions in the natural gas industry may include equipment changes and upgrades, changes in operational practices, and direct inspection and maintenance (US EPA 2006).

CHALLENGES TO REDUCING FUGITIVE EMISSIONS

There is strong growth in LNG and coal production, which could outstrip improvements in emissions intensity. Australia’s LNG exports totalled 24 million tonnes in 2012 (BREE 2013b), and there are over 15 projects in operation, under construction or at initial stages, with a combined annual production capacity around five times that (BREE 2013a). Coal exports are also projected to grow (BREE 2012b).

Technologies to reduce emissions remain an additional cost for coal, oil and gas producers, compared to conventional production. Their uptake can be accelerated by policies or price incentives.

A detailed analysis of progress in reducing fugitive emissions is presented in Appendix D6.

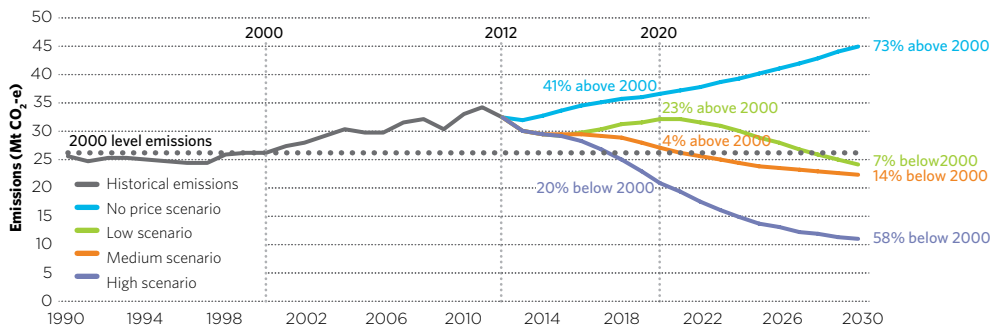
11.4.5 INDUSTRIAL PROCESSES

The main sources of industrial process emissions are metal production, such as iron, steel and aluminium; synthetic greenhouse gases, such as those used for refrigeration and as propellants; chemical processes in fertiliser and explosives manufacturing; and mineral production, particularly cement and lime products.

Industrial process emissions exclude energy-related emissions such as those from burning fossil fuels for heat, steam or pressure. Emissions from industrial processes accounted for 5 per cent of Australia’s emissions in 2012 (Treasury and DIICCS RTE 2013).

In the no price scenario, industrial process emissions are projected to rise (Figure 11.13). With a price incentive, emissions decrease below 2000 levels by 2030. In scenarios with a price incentive, industrial processes contribute a proportionally large share of domestic emissions reductions by adopting readily available and relatively low-cost, low-emissions substitutes, technologies and process improvements.

FIGURE 11.13: INDUSTRIAL PROCESS EMISSIONS, HISTORICAL AND PROJECTED, 1990–2030



Source: Climate Change Authority calculations using results from Treasury and DIICCS RTE 2013

OPPORTUNITIES TO REDUCE INDUSTRIAL PROCESS EMISSIONS

The industrial processes sector could reduce 2020 emissions by between 5 and 16 Mt CO₂-e, compared with the no price scenario (Treasury and DIICCS RTE 2013). Emissions reductions opportunities are projected to be even greater—up to 34 Mt CO₂-e—in 2030, which is 75 per cent lower than the no price scenario.

Almost half of the estimated emissions reductions in the industrial processes sector in 2020 and 2030 could be delivered by nitrous oxide conversion catalysts for nitric acid production. This technology was deployed by Orica in 2012, and has been trialled by Wesfarmers since 2011; Wesfarmers (2013) reported that it has reduced nitrous oxide emissions by an average of 85 per cent. ClimateWorks (2013a) estimates that if this technology is taken up more widely it could reduce the emissions intensity of the nitric acid production process by 44 per cent in 2020 compared with today. The regulation of nitric acid plants, including state-based environmental guidelines, is helping to reduce emissions in this sector.

The other significant emissions reduction opportunity is the destruction and replacement of synthetic greenhouse gases. These gases are used mainly in refrigeration and accounted for about 27 per cent of industrial process emissions in 2012. Synthetic greenhouse gases may be superseded by alternative gases that have low to zero global warming potential. The rate of recovery and destruction of these gases, and the associated emission reductions, will depend largely on incentives in place. The rate of recovery is likely to slow following the government's decision to not provide additional financial support, beyond 30 June 2014, to the existing industry-funded and industry-operated destruction incentives program for waste synthetic greenhouse gases and ozone-depleting substances (DoE 2013).

In the longer term, CCS could significantly reduce industrial process emissions. The International Energy Agency (IEA 2013b) suggests that by mid century, about half of the global emissions reductions that it attributes to CCS could be from industries such as cement, hydrogen production, iron and steel.

CHALLENGES TO REDUCING INDUSTRIAL PROCESS EMISSIONS

Challenges to reducing industrial process emissions include:

- The cost of emissions reduction technologies—financial incentives and other policies can accelerate uptake of technologies to lower emissions, as has occurred in recent years. These incentives could also apply to CCS for industrial applications where the technology is proven but still relatively expensive (IEA 2013c).
- Rising production—particularly in the chemicals sector—that could outstrip improvements in emissions intensity.

A detailed analysis of progress in reducing industrial process emissions is presented in Appendix D7.

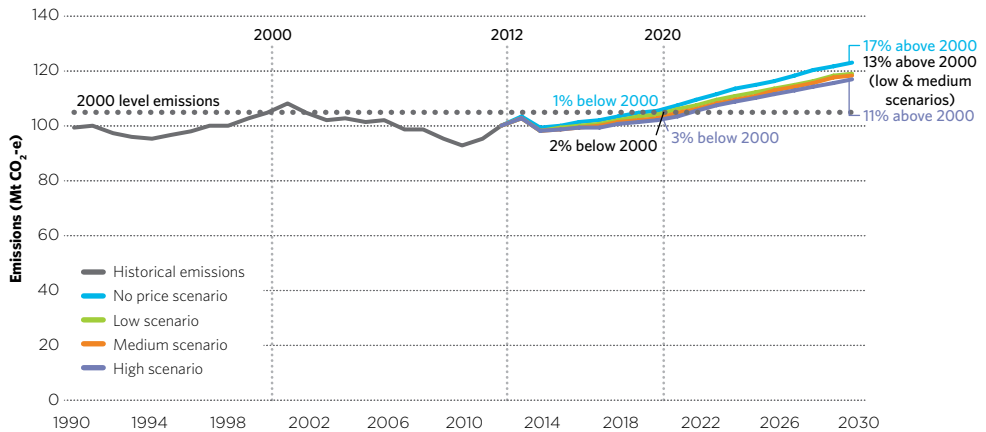
11.4.6 AGRICULTURE

Agriculture emissions result from livestock digestive processes (enteric fermentation), manure management, nitrous oxide emissions from cropping and pastureland soils, prescribed burning of savannas and burning of agricultural residues. The agriculture sector accounted for approximately 17 per cent of Australia's emissions in 2012.

Consistent with Australia's Kyoto Protocol Accounting Framework and the categories of reporting used in the National Greenhouse Gas Inventory, agriculture and LULUCF emissions have been evaluated separately in this report. The Authority recognises that these two sectors are interconnected.

Agriculture emissions have increased by 1 per cent since 1990. Under all modelled scenarios, agriculture emissions are projected to increase strongly in the longer term, driven by strong international demand for agricultural commodities, primarily from emerging Asian economies (Figure 11.14). There are incentives such as the CFI, which may reduce agriculture emissions intensity; however, strong projected activity growth means total agriculture emissions could still grow.

FIGURE 11.14: AGRICULTURE EMISSIONS, HISTORICAL AND PROJECTED, 1990-2030



Source: Climate Change Authority calculations using results from Treasury and DIICCSRTE 2013

OPPORTUNITIES TO REDUCE AGRICULTURE EMISSIONS

The Treasury and DIICCSRTE estimates emissions would be about 1 Mt CO₂-e and 3 Mt CO₂-e lower in 2020 under the low and high scenarios, respectively, relative to the no price scenario. Most of these emission reductions are from livestock.

ClimateWorks (2010) assessed the emissions reduction potential of agriculture and found greater opportunities—reductions of 2-3 Mt CO₂-e in 2020 from livestock at a societal cost of \$17/t CO₂-e or less. ABARES (2013a) analysis suggests that about 7 Mt CO₂-e of emissions reductions, at a cost of \$73/t CO₂-e or less, might be available from livestock in 2020. Apart from manure management, however, most of the projected technologies and practices for reducing livestock emissions are still being developed and are not ready for commercial use. The studies referred to have significant differences in assumptions about available technologies, level of uptake and associated costs.

Productivity gains and increasing profitability are the two main drivers for farmers to invest in activities that lower agriculture emissions intensity. Historically, Australia increased annual cropping productivity by 1.5 per cent a year between 1977 and 2011 (ABARES 2013b). In livestock, beef emissions intensity improved by about 10 per cent between 1990 and 2005 (Henry & Eckard 2008).

The dairy industry is focused on reducing its already low emissions intensity further. It has set an industry-wide target of 30 per cent lower emissions intensity by 2020 (Dairy Australia 2013).

CHALLENGES TO REDUCING AGRICULTURE EMISSIONS

There are limited opportunities to reduce absolute food production emissions given growing demand for Australian agriculture products. Reductions in emissions intensity are expected from new technology and processes in time; however, are unlikely to be enough to offset production growth.

While there are technologies that can reduce emissions intensity in the sector, there are not projected to be sufficient cost-effective emissions technologies available to offset the total growth in emissions. This is the case for greenhouse gas emissions from enteric fermentation in livestock, for example, which was responsible for about two-thirds of emissions from the agriculture sector in 2012 (Treasury and DIICSRTE 2013).

Measuring emission reductions is also an issue; livestock and cropping emissions involve complex interactions within biological systems that are very difficult to measure precisely. A practice that reduces emissions on one farm may have a different effect at another, due to local conditions such as pasture type and weather.

Continued research and technology development is important to support both understanding and uptake of emissions reduction opportunities and general emissions intensity improvements.

Where opportunities to reduce agriculture emissions exist, their uptake can be challenged by limited access to capital. Smaller farms may be unable to achieve economies of scale and may have inadequate access to information about emissions reduction projects. These challenges are exacerbated by the many small and dispersed participants in the sector. A range of approaches could be taken to combat these challenges, such as providing information through rural networks, simplifying methodologies for projects, facilitating access to capital and consolidating projects across many small farms.

A detailed analysis of progress in reducing agriculture emissions is presented in Appendix D8.

11.4.7 LAND USE, LAND USE CHANGE AND FORESTRY

Land use, and the biomass the land supports, forms part of the carbon cycle and affects atmospheric CO₂ levels. Reporting on the LULUCF sector includes:

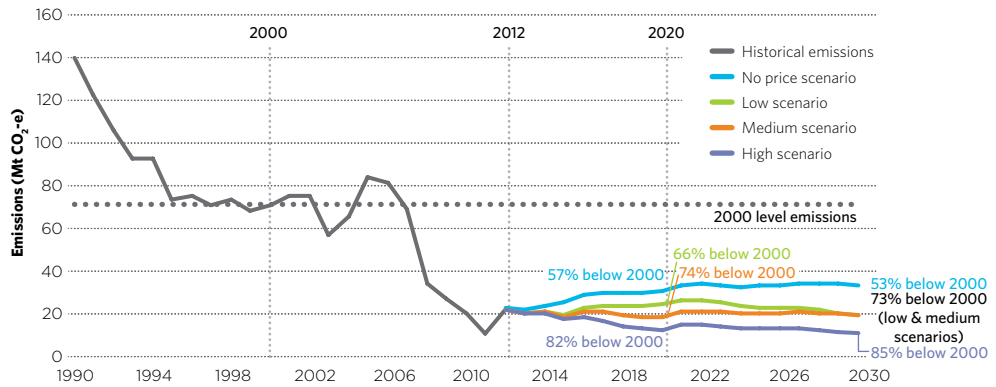
- emissions and sequestration due to the clearance of forested land for new purposes (deforestation)
- new forests on land that was un-forested on 1 January 1990 (afforestation and reforestation)
- other practices that change emissions and sequestration (forest management, cropland management and grazing land management).

Combustion of fossil fuels from forestry and land management activities, such as diesel used in logging machinery, is covered in the direct combustion sector. LULUCF accounted for approximately 4 per cent of Australia's emissions in 2012.

LULUCF has been the biggest sectoral contributor to emissions reductions in Australia since 1990. Net emissions from the sector have declined by 85 per cent from 140 Mt CO₂-e in 1990 to 21 Mt CO₂-e in 2012. This trend, however, is not projected to continue (Figure 11.15).

Macroeconomic factors, such as farmers' terms of trade and prices of wood commodities, have been the main determinant of LULUCF emissions. The progressive introduction of state and territory land clearing restrictions has also played a significant role in reducing emissions since 1990; most notably, the restrictions introduced in Queensland in 2004 and 2009. Incentives (such as Managed Investment Schemes) boosted forest plantations in the 1990s, but it is unlikely all of these forests will be replanted once harvested. Over the medium to longer term, a combination of subdued forestry demand, reduced land clearing restrictions and pressure from increased cattle herd numbers after 2020 all contribute to projected emissions trends.

FIGURE 11.15: LULUCF EMISSIONS, HISTORICAL AND PROJECTED, 1990–2030



Source: Climate Change Authority calculations using results from Treasury and DIICCSRTE 2013

OPPORTUNITIES TO REDUCE LULUCF EMISSIONS

Price incentives could play an important role in LULUCF emissions reductions. Relative to the no price scenario, 12 Mt CO₂-e and 14 Mt CO₂-e of emissions reductions could be delivered in 2020 and 2030, respectively, under the medium scenario. Under the high scenario, emissions reductions may be 18 Mt CO₂-e in 2020 and 23 Mt CO₂-e in 2030. Most of the projected emissions reductions in response to the price incentive come from forest management and vegetation regeneration.

Since January 2013, Australia has been required to count net emissions associated with forest management towards its emissions commitments under the Kyoto Protocol, and has also elected to include net emissions associated with cropland management, grazing land management and revegetation activities (see Chapter 7). Cumulatively, over the period from 2013 to 2020, the Treasury and DIICCSRTE modelling projects LULUCF emission reductions associated with these changes of 90 Mt CO₂-e irrespective of price incentives. With price incentives, cumulative emission reductions are projected to increase to 116 Mt CO₂-e in the low scenario, and up to 126 Mt CO₂-e in the medium scenario. Similarly, the ANU Centre for Climate Law and Policy estimates potential LULUCF emissions reductions of 110–115 Mt CO₂-e from forest management, cropland management, grazing land management and revegetation activities from 2013 to 2020 (*Issues Paper submission*).

Grundy et al. (forthcoming 2014) finds that, with strong price incentives, non-harvest carbon plantations and native vegetation could greatly increase sequestration to 2050. It also projects low volumes of sequestration before 2030, even with strong price incentives, due in part to probable slow uptake of new land uses and the physical characteristics of carbon sequestration.

From 2031 to 2050, Grundy et al. (forthcoming 2014) projects average annual emission reductions of between 100 and 500 Mt CO₂-e would be economically and technically feasible if payments to landholders are broadly consistent with the CFI and the carbon price trajectories in the medium and high scenarios modelled by the Treasury and DIICCSRTE (2013). The upper end of this range suggests there is potential to achieve 80–100 per cent reduction in Australia’s emissions in 2050 (compared to 2000 levels) with little or no use of international units, through a combination of land sector credits and emissions reductions in energy and other sectors.

CHALLENGES TO REDUCING LULUCF EMISSIONS

Historically, land clearing regulations have been an important driver of land sector emissions reductions. The recent dilution of land clearing restrictions in Queensland, New South Wales and, more recently, Western Australia could make it harder to reduce land sector emissions.

LULUCF emissions reductions also face many barriers similar to those of agriculture. Effective methodologies to ensure that emissions reductions are measurable and robust are critical. Substantial research is likely to be required to design effective incentive policies that accurately measure emissions reductions from changed land and forest management practices, and ensure that attributed emissions reductions are robust and permanent.

For smaller scale operations, available returns may be insufficient to make adopting emissions reductions technologies or practices worthwhile, and limited access to capital may also be a barrier. Requirements for ‘permanence’ in carbon sequestration projects, such as forestry, may also fix land uses for periods of up to a century. For activities such as forestry plantings on pasture lands, landowners will need to consider the value of alternative uses. Projected increased demand for agricultural commodities may make forestry investments less attractive, relative to investing in agriculture.

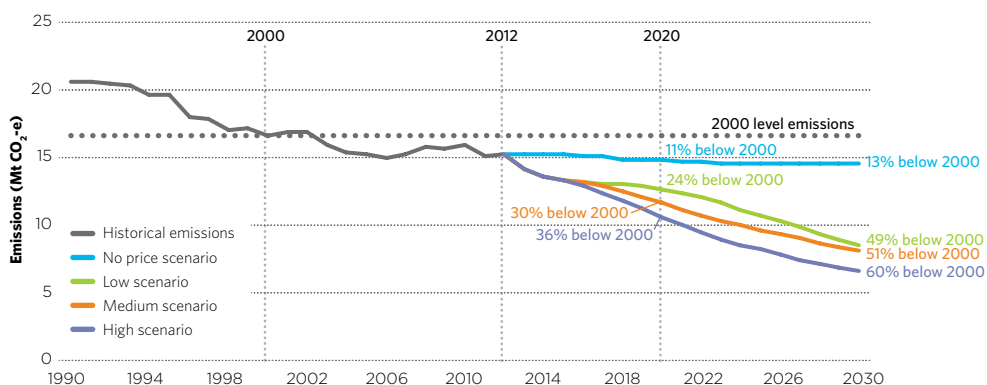
A detailed analysis of progress in reducing LULUCF emissions is presented in Appendix D9.

11.4.8 WASTE

Waste includes solid waste and wastewater from residential, commercial and industrial activity. Waste emissions are mainly methane and nitrous oxide, which arise as organic waste decomposes in the absence of oxygen. The waste sector accounted for 3 per cent of Australia’s emissions in 2012.

Waste sector emissions have decreased by 26 per cent since 1990 despite population growth and increased waste volumes. Under all modelled scenarios, waste emissions will continue falling (Figure 11.16). In the absence of a carbon price or any new policy measures, waste emissions are projected to fall marginally to about 15 Mt CO₂-e in 2030. Further emissions reductions of between 6 and 8 Mt CO₂-e (compared to the no price scenario) could be expected under the scenarios with a price incentive.

FIGURE 11.16: WASTE EMISSIONS, HISTORICAL AND PROJECTED, 1990-2030



Source: Climate Change Authority calculations using results from Treasury and DIICSRTE 2013

Gas capture technologies can significantly reduce waste emissions. Historically, both regulatory and market-based measures have successfully driven the deployment of these technologies. Direct regulation of landfills for health and safety purposes has played a major role, as have market incentives. The New South Wales Greenhouse Gas Reduction Scheme and the RET have been important in reducing emissions from landfill. The RET and the CFI are expected to drive further reductions.

OPPORTUNITIES TO REDUCE WASTE EMISSIONS

The major emissions reduction opportunity for waste is the expansion of alternative waste treatment facilities to reduce waste volumes being sent to landfill. This relies on development of new facilities and installation of new technologies, such as food waste treatment and other thermal energy recovery technologies. Further emissions reductions could be generated by improving gas capture technology efficiency rates at landfill and wastewater facilities, and extending coverage of these technologies to smaller facilities. A price incentive would increase uptake of both gas collection and destruction and alternative waste treatment technologies. The CFI already provides incentives to destroy methane emissions from 'legacy' waste (deposited at landfills before July 2012).

There is some evidence that increasing the cost of landfill disposal makes alternative waste treatment a more attractive option as it drives waste streams away from landfill. This has been addressed via increased landfill levies in some Australian states and in the UK.

CHALLENGES TO REDUCING WASTE EMISSIONS

Australia has high levels of adoption of conventional emissions reduction technologies such as gas capture and alternative waste treatment relative to other countries.

There are several barriers to realising further emission reductions in the waste sector:

- Installing new technologies involves large capital costs that may take an extended operating period to recover. This suggests that a strong and stable price incentive, or a clear and enforceable regulatory requirement, would be needed to promote investment in these technologies.
- New waste treatment technologies and processes such as food waste treatment and thermal treatment plants may face hurdles of gaining community acceptance, finding suitable available land, meeting local planning requirements and gaining sufficient funding.
- Alternative waste treatment and other emissions reduction technologies require a minimum scale to be cost-effective. Smaller towns in rural and regional areas often do not generate enough waste for local councils to justify the investment.

A detailed analysis of progress in reducing waste emissions is presented in Appendix D10.

CONCLUSIONS

- C.16** The rate of reduction in emissions intensity since 1990 is not sufficient to drive absolute reductions in Australia's emissions in the period to 2030.
- C.17** Without a price incentive or additional policies, economy-wide emissions are projected to rise to 17 per cent above 2000 levels in 2020 and 37 per cent in 2030.
- C.18** Australia has extensive opportunities to reduce emissions at relatively low costs, but it will take time to replace the stock of buildings, vehicles, equipment and plant. To achieve Australia's emissions reduction goals and avoid locking in future emissions growth, stable, cost-effective and complementary policies need to be in place this decade.
- C.19** Electricity sector emissions are projected to grow strongly without a price incentive or other policy mechanism. With price incentives, the sector could be the single largest source of domestic emissions reductions.
- C.20** Without a price incentive, rapid growth in demand for road transport and domestic air travel is projected to drive increasing transport emissions. Appropriate policies could deliver significant transport emissions reductions.