Australian Government
Climate Change Authority

LIGHT VEHICLE EMISSIONS STANDARDS FOR AUSTRALIA
RESEARCH REPORT

JUNE 2014

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CLIMATE
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SUMMARY

Australia has an opportunity to reduce greenhouse gas emissions and lower fuel bills for Australian motorists by making light vehicles more efficient. A light vehicle emissions standard is the best way to achieve this.

Reducing emissions from all light vehicles (including both passenger and light commercial vehicles) would support Australia's contribution to global efforts to limit the harmful impacts of climate change. Transport accounts for 16 per cent of Australia's greenhouse gas emissions and light vehicles alone account for 10 per cent. Phase one of the proposed standard (2018–25) is projected to avoid 59 million tonnes of emissions over the period to 2030, roughly equal to the current annual emissions of all light vehicles.

Australians would benefit if light vehicles used less fuel and emitted fewer greenhouse gases. Technologies to reduce fuel use and associated emissions are readily available and are relatively inexpensive. Improving light vehicle efficiency is one of the lowest cost emissions reduction opportunities in the Australian economy.

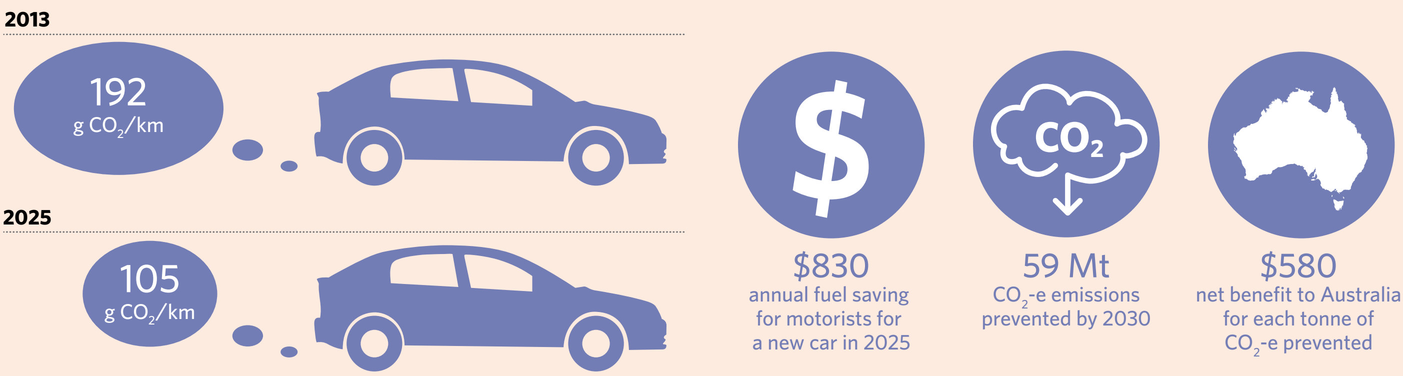
Australia lags behind many other countries in light vehicle efficiency. While the efficiency of Australia's light vehicle fleet is improving over time, more can be done. The Authority's analysis, drawing on international experience and principles of good policy design, shows mandatory standards are a cost-effective policy for reducing light vehicle emissions. A mandatory standard is likely to complement the Emissions Reduction Fund and existing arrangements in the Australian transport sector.

An emissions standard for all new light vehicles sold in Australia from 2018 would deliver clear benefits. A standard that is achievable and would deliver significant benefits to Australia and Australian motorists could:

- set a target to reduce the emissions intensity of the Australian light vehicle fleet from its current level of 192 grams of carbon dioxide per kilometre (g CO_2/km) to 105 g CO_2/km in 2025
- oblige suppliers of new light vehicles to provide more efficient vehicles to the Australian market over time
- build on existing arrangements to minimise any new regulatory burden.

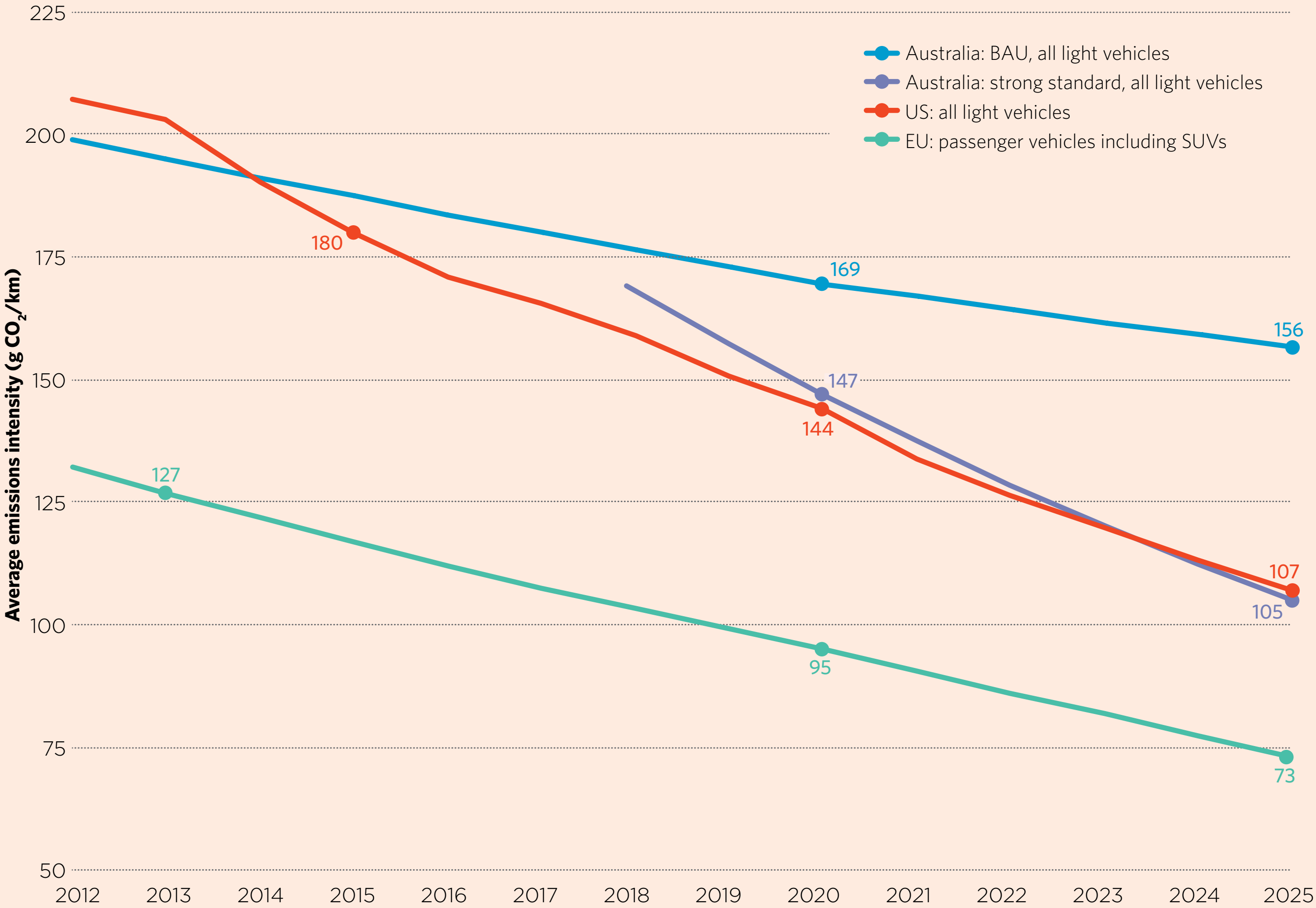
The benefits of a light vehicle emissions standard substantially outweigh the costs at both private and national levels. A 105 g CO_2/km target could increase the average cost of a new car in 2025 by about $1,500, but this would be more than offset by fuel savings of $830 in the first year and $8,500 over the life of the vehicle, leaving motorists better off. A standard would also prevent emissions and save Australia $580 for each tonne of CO_2 avoided (Figure 1). Of the standards examined by the Authority, the strongest standard delivered the largest net benefits.

FIGURE 1: BENEFITS OF A LIGHT VEHICLE EMISSIONS STANDARD



Source: Climate Change Authority

FIGURE 2: EMISSIONS INTENSITY OF NEW LIGHT VEHICLES IN AUSTRALIA UNDER A 'STRONG' STANDARD COMPARED WITH US AND EU TARGETS



Note: See Chapter 4 for information about this chart. BAU is business as usual. SUV is sports utility vehicle.
Source: Climate Change Authority using Reedman and Graham 2013b, ICCT 2014 and EC 2014

Early adoption of a standard maximises the benefits, because it takes time for changes to new vehicles to improve the fleet as a whole. Of the standards examined by the Authority, a standard starting in 2018 and reaching 105 g CO_2/km by 2025 generates the greatest emissions reductions and financial benefits for Australian motorists. It is broadly aligned with the targets introduced in the United States and trails the stronger European Union targets (Figure 2). The Authority believes it is a sensible first step in improving Australia's light vehicle fleet.

Light vehicle emissions standards should be designed to promote environmental goals, policy stability and equity, and minimise regulatory burden. This suggests the following features:

- Coverage of new passenger and light commercial vehicles under a single light vehicles standard.
- Commencement in 2018, with annual obligations defined to 2025. Australian vehicle manufacturers have announced that they will cease local operations by 2018, and would therefore be unaffected by a light vehicle emissions standard commencing in 2018.
- An obligation to comply with the standard on all suppliers of new light vehicles to the Australian market who sell more than 2,500 vehicles each year, with financial penalties for failure to comply.
- Flexible compliance mechanisms, including a fleet averaging approach with banking and limited borrowing allowed during the first phase.
- Adoption of the existing emissions test under the Australian Design Rules for motor vehicles.
- A review in 2021 to consider the operation and design of the scheme and recommend new national average targets for phase two, after 2025.

CONTENTS

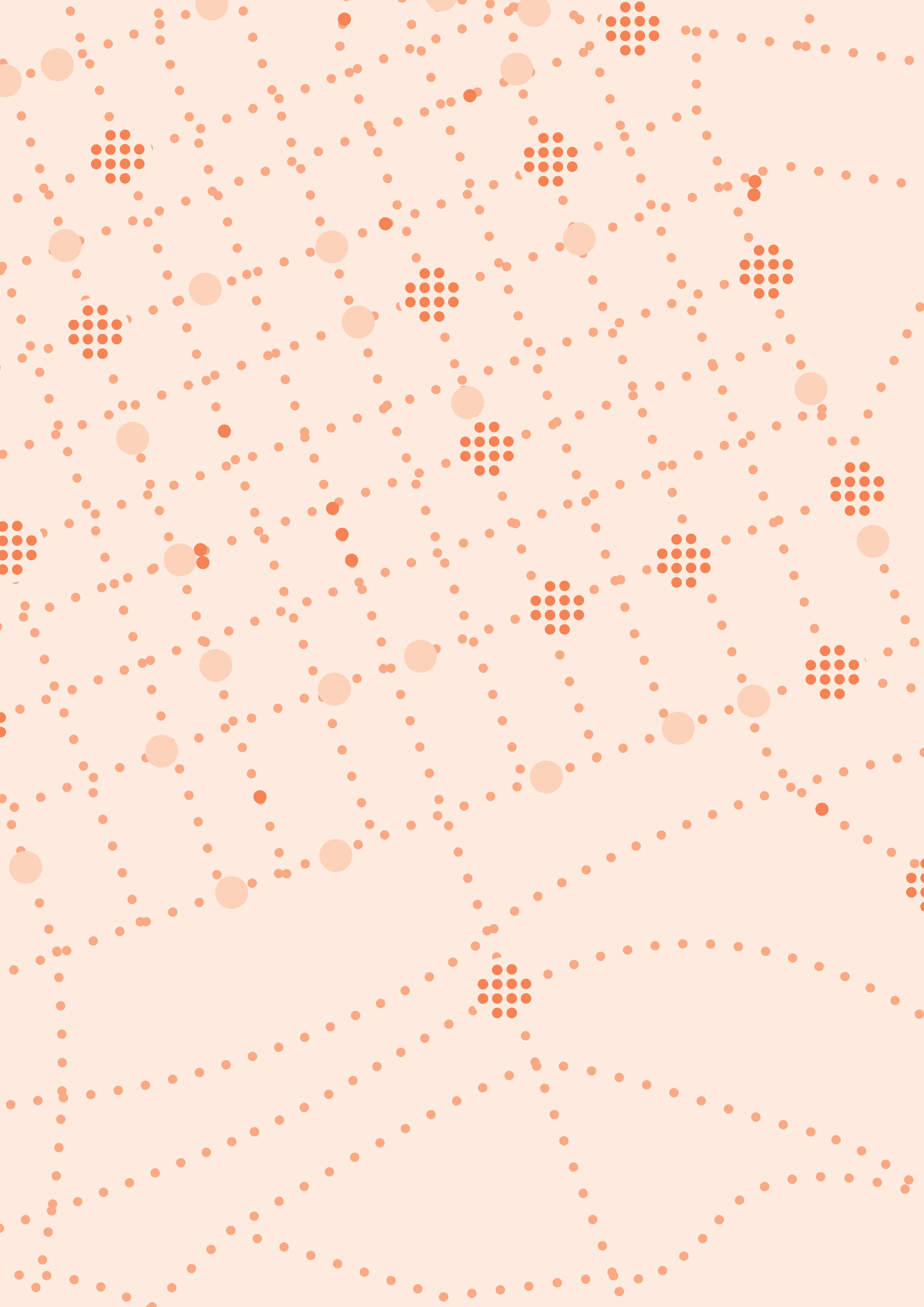
ACKNOWLEDGEMENTS

The Authority would like to thank the many people and organisations who contributed time and expertise to the preparation of this report. These contributions have enhanced the quality of the work.

Several government departments and public agencies have contributed to the Authority's work, including the Department of the Environment, Department of Industry, Department of Infrastructure and Regional Development, National Transport Commission and Office of Best Practice Regulation.

The Authority consulted widely with industry and non-government stakeholders, and is grateful for the feedback provided by the Australian Automobile Association, ClimateWorks Australia, the Federal Chamber of Automotive Industries (FCAI), Future Climate Australia, the National Roads and Motoring Association (NRMA), and the Australian Industry Group.

The Authority is particularly grateful for expert review from the Commonwealth Scientific and Industrial Research Organisation (CSIRO) and the International Council on Clean Transportation (ICCT).



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INTRODUCTION

1.1 THE AUTHORITY AND VEHICLE EMISSIONS STANDARDS

The Climate Change Authority is an independent statutory agency, established to provide expert advice on Australian climate change policy.

The Authority's work is guided by a set of principles under the *Climate Change Authority Act 2011* (Cth). The principles require that measures responding to climate change should be economically efficient, environmentally effective, equitable and in the public interest. These principles have guided the Authority's analysis of vehicle emissions and underpin this report.

In its February 2014 report, *Reducing Australia's Greenhouse Gas Emissions—Targets and Progress Review,* the Authority examined opportunities to reduce Australia's emissions and help achieve its emissions reduction goals. Australia's emissions reductions contribute to the global goal of limiting warming to less than 2 degrees Celsius compared to pre-industrial levels. The Authority noted that the transport sector is a significant and growing source of emissions; it currently accounts for 16 per cent of Australia's emissions and light vehicles alone account for 10 per cent. The Authority identified a variety of low-cost opportunities to reduce emissions in the sector; in particular recommending:

The government investigate the near-term introduction of fleet-average CO_2 emissions standards for light vehicles in Australia as a way to secure significant, cost-effective emissions reductions and related co-benefits (CCA 2014a, p 166).

This report provides further analysis of light vehicle emissions standards, which demonstrates that standards are a cost-effective way to reduce Australia's greenhouse gas emissions and light vehicle fuel use. Standards should be designed to maximise benefits and minimise costs; if introduced soon, standards could improve the efficiency of almost half of the Australian fleet by 2025.

1.2 PREVIOUS WORK ON LIGHT VEHICLE EMISSIONS STANDARDS

While there have been significant improvements to the emissions intensity of Australian light vehicles, the fleet remains among the least efficient in the world. A significant body of evidence and international experience shows that Australia could benefit from mandatory light vehicle emissions standards.

Light vehicle fuel efficiency and greenhouse gas emissions have long been discussed in Australia. Voluntary fuel consumption targets for passenger vehicles were first raised in 1978. Targets have accompanied fuel efficiency improvements, with fuel consumption targets per 100 kilometres dropping from 9.5 litres by 1983 to 6.8 litres by 2010 (PC 2005, p. 245). In 2005, the industry adopted a voluntary target to reduce average emissions for all new light vehicles from 245 to 222 g CO_2/km by 2010 (FCAI 2008). This target was achieved two years early and not extended.

In July 2009, the comprehensive 10-year *National Strategy on Energy Efficiency* from the Council of Australian Governments (COAG) included measures to accelerate energy efficiency improvements and deliver cost-effective energy efficiency gains across all sectors of the

Australian economy. A key element of the strategy for the transport sector was to assess the costs and benefits of introducing CO_2 emission standards for light vehicles (COAG 2009, p. 20). In 2010, the Task Group on Energy Efficiency recommended that the government consider the introduction of a mandatory CO_2 standard for light vehicles (2010, p. 4).

In 2011, the Department of Infrastructure and Transport released a discussion paper seeking views on the most appropriate regulatory framework and target for an emissions standard (DIT 2011a). Stakeholders, including the Australian car manufacturing sector, expressed a range of views.[1]

There is a significant and growing body of evidence from Australia and around the world that there are substantial low-cost emissions reduction opportunities from light vehicle efficiency technologies, and that light vehicle emissions standards have successfully encouraged greater penetration of those technologies in the market.

Most recently, ClimateWorks (2014) found that improving the fuel efficiency of Australia's light vehicle fleet could deliver substantial environmental and economic benefits. These included cumulative financial savings to vehicle owners of $7.9 billion across the economy within 10 years.[2] The CSIRO (2012) found that the largest emissions reductions available in Australia's transport sector are from more efficient fuel use in light vehicles.

The International Energy Agency (IEA) strongly encourages governments to implement policies that include light vehicle emissions standards because they have proven to be effective in mobilising the large, low-cost opportunity available in light vehicle efficiency technologies (IEA 2012a).

1 The paper and submissions are available at www.infrastructure.gov.au/roads/environment/CO2_emissions/index.aspx.

2 ClimateWorks' estimate is based on a standard introduced by 2016, with a target of 130 g CO_2/km in 2020 and 95 g CO_2/km in 2024.

1.3 AN EMISSIONS STANDARD FOR LIGHT VEHICLES IN AUSTRALIA

A fleet-average light vehicle emissions standard would set a national average target for new vehicles sold in Australia. Vehicle suppliers would have specific obligations, designed to ensure the national average target is met. Over time, a standard would contribute to emissions reductions as more vehicles in the fleet become more efficient. The standard would have costs, primarily a modest increase in the price of new light vehicles. These costs would be clearly outweighed by benefits, including reduced greenhouse gas emissions, lower fuel costs for motorists and improved energy security for Australia.

The Authority has assessed the range of options available to policy makers in designing a light vehicle emissions standard, and identified an effective and least-cost model (see Figure 1.1) that would deliver net benefits with a low regulatory burden.

BOX 1: IMPORTANT TERMS IN THIS REPORT

Light vehicles—all road vehicles under 3.5 tonnes gross vehicle mass, including passenger vehicles, sports utility vehicles (SUVs) and light commercial vehicles, but excluding motorcycles.

Vehicle fuel efficiency—the amount of fuel consumed by a vehicle over a given driving distance; for example, litres per kilometre (L/km).

Emissions intensity—the amount of greenhouse gases emitted by a vehicle over a given driving distance; for example, grams of carbon dioxide per kilometre (g CO_2/km). There is a direct relationship between fuel efficiency and emissions intensity for any given fuel. Different fuels have different emissions intensities.

FIGURE 1.1: THE PROPOSED LIGHT VEHICLE EMISSIONS STANDARD

Source: Climate Change Authority

The government would set a national average target for emissions intensity of the new light vehicle fleet in Australia in each year. The target would be expressed in grams of carbon dioxide emitted per kilometre (g CO_2/km). The target would relate to the average emissions intensity of the Australian fleet—not individual vehicles.

The government would translate the national average target into an attribute-based limit curve based on the Australian fleet mix. It would use a mathematical relationship between the size (footprint) of vehicles and their emissions intensity to set a limit on the average emissions intensity of the fleet. Larger cars would be permitted somewhat more emissions than smaller cars under the standard, reflecting the reality that larger cars can be more emissions-intensive. The footprint approach recognises the different consumer utility of different vehicles.

Each supplier of new light vehicles to the Australian market would use the limit curve to determine the mix of vehicles it supplies to the market each year. A supplier could sell vehicles above the limit curve provided they are offset by sufficient sales of vehicles under the limit curve.

A supplier could improve the efficiency of all vehicles in its fleet or sell more highly efficient vehicles to offset its less efficient vehicles. This imposes a more equitable burden across suppliers that specialise in different market segments.

The standard would take effect in 2018, with annual limit curves defined to 2025. This gives the light vehicle sector time to prepare for the scheme and a clear pathway for improvement.

Each supplier would have an obligation to comply with the limit curve, with penalties for non-compliance. A supplier could bank or borrow credits for compliance from one year to use in another year.

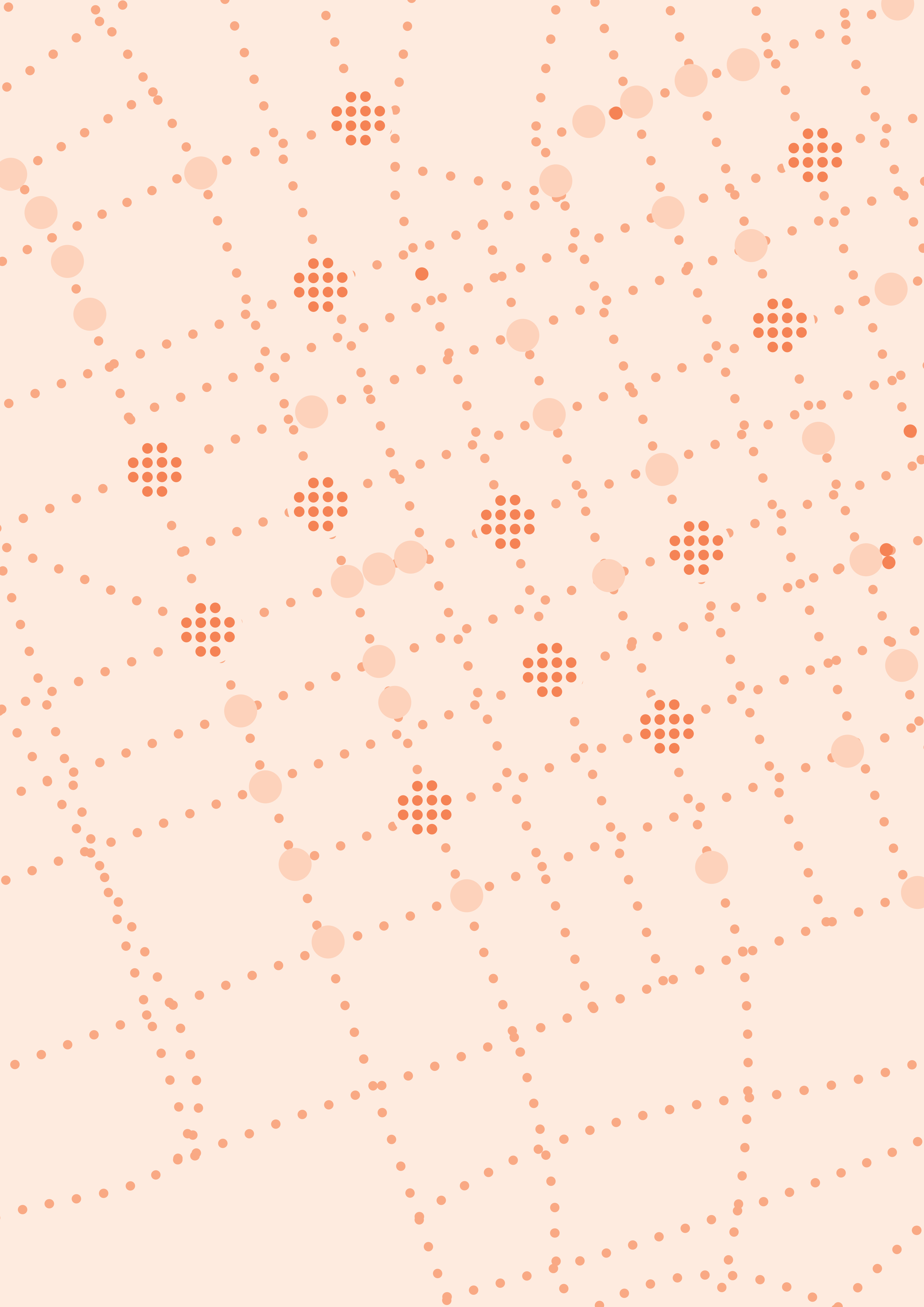
1.4 STRUCTURE OF THIS REPORT

This report builds on previous Australian and international work, which has established a clear case for a light vehicle emissions standard in Australia and generated public discussion about the design of such a policy. This report:

- identifies opportunities to reduce transport emissions, particularly from light vehicles
- identifies policy options and makes a case for regulation
- describes the likely costs and benefits of a light vehicle emissions standard in Australia
- identifies the important policy design choices in making a standard
- makes findings about arrangements that would maximise the benefits of a standard while minimising the costs of regulation.

The report is structured as follows:

- Chapter 2 sets out trends in light vehicle emissions in Australia and identifies significant opportunities for reducing those emissions
- Chapter 3 examines the case for regulation and compares mandatory light vehicle emissions standards against other policy alternatives
- Chapter 4 identifies the appropriate national average target, taking account of public and private costs and benefits
- Chapter 5 outlines the preferred design of a standard to maximise the benefits and minimise the costs of the scheme
- Chapter 6 identifies a small number of issues requiring further research.



OPPORTUNITIES TO REDUCE LIGHT VEHICLE EMISSIONS IN AUSTRALIA

2

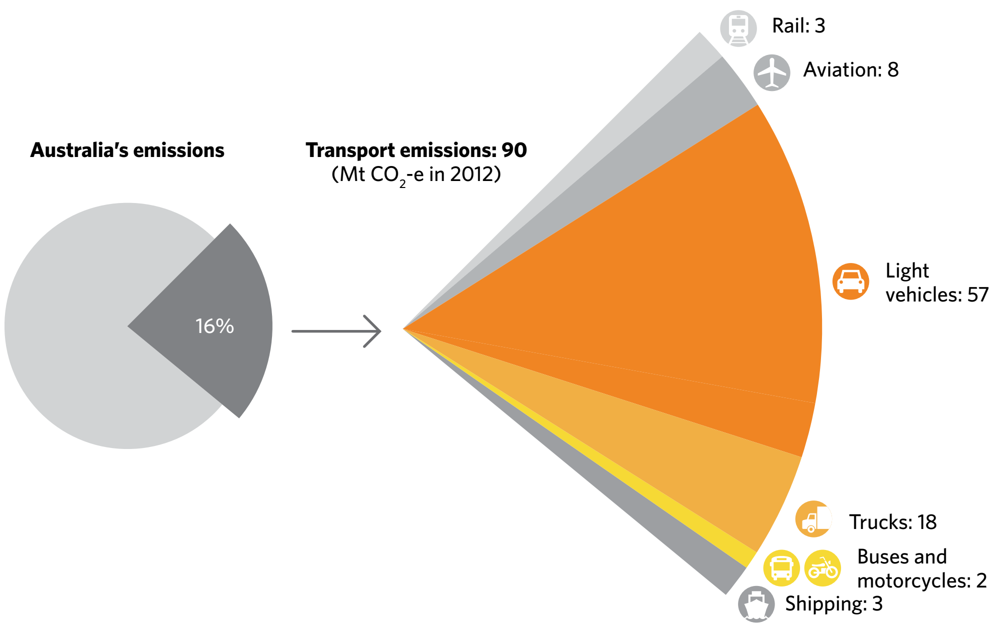
The transport sector accounts for 16 per cent of Australia's greenhouse gas emissions. Light vehicles account for the largest share—10 per cent of Australia's total emissions.

The Australian light vehicle fleet has become more efficient and less emissions-intensive over time but large opportunities for further improvements remain. Technologies to improve light vehicle efficiency are readily available and represent one of the lowest cost emissions reductions opportunities in the Australian economy.

2.1 AUSTRALIA'S TRANSPORT EMISSIONS

The transport sector spans four modes—road, rail, aviation and shipping. Greenhouse gas emissions from transport come primarily from fossil fuels combusted in vehicles. The domestic transport sector contributed 90 Mt CO_2-e, or 16 per cent of Australia's greenhouse gas emissions in 2012 (DoE 2014a, p. 2) (Figure 2.1). Australia's per capita transport emissions are higher than those of most other countries (IEA 2013a, p. 104). This is partly because we use more road transport and partly because our road passenger transport is relatively inefficient.

FIGURE 2.1: AUSTRALIA'S TRANSPORT EMISSIONS BY MODE, 2012



Source: DoE 2014a; Treasury and DIICCSRTE 2013
Note: Figures do not add due to rounding.

Transport emissions increased by 50 per cent between 1990 and 2012, the fastest sectoral growth over the period (DoE 2014a, p. 2). Emissions increased because growth in transport activity outpaced improvements in fuel efficiency. While per person ownership and use of light passenger vehicles has stabilised after decades of growth, freight and aviation activity continues to grow. These trends are reflected in stable automotive petrol consumption and strong increases in diesel and aviation turbine fuel consumption over the past five years (22 and 28 per cent respectively) (DoE 2014b, p. 11).

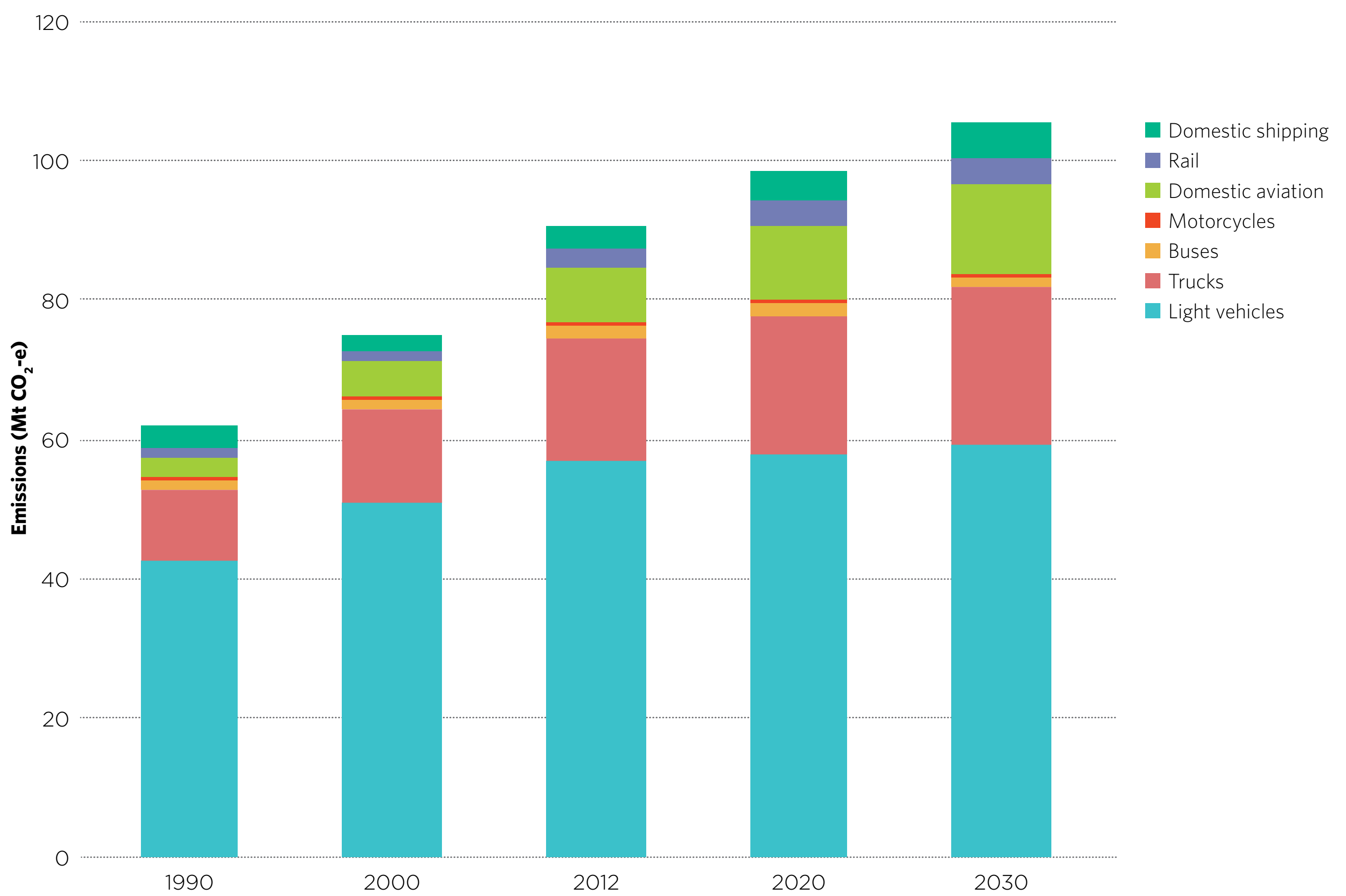
With no further policy action, overall transport emissions are projected to increase in the period to 2030, as demand growth continues to outpace efficiency improvements. Figure 2.2 shows historical and projected trends of Australia's transport emissions, by mode of transport. The projected growth is in the absence of a carbon price and without any further policy action.

In this graph, and throughout this report, transport emissions refer to the 'tailpipe' emissions from vehicles. Emissions from generation of electricity used by electric vehicles are accounted for in the electricity sector. Combustion of biofuels produces zero emissions for transport accounting purposes, but biofuel production emissions can be substantial and are included in the agriculture or industry sectors. Both of these issues are discussed further below.

Key trends include:

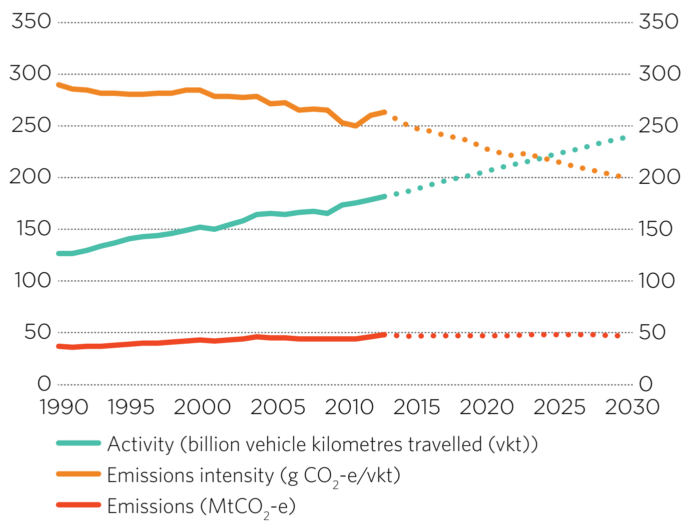
- Road transport is the dominant source of transport emissions, contributing 85 per cent of all transport emissions in 2012 (77 Mt CO_2-e). This includes motorcycles, cars and light commercial vehicles, rigid and articulated trucks and buses (CCA 2014a, p. 274).
  - Light vehicles are the largest contributor, emitting 57 Mt CO_2-e in 2012—almost two-thirds of transport emissions and 10 per cent of Australia's total emissions (CCA 2014a, p. 274). Growth in road passenger activity has slowed and stabilised over the past decade (Figure 2.3). Historically, passenger travel has increased with rising incomes. Recent trends suggest that the average daily time spent commuting has peaked and future growth in light passenger vehicle activity will likely come predominantly from population increases (BITRE and CSIRO 2008, pp. 7–8). Light commercial vehicle activity is projected to grow more than twice as fast as passenger vehicles to 2030, but will still contribute less than a quarter of the total kilometres travelled by light vehicles (Treasury and DIICCSRTE 2013).

FIGURE 2.2: TRANSPORT EMISSIONS BY MODE OF TRAVEL, SELECTED YEARS, 1990–2030



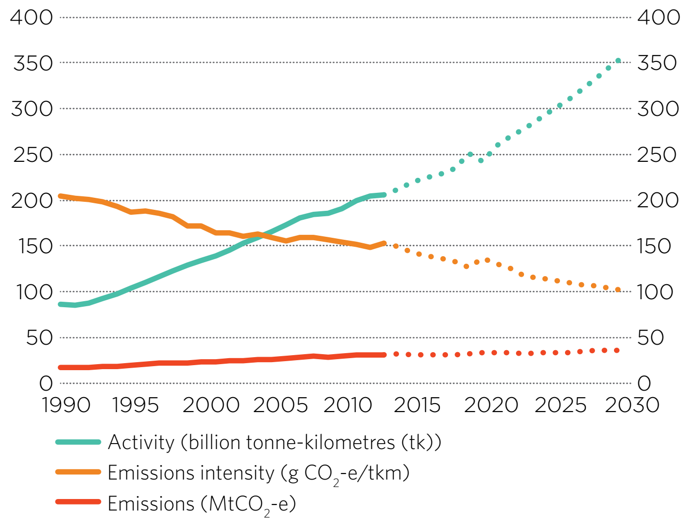
Note: Future projections are based on a no carbon price scenario.
Source: Climate Change Authority calculations using results from Treasury and DIICCSRTE 2013, and Reedman and Graham 2013a

FIGURE 2.3: PASSENGER ROAD EMISSIONS, ACTIVITY AND EMISSIONS INTENSITY, 1990–2030



Note: Future projections under a no carbon price scenario. Activity includes motorcycles and passenger vehicles only and does not include light commercial vehicles.
Source: Climate Change Authority calculations using results from Treasury and DIICCSRTE 2013

FIGURE 2.4: ROAD FREIGHT EMISSIONS, ACTIVITY AND EMISSIONS INTENSITY, 1990–2030



Note: Future projections under a no carbon price scenario. Activity includes light commercial vehicles and rigid and articulated trucks.
Source: Climate Change Authority calculations using results from Treasury and DIICCSRTE 2013, and BITRE 2012

- Road freight is the second-largest contributor to road transport, with trucks accounting for 20 per cent of transport emissions in 2012 (BITRE 2013b, p. 135). The road freight task is growing quickly—up 42 per cent between 2002 and 2012 to 208 billion tonne-kilometres (BITRE 2013b, p. 47)—and is projected to increase further, to 357 billion tonne-kilometres in 2030 (see Figure 2.4). This means emissions from trucks are projected to rise much faster than those from other types of road vehicles, despite improvements in emissions intensity (Treasury and DIICCSRTE 2013).

- Domestic aviation activity, dominated by passenger transport, accounts for 9 per cent of transport emissions. Aviation activity increased by 80 per cent between 2001 and 2011, and is projected to approximately double from 2011 levels by 2030 (CCA 2014a, p. 275). This strong growth is largely driven by economic growth and increasing passenger preference for air travel over road or rail (BITRE 2013a and PC 2011, p. 60).
- Emissions from rail and domestic shipping each accounted for about 3 Mt CO_2-e, or 3 per cent of total transport emissions in 2012 (Treasury and DIICCSRTE 2013).

CONCLUSION:
C.1 Transport accounts for 16 per cent of Australia's greenhouse gas emissions. Light vehicles alone contribute 10 per cent.

2.2 OPPORTUNITIES FOR REDUCING TRANSPORT EMISSIONS

Australia's growing transport demand is not unusual. The IEA projects global travel to double between 2010 and 2050. Without further policy action, global transport emissions could grow by 70 per cent by 2050, despite continuous efficiency improvements (2013b, p. 12).

The Authority's 2014 Targets and Progress Review found that there are three broad ways to reduce transport emissions without diminishing living standards:

- increased efficiency of motorised vehicles
- reduced emissions intensity of fuels
- more efficient demand management.

2.2.1 INCREASED EFFICIENCY OF MOTORISED VEHICLES

Reducing the amount of carbon-containing fuel required to transport people and freight also reduces greenhouse gases emitted—that is, it improves the emissions intensity of the vehicle.

It would be costly and impractical to retrofit an existing light vehicle fleet with new technologies (IEA 2012b, p. 6). Fleet improvements can be achieved effectively over time by improving the design of new vehicles. As the fleet composition changes to include more new and efficient cars, and old vehicles are retired, the average efficiency of the fleet improves.

2.2.2. REDUCED EMISSIONS INTENSITY OF FUELS

The second way that transport emissions can be reduced is by switching from conventional fuels with higher emissions to alternative fuels with potentially lower emissions, such as electricity, natural gas and sustainable biofuels (for example, ethanol and biodiesel produced from crops like wheat, maize or sugar cane, or canola).

The level of CO_2 emitted from the combustion of fuels depends on both their energy content and carbon content. For example, diesel has a higher energy and carbon content, and therefore higher emissions per litre, than petrol. A diesel engine, however, is more efficient than a conventional petrol engine, so its fuel consumption and CO_2 emissions are lower for each kilometre travelled.

The net effect of different fuels on national emissions also depends on the upstream emissions from their production. Emissions from running a vehicle on electricity, for example, depend on how the electricity is generated. When powered by the current average Australian grid, the fully electric vehicles currently available in Australia are less emissions-intensive than the average light car, which is the most efficient class of light vehicle (Climate Change Authority calculation based on CCA 2014a; NTC 2013 and Commonwealth of Australia 2014c).

Similarly, the overall, or 'lifecycle', emissions of biofuels can vary dramatically depending on the source of the feedstock (PC 2011, p. 7). Given the feedstocks currently used in Australia, however, biofuels generally do have lower emissions intensity than fossil-derived fuels on a lifecycle basis.

Biofuel production also involves water and land use, in some cases displacing food crops. Advanced, second- and third-generation biofuels such as lignocellulose use non-food resources including forestry and urban waste, but these are not yet sufficiently developed for deployment on a commercial scale (Reedman and Graham 2013a, p. 33).

2.2.3 MORE EFFICIENT DEMAND MANAGEMENT

The third way transport emissions can be reduced is by changing the way people and freight are moved, and reducing the need for movement while maintaining living standards. These changes improve the emissions intensity of travel or reduce transport demand. The potential for passenger mode shift is difficult to quantify—users' mode selection depends on the price and desirability of the alternative transport options available and, potentially, policies and programs that influence travel behaviour.

Australia's cities are more sparsely populated than most cities of the world (DIT 2013, p. 112), which can present a challenge to broader use of public and active transport. Nevertheless, both global and national assessments (IEA 2013b, pp. 44–5; DCCEE 2010, pp. 130–2) highlight many opportunities, including:

- Mode shift—moves passengers and freight from higher to lower emissions modes; for example, from road to public transport, walking, cycling and rail. Improvements to public transport can reduce congestion while improving travel time and reducing household transport expenses.
- Intelligent transport systems (ITS)—use emerging communications and data systems to better manage logistics and transport use, including by reducing congestion and optimising fuel use. The IEA estimates that ITS could reduce truck fuel use by 2–10 per cent through technologies such as intelligent control of acceleration and speed, and predictive cruise control (IEA 2012a, p. 27).
- Urban and transport planning—can help reduce travel requirements and encourage mode shift to active and public transport; for example, by locating employment and community services like schools close to communities that need them, or creating streetscapes that encourage walking rather than driving.

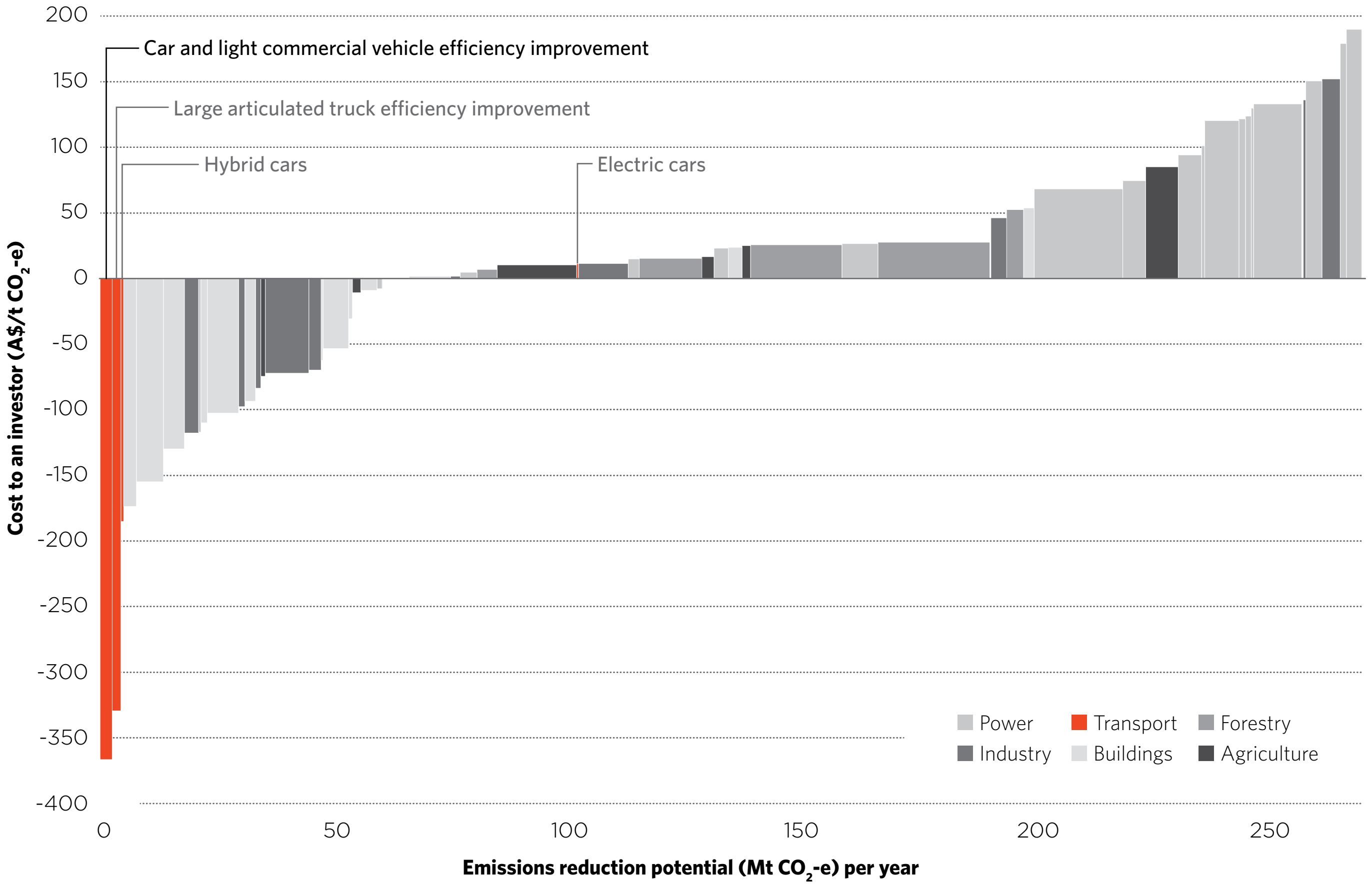
2.2.4 OPPORTUNITIES IN THE MEDIUM AND LONGER TERM

Over the period to around 2030, technologies to improve the fuel efficiency of new conventional light vehicles offer the largest and best-value emissions reduction opportunities in the Australian transport sector.

Significant improvements in light vehicle efficiency are required in a cost-effective pathway to meet the global goal to limit warming to less than 2 degrees. Conventional internal combustion engines are projected to remain the dominant propulsion system used in road vehicles to 2030, even in a 2 degree scenario (IEA 2012b, p. 10).

Relative to other sectors, vehicle efficiency improvements are some of the lowest cost opportunities to reduce emissions, delivering net savings to motorists because higher vehicle purchase costs can be more than offset through lower running costs. ClimateWorks Australia (2014, pp. 4–5) identified that the most financially attractive emissions reduction opportunity across the entire economy could be fuel efficiency improvements to light vehicles with internal combustion engines, providing savings to vehicle users of $350 for each tonne of CO_2 that is not emitted (Figure 2.5).

FIGURE 2.5: OPPORTUNITIES TO REDUCE EMISSIONS IN AUSTRALIA IN 2020



Source: ClimateWorks Australia 2014
Note: Costs are in 2010 Australian dollars

ClimateWorks estimates that conventional light vehicle efficiency improvements could provide fuel savings of $500 per year in 2020, rising to $852 per year in 2024 (2014, p. 11). It also found that even if vehicle purchasers paid up to $2,500 per vehicle more to cover the costs of improved efficiency technologies, they would recover these costs within three years through fuel savings (2014, p. 2). This is consistent with international assessments (for example, IEA 2009) that if strong enough measures were implemented globally, the fuel consumption of new light vehicles could be halved by 2030 at low or possibly negative cost to consumers.

In the longer term, light vehicle electrification and biofuels for light vehicles could deliver significant reductions (Graham et al. 2012a). Biofuels for heavy vehicles and greater use of natural gas could reduce the emissions intensity of Australia's heavy vehicle fleet (Graham et al. 2012b, p. 45). Assessing the emissions reduction potential of a large range of transport options, the Australian Low Carbon Transport Forum found that the top four options for delivering emissions improvements were all changes to light vehicles—electrification, use of biofuels, fuel efficiency technologies and downsizing (Table 2.1).

TABLE 2.1: ESTIMATED OPPORTUNITIES FOR ANNUAL EMISSIONS REDUCTIONS IN 2050 FROM TRANSPORT SECTOR

OPPORTUNITIES	ESTIMATED ANNUAL EMISSIONS REDUCTION (FULL FUEL CYCLE) IN 2050 (Mt CO_2-e)*
Increased vehicle efficiency technologies	
Light vehicles	19.4
Trucks and buses	7.2
Aircraft	5.2
Shipping	0.7
Rail	0.9
Reduced emissions intensity of fuels	
Electric light vehicles	22.8**
Electric trucks and buses	1.9
Light vehicle biofuels	11.8
Truck and bus biofuels	14.3
Aviation biofuels	6.2
Shipping biofuels	2.0
Rail biofuels	2.4
More efficient transport demand management	
Urban road pricing and other pricing incentives	3.9
Urban design	1.0
Mode shift, urban car to less emissions-intensive mode	1.22
Freight mode shift and improved logistics	3.1

Note: *Emissions reduction estimates are the calculated contribution to aggregate abatement from the full fuel cycle (including 'upstream' emissions from fuel production) if the full range of opportunities is introduced in sequence. Estimated abatement from each of the opportunities if introduced in isolation is significantly higher in many cases. **Assumes significant decarbonisation of the electricity supply, from 0.724 t CO_2/MWh in 2020 to 0.209 t CO_2/MWh in 2050.
Source: Graham et al. 2012b

The fact that emissions reduction opportunities from deploying more efficient technologies in conventional vehicles are both relatively low cost and important for achieving global temperature goals suggests light vehicles are a sensible place to focus Australia's current efforts to reduce emissions from the transport sector. A technology-neutral policy such as mandatory vehicle standards (see Chapter 3) will encourage both the low-cost improvements in conventional vehicle technology currently available, and the deployment of alternative vehicles over time.

In some cases, regulation of a particular industry sub-sector may drive activity into other sub-sectors, thereby undermining the intended emissions reductions and other benefits. This is very unlikely in the case of light vehicle emission standards. Standards reduce vehicle operating costs (see Chapter 4), so they create little incentive for regulatory avoidance. Further, other vehicle types are generally poor substitutes for light vehicles—for example, households and businesses are unlikely to switch from cars and vans to heavy duty trucks. Finally, if standards were to encourage mode shifts—for example, from private to public transport—this would tend to strengthen rather than undermine the emissions savings.

CONCLUSION

C2. In the medium term, improving the efficiency of road passenger transport using existing technologies is one of the lowest cost emissions reduction opportunities in the Australian economy.

The next section provides an overview of Australia's light vehicles and how the fleet has evolved since 2005.

2.3 CHARACTERISTICS OF AUSTRALIA'S LIGHT VEHICLE FLEET AND ITS USE

Australia's light vehicle market consists of all road vehicles less than 3.5 tonnes (other than motorcycles) and is classified into light passenger vehicles (cars and SUVs) and light commercial vehicles (sometimes called light trucks).

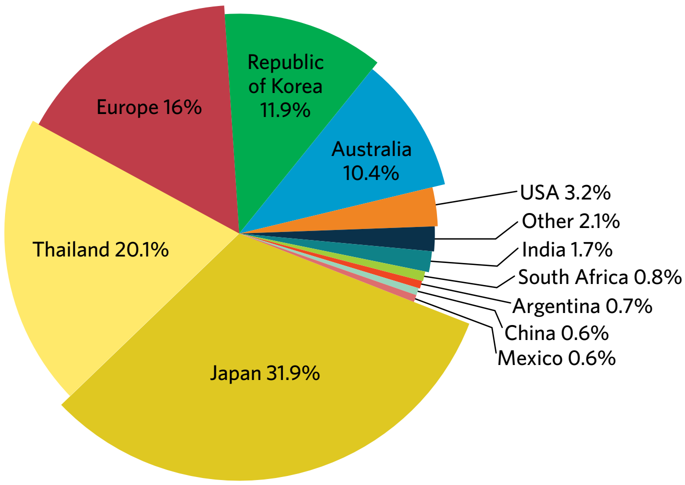
Australian road vehicles travelled over 211 billion kilometres in 2012, or 14,000 km on average per vehicle. Light vehicles accounted for 91 per cent of all road kilometres travelled and consumed 75 per cent of road transport fuel. Passenger vehicles were predominantly fuelled by petrol (85 per cent of fuel consumption), while half of all fuel consumed by light commercial vehicles was diesel (ABS 2013b, p. 7). Australian light vehicles emitted an average of 3.75 tonnes of greenhouse gases in 2012 (Climate Change Authority calculations based on ABS 2013a; BITRE 2013b).

About one million new light vehicles are purchased in Australia each year, adding to a fleet of about 16 million vehicles. Over the five years to 2013, the fleet grew at an average annual rate of 2.4 per cent (ABS 2013a, p. 8). In 2013, the average car was 9.8 years old and the average light commercial vehicle was 11.3 years old (ABS 2013a, p. 11). The average Australian light vehicle has a lifespan of about 20 years (DCCEE 2010, p. 137) and about 4 per cent of the fleet is retired each year (ABS 2013a, p. 21).

The Australian new vehicle sales market is classified into three buyer types—private (that is, households), government and business. In 2013, private sales accounted for over half of new light vehicle sales, followed by 43 per cent from business and 4 per cent from governments (NTC 2014). Privately purchased vehicles have the lowest average vehicle emissions intensity, followed by business and then government. The higher emissions intensity of government vehicles may be attributable in part to purchasing policies in some jurisdictions that favour domestically produced vehicles, which have higher emissions intensities than the average new light vehicle (NTC 2014). With the end of domestic manufacturing, any remaining such policies will need to be reviewed, and fuel economy or emissions intensity could be expected to play a larger role in purchasing decisions. Between 2005 and 2013, the average emissions intensity of vehicles for each class of purchaser fell, with the largest falls in emissions coming from business purchases (22 per cent over the period), followed by government (20 per cent) and private buyers (17 per cent) (NTC 2009, 2011, 2012, 2013, 2014).

Most new vehicles sold in Australia are produced overseas, with the domestic industry supplying about 10 per cent of the new vehicle fleet in 2013. The largest source of imported vehicles was Japan, which supplied about one-third of Australia's new vehicles, followed by Thailand, Europe and Republic of Korea (Figure 2.6).

FIGURE 2.6: NEW ROAD VEHICLES BY COUNTRY OF ORIGIN, 2012



Source: FCAI 2014

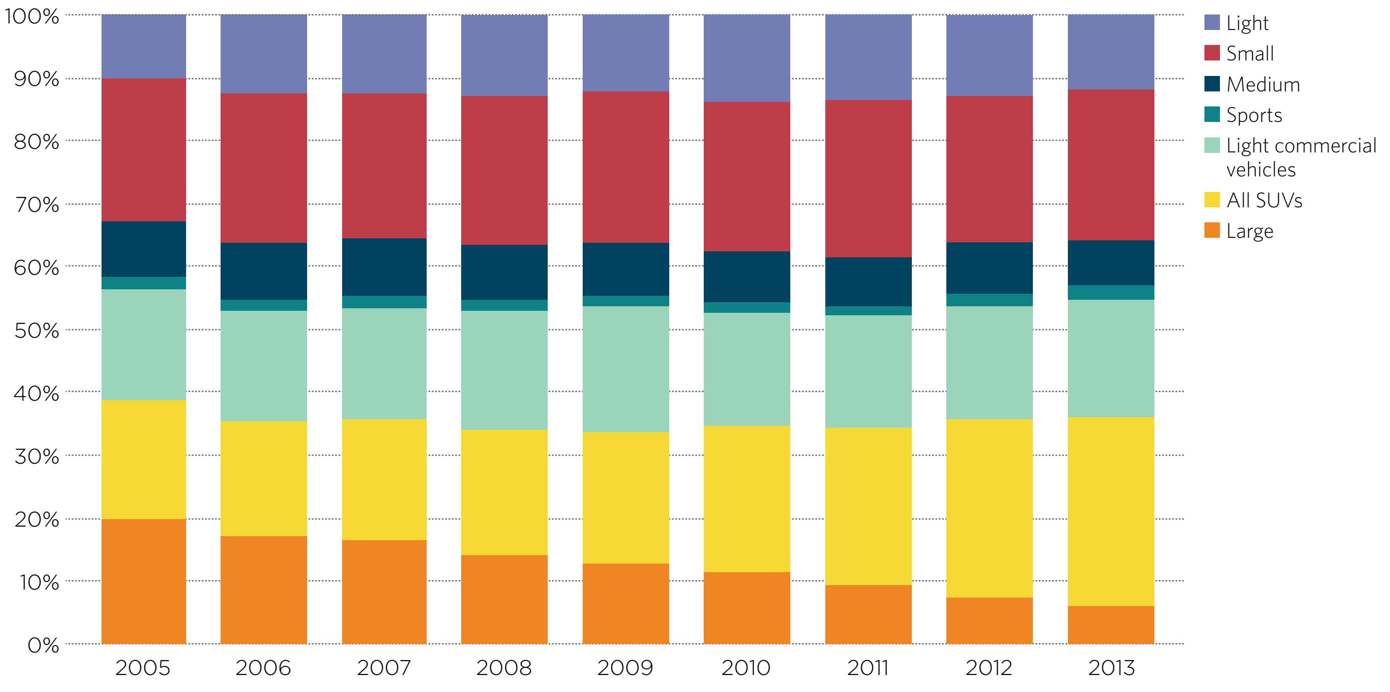
Australia's light vehicle fleet mix has changed over the past decade, with a shift in new vehicle sales towards SUVs at the expense of larger cars and, to a lesser extent, towards smaller cars (Figure 2.8). Since 2005, the market share of larger vehicles has fallen by 14 percentage points. Over the same period, the market share of SUVs increased by 12 percentage points, and light passenger vehicles increased by 2 percentage points. Figure 2.7 shows the highest selling model for each vehicle class.

FIGURE 2.7: HIGHEST SELLING MODELS IN 2013, BY VEHICLE CLASS

LIGHT	SMALL	MEDIUM	LARGE
			
Mazda 2	Toyota Corolla	Toyota Camry	Holden Commodore
SPORTS	**SUV**	**LIGHT COMMERCIAL**	
			
Toyota 86	Mazda CX5	Toyota Hilux	

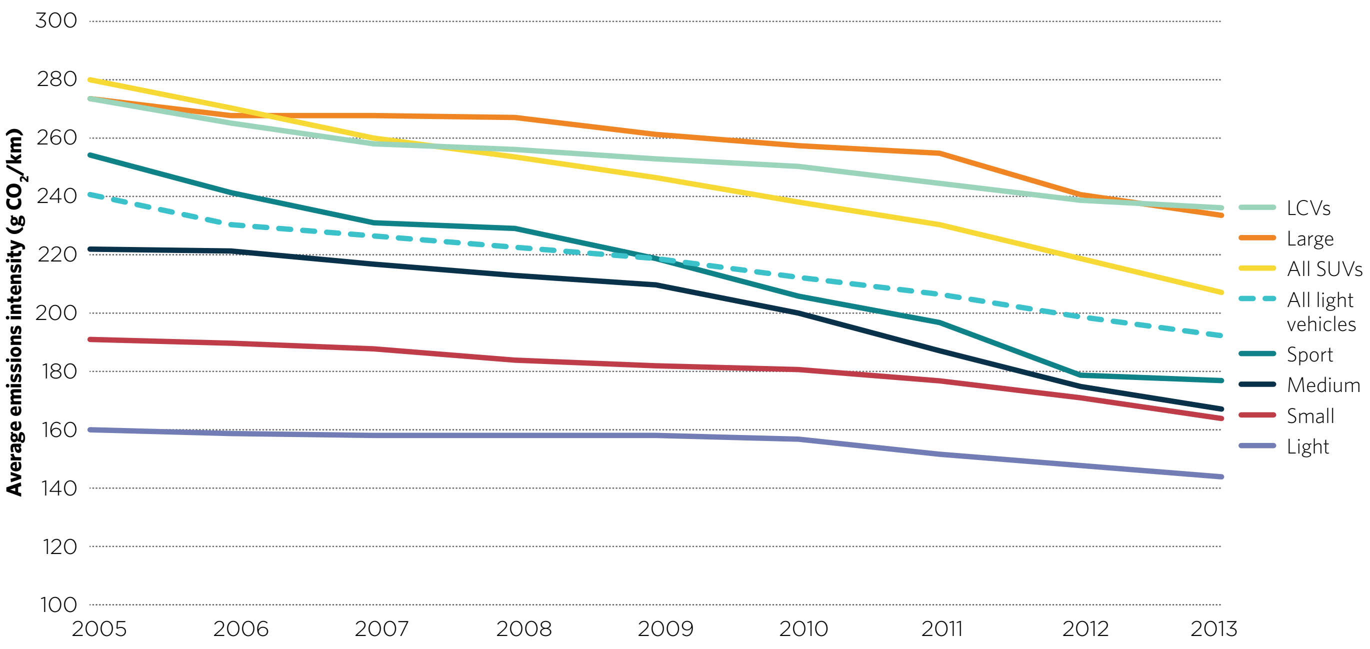
Source: National Transport Commission 2014

FIGURE 2.8: NEW VEHICLE SHARES BY CLASS OF LIGHT VEHICLE, 2005–13



Note: Large includes large, upper large and people mover vehicles.
Source: Climate Change Authority calculations using results from the National Transport Commission's carbon dioxide emissions reports for new Australian vehicles 2009–14

FIGURE 2.9: NEW VEHICLE AVERAGE EMISSIONS INTENSITY BY VEHICLE CLASS, 2005–13



Note: Large includes large, upper large and people mover vehicles.
Source: Climate Change Authority calculations using results from the National Transport Commission's carbon dioxide emissions reports for new Australian vehicles 2009–14

All classes of light vehicles in Australia are becoming more efficient—tested average emissions intensity from new light vehicles sold in Australia fell by 3.3 per cent per year over the period 2005–13, from 252 g CO_2 per km to 192 g CO_2 per km (NTC 2014, p. 16). Figure 2.9 shows that all light vehicle classes have improved their average emissions intensity since 2005, with larger vehicles making the largest improvements. The shift from large cars into SUVs over the period has lowered the emissions intensity of new light vehicles—in 2013, the average SUV was 11 per cent less emissions-intensive than the average large vehicle. Despite these improvements, the Australian fleet remains more emissions-intensive than that of most other OECD countries (ICCT 2014).

Overall emissions from light vehicles have been increasing but are projected to stabilise. Between 2002 and 2012, emissions increased by 11 per cent because growing light vehicle activity more than offset improvements in emissions intensity (BITRE 2013b, p. 135). Over the period to 2030, total light vehicle emissions are projected to be roughly stable (Figure 2.2).

2.4 OPPORTUNITIES TO IMPROVE EMISSIONS INTENSITY OF THE LIGHT VEHICLE FLEET

Light vehicle emissions intensity can be reduced in two main ways:

- Changes in consumer preferences towards smaller vehicles, which have lower emissions on average. These shifts could be to a smaller vehicle within a class (for example, shifting from a large SUV to a small SUV), or between classes (for example, shifting from a large SUV to a medium-sized car).
- Changes in vehicles, including both vehicle and fuel efficiency technologies.

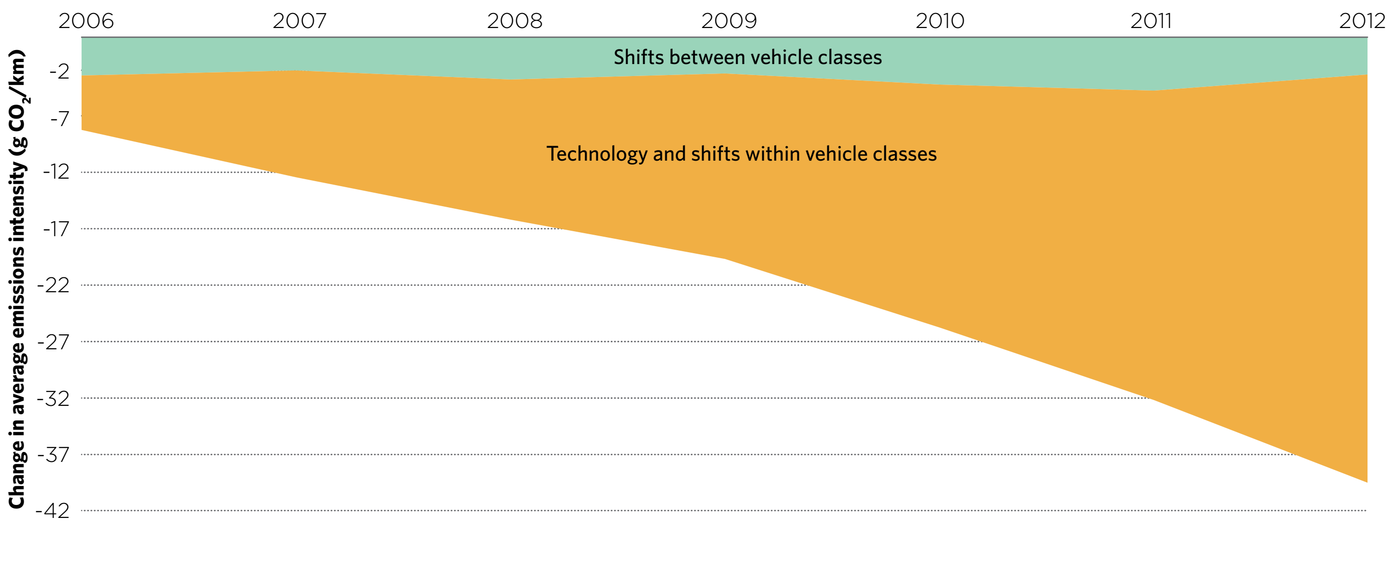
2.4.1 IMPROVING EFFICIENCY THROUGH CHANGES IN THE FLEET MIX

The overall level of emissions from the Australian light vehicle fleet is affected by the composition of that fleet. Smaller vehicles are generally more fuel-efficient than larger vehicles, although there is significant variation within vehicle classes. Figure 2.9 shows recent improvements and the significant gap between the efficiency of smaller and larger new light vehicles. Increasing the proportion of smaller cars in the Australian fleet is likely to decrease emissions, even if there were no further improvements to the efficiency of individual vehicles.

2.4.2 IMPROVEMENTS IN LIGHT VEHICLE TECHNOLOGY

While a shift to smaller vehicles would reduce emissions intensity, Australia's recent history shows that large improvements can be achieved even without big shifts to smaller vehicles. The Authority has calculated that technology improvements and within-class shifts have been the main driver of improvement in Australia's average new light vehicle emissions intensity between 2005 and 2012. These two factors contributed over 90 per cent (over 36 g CO_2/km) of the fleet's average emissions intensity reductions over the period (Figure 2.10). On average, technology improvements and within-class shifts reduced average light vehicle emissions by about 5 g CO_2/km per year from 2005 to 2012.

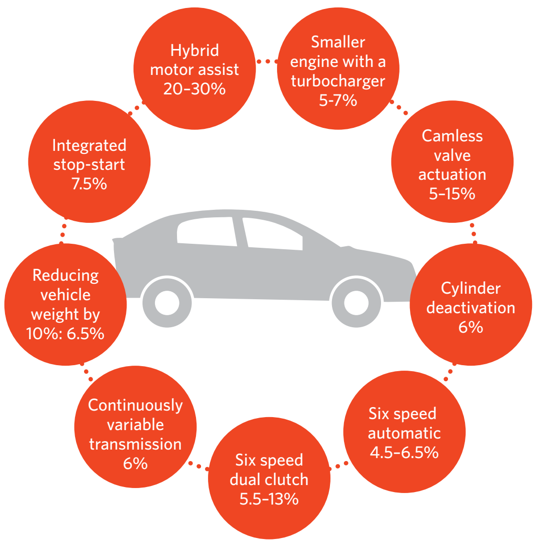
FIGURE 2.10: DECOMPOSITION OF CHANGES IN AVERAGE NEW LIGHT VEHICLE EMISSIONS INTENSITY, 2005–12



Source: Climate Change Authority calculations using national light vehicle sales, vehicle classifications and carbon dioxide emissions from the National Transport Commission's carbon dioxide emissions reports for new Australian vehicles 2009–13

There are many proven, cost-effective and currently available technologies to improve light vehicle efficiency and thereby reduce emissions intensity; for example, these include reducing vehicle weight, and implementing more efficient engines and more efficient drive trains. International research suggests that currently available technologies could achieve a 30 per cent reduction in new light vehicle emissions intensity in most countries within a decade (DIT 2011a, p. 10) and retain scope for further improvements. Figure 2.11 shows some promising vehicle technologies for improving fuel efficiency, along with an estimate of the emissions they may save.

FIGURE 2.11: ESTIMATED CO_2 EMISSIONS INTENSITY REDUCTIONS FROM AVAILABLE FUEL-SAVING TECHNOLOGIES



Source: DIT 2011, p. 11

The next section considers the Australian policy context in which vehicle efficiency improvements would be made.

2.5 CURRENT POLICIES AFFECTING LIGHT VEHICLES

A range of policies in operation in Australia affect aggregate light vehicle emissions and costs, and therefore the costs and benefits of standards.

2.5.1 STANDARDS TO REDUCE VEHICLE AIR POLLUTION

Australia, like many other countries, already has vehicle standards to reduce air pollutants. These have been in place since the early 1970s (DIRD 2014a). Australia's existing vehicle emissions standards regulate air pollutants to improve human health and air quality (DIT 2010, p. 26). Vehicles significantly contribute to levels of hydrocarbons, oxides of nitrogen, carbon monoxide and particulate matter in the air, which can adversely affect acute and chronic health conditions (DIT 2010, pp. 17, 22).

Australia's existing vehicle emissions standards are set by Australian Design Rules (ADRs), which are legislative instruments under the *Motor Vehicle Standards Act 1989* (Cth) (DIT 2010, p. 11). The ADRs specify the maximum level of emissions permitted by a vehicle under a specified test (DIRD 2014a).

In 2011, the Commonwealth Government announced the adoption of stronger emissions standards, the first stage of which ('Euro 5' standards) will be fully implemented in 2016 (Commonwealth of Australia 2011). These standards mirror those adopted by the European Union, but on a staggered time frame.

2.5.2 POLICIES AND MEASURES ADDRESSING LIGHT VEHICLE GREENHOUSE GAS EMISSIONS

The Commonwealth Government's proposed Direct Action Plan revises Australia's approach to reducing greenhouse gas emissions, including those from the transport sector. Its centrepiece is the Emissions Reduction Fund (ERF), which will purchase emissions reductions from projects and activities according to approved methodologies. The ERF could help to encourage emissions reductions from light vehicles; Chapter 3 discusses the interactions between the ERF and light vehicle emissions standards, concluding that the two can be complementary.

Other measures include:

- Information measures—Australia has compulsory fuel consumption labelling for new vehicles, with relevant information about specific vehicles available online.
  - A fuel consumption label has been mandatory for new light vehicles since 2001. The label is model-specific and since 2003 has provided information on both fuel consumption and CO_2 emissions (DIRD 2013).

  - The Green Vehicle Guide is an online consumer information resource that rates new vehicles based on their greenhouse and air pollution emissions. The rating is calculated using data provided by manufacturers when their vehicles are tested against the relevant ADRs (Commonwealth of Australia 2014).
- Fiscal measures
  - State and territory vehicle purchase and registration charges can be designed to create incentives to buy low-emissions vehicles. For example, the ACT differentiates charges based on vehicle emissions: its Green Vehicles Duty Scheme reduces stamp duty costs as the vehicle's Green Vehicle Guide rating improves (TAMS 2011). All other states and territories calculate stamp duty and registration costs based on vehicle value, or attributes such as vehicle mass or cylinder count, although some (such as Victoria) offer modest technology-specific discounts for hybrid vehicles (VicRoads 2014).

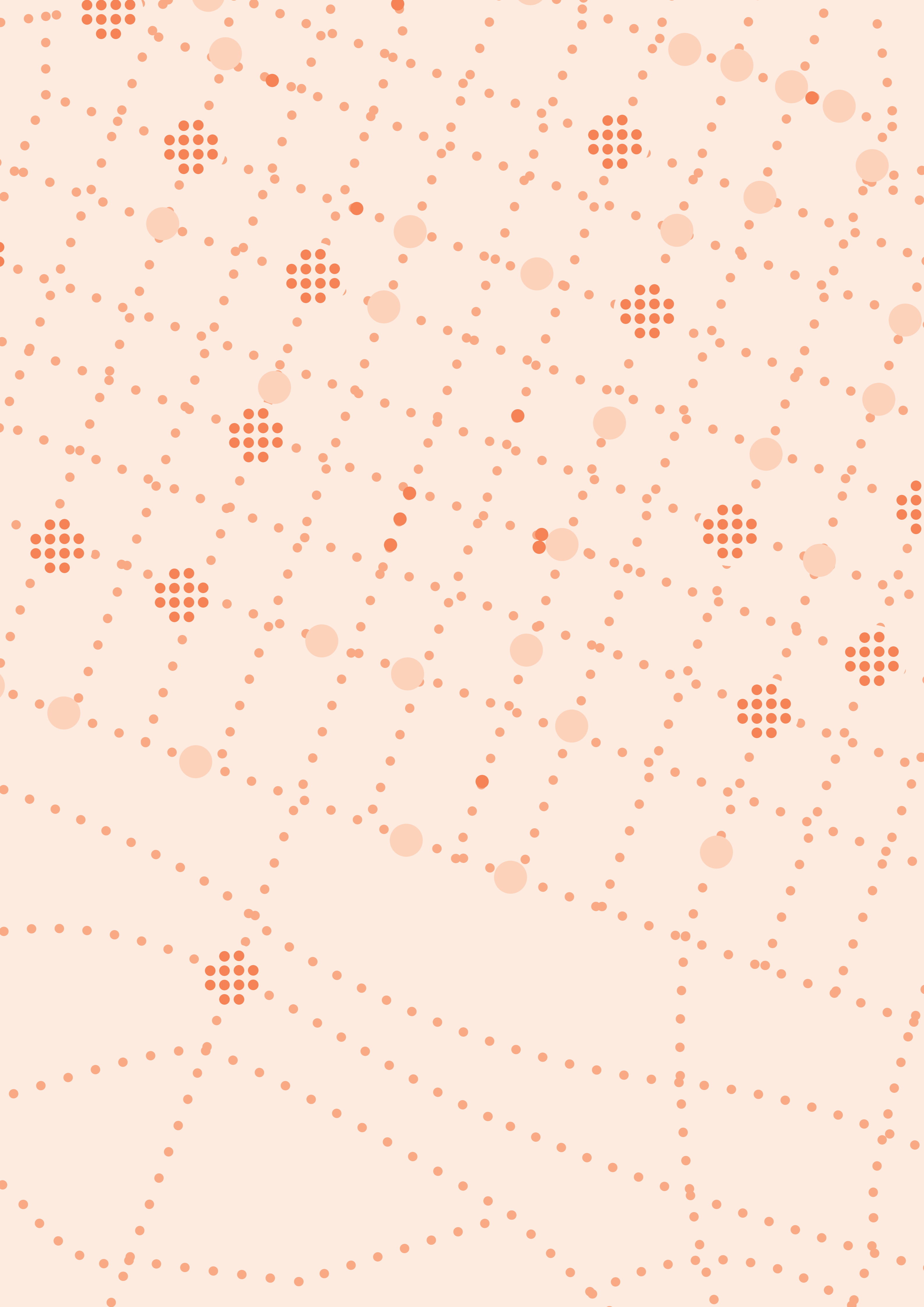
The vehicle industry has introduced its own measures in the past. In 2003, the Federal Chamber of Automotive Industries (FCAI) agreed to a Code of Practice with a voluntary 2010 fuel consumption target of 6.8 litres per 100 km (equivalent to about 160 g CO_2/km for a petrol vehicle and 187 g CO_2/km for a diesel). This target was not met. A subsequent voluntary emissions intensity target of 222 g CO_2/km by 2010 was met in 2008 and not renewed (PWC 2010, p. 22).

2.5.3 POLICIES AFFECTING LIGHT VEHICLE COSTS AND AVAILABILITY

Other transport policies affect fuel and vehicle costs:

- Fuel excise applies to both petrol and diesel, with a nominal rate of 38.143 c/L applied since 2001. The Commonwealth Government has proposed that, from 1 August 2014, excise will increase with the consumer price index. This would increase retail fuel prices and, in turn, increase the potential benefit of more fuel efficient vehicles.
- Import tariffs are duties imposed on imported vehicles. A tariff based on vehicle import prices is currently levied on vehicles imported from some countries, including the EU and Japan (5 per cent) and the Republic of Korea (4 per cent). Under recent agreements, cars from Japan and Korea will in future be exempt from tariffs (Australian Government 2014a and 2014b). The Authority estimates that the average impact of tariffs on the purchase price of vehicles in 2012 was about $1,200 per vehicle subject to tariffs (Authority calculations based on PC 2012 and ABS 2014), with the actual amount varying by vehicle type.
- Second-hand vehicles are subject to a $12,000 import duty and require a Vehicle Import Approval. The Productivity Commission noted that these requirements create barriers to the importation of second-hand vehicles into Australia (PC 2014, p. 99). They found that the policy rationale for these barriers is weak but, should the barriers be relaxed, appropriate regulatory measures would be required to ensure environmental performance, safety and other requirements are met. This is discussed further in Chapter 5 and Appendix C.
- The Luxury Car Tax (LCT) is a 33 per cent tax on the value of cars over $60,316 (ATO 2013). The LCT is tiered based on fuel consumption—for vehicles with fuel consumption below seven litres per 100 km (equivalent to 160 g CO_2 per km for petrol and 187 g CO_2 per km for diesel), the LCT has a higher threshold of $75,375 (ATO 2013). Exemptions include non-passenger commercial vehicles and emergency vehicles (PC 2014, p. 103). The Productivity Commission suggested the *Taxation White Paper* consider removing the LCT (2014, p. 104).
- Fringe benefits tax (FBT) is paid on certain benefits employers provide to their employees in place of salary or wages. A common benefit offered to employees is a car, with the rate of FBT payable varying with the number of kilometres the vehicle travels. The Commonwealth Government has indicated that this policy is not subject to review.

The next chapter discusses why policy action is needed to reduce greenhouse gas emissions from light vehicles in Australia and why fleet average emissions standards are a cost-effective policy tool.



3

POLICIES FOR REDUCING LIGHT VEHICLE EMISSIONS

Light vehicle emissions standards are a crucial part of a cost-effective strategy for overcoming market failures and behavioural barriers to more fuel-efficient and lower emissions vehicles. Introducing a light vehicle emissions standard in Australia is consistent with the government's principles for best practice regulation.

Mandatory standards would complement the Direct Action Plan to reduce Australia's emissions to 5 per cent below 2000 levels by 2020 and its centrepiece, the Emissions Reduction Fund.

Chapter 2 showed there are opportunities to reduce Australia's greenhouse gas emissions by improving the efficiency of light vehicles. This chapter considers whether government intervention is required to realise these efficiency improvements and, if so, which policy tools to use. It asks:

- whether regulation of light vehicle emissions is necessary
- how market and behavioural barriers affect policy development
- what international experience can tell us about policy options to reduce light vehicle emissions
- which policy options would generate the greatest benefits in Australia
- how a light vehicle emissions standard might interact with the Emissions Reduction Fund (ERF).

3.1 STANDARDS AND THE GOVERNMENT'S DEREGULATION AGENDA

The Commonwealth Government has placed a high priority on reducing red tape and unnecessary regulatory burdens on individuals, businesses and community organisations. The government has expressed concern that excessive regulation can deter investment and innovation, and stifle productivity (Frydenberg 2013). It has a target of reducing the cost of regulation by $1 billion per year (DPMC 2013).

The government's approach is to ensure that 'regulation is never adopted as the default solution, but rather introduced as a means of last resort' (DPMC 2014, p. i). *The Australian Government Guide to Regulation* (DPMC 2014) sets out 10 principles for policy makers, designed to promote 'better regulation, not more regulation'. The first three principles are:

1. Regulation should not be the default option for policy makers: the policy option offering the greatest net benefit should always be the recommended option.
2. Regulation should be imposed only when it can be shown to offer an overall net benefit.
3. The cost burden of new regulation must be fully offset by reductions in the existing regulatory burden.

The government has made some changes to the process for developing regulatory policy. Australian policy makers have long been required to prepare regulation impact statements (RIS) for new policy proposals. A RIS clearly articulates a policy problem, identifies a range of options for solving it, and estimates the costs and benefits, in a broad sense, of the different options. The solution that provides the largest net benefit is the one that should be recommended. An additional step in the 2014 guidelines is that policy makers must identify 'offsets' in other areas—that is, regulatory burdens that can be removed. In this way, the overall level of regulatory burden on the Australian economy and community is unchanged by the new regulation (OBPR 2014, pp. 9–11).

The Authority has considered the main costs and benefits of options to improve the emissions intensity of new light vehicles. Mandatory light vehicle standards are likely to offer the greatest net benefit of available policy options. Standards could be complemented by enhancing existing information measures and better targeting light vehicle taxes and charges to encourage use of more efficient vehicles. The costs and benefits of an emissions standard are discussed in detail in Chapter 4. Further analysis, however, would be required to produce a RIS before this policy could be fully developed and implemented. This RIS would also include proposals for offsets from the existing regulatory burden. The Authority is not in a position to discuss regulatory impacts and offsets but would not expect to see such an attractive policy fall at this regulatory hurdle.

The rest of this chapter explains the Authority's reasoning for proposing a light vehicle emissions standard.

3.2 WHY IS A POLICY RESPONSE NECESSARY? MARKET FAILURES AND BARRIERS TO IMPROVING VEHICLE EFFICIENCY

Energy efficiency policies generally—and vehicle efficiency policies specifically—help respond to the problem of climate change. They aim to reduce emissions of greenhouse gases into the atmosphere and thereby contribute to limiting the dangerous impacts of climate change. All countries need to implement strong emissions reduction policies over the coming decades if the global 2 degree goal is to be met. The subject of this paper addresses just one area—but a significant one—for potential emissions reductions in Australia.

Having established that there are opportunities to reduce emissions by improving the efficiency of light vehicles (Chapter 2), it is still necessary to establish that government intervention is required to realise those opportunities. Before regulating, policy makers will be interested in the light vehicle market and consumer behaviour. The main questions here are whether there are market failures or barriers that prevent consumers from realising the private financial benefits of more efficient vehicles and the social goods of reduced greenhouse gas emissions together with questions of improved energy productivity and security.

This is one instance of a larger question—whether private markets can be relied upon to deliver the socially best level of energy efficiency and greenhouse gas emissions, and whether regulatory intervention is likely to be beneficial in net terms, taking into account the administrative, compliance and other costs of regulation. Different types of barriers and impediments facing individuals and businesses can prevent markets from producing outcomes that maximise overall (social) wellbeing from vehicle choice—such as market failures, behavioural and cultural barriers, and other impediments.

Market failures are departures from the characteristics necessary for unregulated markets to deliver outcomes that maximise both private (household and business) as well as overall (social) wellbeing (PC 2005, pp. 45–66; OBPR 2014).

The most relevant market failures with respect to light vehicle efficiency are:

- problems with the amount and/or distribution of information in the market
- the absence of a market for greenhouse gas emissions (it is a 'missing' market).

Vehicle makers and buyers generally have asymmetric information about the costs of improving vehicle efficiency (Green 2010, p. 7). Vehicle makers know the relationship between fuel efficiency and additional vehicle costs for a large range of technologies, including those not currently included in their vehicles, while vehicle buyers generally only know (and can act on) the trade-offs between vehicle costs and efficiency that are currently on offer. If buyers undervalue efficiency improvements, or have limited capacity to assess the value of those improvements when making purchasing decisions (discussed below), then manufacturers have no incentive to supply vehicles that maximise private or social wellbeing.

In the absence of an incentive to reduce greenhouse gas emissions from light vehicles (either explicitly through a price or implicitly by regulation), the market for greenhouse gas emissions is 'missing'. As a result, motorists will not take into account the social costs of the emissions they produce when driving, and emissions will be too high from the perspective of society as a whole.

Behavioural, cultural and organisational barriers can contribute to individuals or businesses not always making privately cost-effective choices about energy efficiency (PC 2005, p. 54). Current Commonwealth Government guidance notes that government intervention can be warranted in these situations (DPMC 2014, p. 24).

An important behavioural barrier is that any individual's ability to obtain and process complex, changing and uncertain information is finite. In response to complexity, rather than calculate the best possible private decision, individuals tend to adopt rules-of-thumb. Such strategies include purchasing the same brand as a friend, purchasing the same brand that they have bought before, or using simplified choice criteria that focus on a subset of the features of a good (Green 2010, p. 8).

Evidence suggests these rules-of-thumb are prevalent in vehicle purchasing and affect the take-up of more efficient vehicles. While a recent survey found that Australians rate fuel efficiency and size as the two most important considerations when buying a car (AAA 2013, p. 13), there is very little evidence on how they assess fuel efficiency—particularly over the longer term. Calculating the benefits from improved fuel efficiency requires both specific information and strong mathematical skills, and is unlikely to be done by all purchasers or for all purchases (see, for example, ABS 2013). Evidence from overseas markets such as the US indicates that buyers behave as if they heavily discount future savings from reduced fuel use (see, for example, Green 2010, p. 17; IEA 2012a, p. 35).

These behavioural barriers are likely to have a more pronounced effect on household rather than business vehicle purchases. Nevertheless, there is substantial evidence that similar barriers can also prevent businesses investing in cost-effective efficiency improvements, especially when energy is a small and static share of overall costs (see, for example, ClimateWorks 2013). In addition, business buyers are likely to require payback periods of three years or fewer on a more efficient vehicle because most fleet vehicles are re-sold within this period. As just under half of new cars are purchased by businesses (NTC 2013), this 'split incentive' could limit the take-up of vehicles that would deliver overall financial benefits for motorists but not their first owner.

Other barriers and impediments such as the risk and uncertainty (around, for example, future fuel prices and the actual as opposed to tested fuel consumption of a vehicle) can also affect consumers' choices.

3.3 POLICIES TO IMPROVE LIGHT VEHICLE EFFICIENCY

3.3.1 POLICY OPTIONS

Any effective policy approach to reducing emissions from light vehicles must consider whether policy intervention is necessary, the range of policy options available and which is the best overall. The barriers to improving light vehicle efficiency outlined in Section 3.2 bear upon these considerations.

The deployment of technologies into new vehicles is much more practical and less costly than retrofitting existing vehicles (IEA 2012b), and more cost-effective than providing incentives for early retirement (IEA 2009, p. 192). This section, therefore, analyses options for improving the efficiency of the vehicle stock by improving new light vehicles. These options fall into five categories:

- No change (the 'do nothing' option)—the continuation of current policies, namely providing information on emissions intensity at the point of sale and via a government website (Chapter 2) and relying on the indirect effects of overseas standards.
- 'Self-regulation'—most likely through the re-introduction of voluntary standards for new light vehicle emissions intensity. Past experience suggests any voluntary standards would likely involve an overall national target, without individual manufacturer targets or compliance arrangements.
- Information and labelling—programs that identify the efficiency, greenhouse gas emissions, fuel economy and/or running costs of new vehicles. These can help consumers to make informed decisions when purchasing a light vehicle by providing clear, trustworthy information. The information should be provided in a form that enables consumers to readily evaluate and compare different vehicles based on both the purchase price and operational costs.
- Fiscal measures—direct financial incentives to use more fuel-efficient vehicles, such as vehicle taxes and charges differentiated according to fuel economy or emissions. This category could also include carbon pricing schemes applied to fuels, and baseline and credit schemes. Baseline and credit schemes are discussed in Section 3.4; carbon pricing schemes are not considered further, being outside current government policy. Because congestion pricing primarily addresses the social costs of vehicle use in specific times and places, rather than their efficiency, it is not considered here.
- Standards—regulation that requires improvements in efficiency, such as mandatory light vehicle emissions standards. These are designed to oblige manufacturers to deploy fuel-efficient technologies more rapidly than they might otherwise.

Some combination of these types of policies may be implemented as a complementary package or they may operate as standalone measures. Several countries have introduced light vehicle emissions standards, alongside information and labelling requirements and financial incentives (IEA 2012b).

3.3.2 COMPARING POLICY OPTIONS FOR IMPROVING LIGHT VEHICLE EMISSIONS INTENSITY

The Authority has considered the range of policy options and found:

- Despite ongoing improvements to its emissions intensity, the Australian light vehicle fleet remains less efficient than those of other countries and the benefits of contemporary vehicle efficiency technologies will not be realised without additional policy intervention.
- Voluntary standards in the past have not been effective in driving cost-effective and beneficial reductions in emissions intensity and are unlikely to be any more effective in the future.
- Information could be more effectively provided by following international best practice for consumer information and labelling but this is unlikely to be enough to realise the cost-effective emissions reduction opportunities that currently exist.
- States and territories could consider revising stamp duty and registration charges to create incentives to buy efficient vehicles. This could be done in a revenue-neutral way; for example, moving from existing schemes that

differentiate charges according to technical characteristics to differential charges based on emissions intensity.

- Mandatory standards are considered the best approach to provide a cost-effective and technology-neutral way of overcoming the identified barriers to vehicle efficiency improvements, reducing emissions and enhancing Australia's energy productivity.

The rest of this section analyses each of the options in turn.

THE 'DO NOTHING' OPTION

Vehicle markets are global and, as discussed below, standards in other countries are becoming stronger over time (Table 3.1). This invites the question—'Would Australia receive the benefits of mandatory standards applied elsewhere even if it does not impose any additional policies?' If the answer is "yes", Australia could reap the benefits of standards without imposing additional domestic regulation.

As noted, the efficiency of the Australian fleet has improved, and improvements have accelerated in the last five years, perhaps influenced in part by global manufacturers responding to the introduction of emissions standards in major overseas markets, and higher oil prices since 2005. This trend may continue as mandatory vehicle emissions standards in other countries become increasingly ambitious over the period to 2025. On the other hand, considerable recent research suggests that without a mandatory standard in Australia, the business-as-usual rate of improvement could slow from its recent average (3.2 per cent a year over 2009–13 to 2 per cent a year or fewer between now and 2020, increasing the gap between Australia and other countries (see Appendix B). Evidence suggests that Australia currently obtains some but not all of the benefits of mandatory standards that improve vehicle efficiency in other major markets.

Australia imports 90 per cent of its new vehicles (see Chapter 2), and almost 75 per cent of new vehicles come from countries with mandatory standards in place. Nevertheless, the efficiency of Australian light vehicles remains well behind most other markets. These differences in emissions intensity of the Australian and other fleets are explained in part by the differences in the mix of models. Australia has more large passenger vehicles than some countries (NTC 2014). Even so, the variants of models offered in Australia are often less efficient than the same model sold in other markets. The most efficient variants of some models available in Australia consume about 20 per cent more fuel on average than the most efficient variant of the same make and model available in the UK (Figure 3.1).

TABLE 3.1: GLOBAL COMPARISON OF STANDARDS FOR PASSENGER VEHICLES

JURISDICTION AND FIRST COMPLIANCE YEAR	BASIS FOR STANDARD	FUTURE TARGET YEAR/S	EQUIVALENT CO_2 TARGET (g CO_2/km)	EQUIVALENT FUEL ECONOMY TARGET (L/100km)	ANNUALISED PERCENTAGE REDUCTION (DURING EACH COMPLIANCE PERIOD)^	ANNUALISED PERCENTAGE REDUCTIONS (VARIOUS HISTORICAL PERIODS)
EU 2009	CO_2 emissions	2015 2020* 2025**	130 95 68-78**	5.6 4.1 2.9-3.3	Achieved in 2013 4.1 3.9-6.5	2000-09: 1.8 2009-13: 3.4
United States 1975	Fuel economy and GHG	2020 2025	121 93	5.2 4.0	5.1 5.1	2000-13: 1.9
Japan 1985	Fuel economy	2015 2020	125 105	5.3 4.5	Achieved in 2011 1.4	2000-11: 3.2
Republic of Korea 2006	Fuel economy and GHG	2015	153	6.5	2.2	2003-11: 4.0
China 2004	Fuel economy	2015 2020**	161 117**	6.9 5.0	2.3 6.2	2002-12: 2.1
India 2016	CO_2 emissions	2016 2021	130 113	5.6 4.8	1.2 2.8	2006-12: 1.9
Canada 2011	GHG	2016 2025**	147 93**	6.3 4.0	5.2 5.0	2000-13: 1.3
Mexico 2012	Fuel economy and GHG	2016	153	6.5	3.8	2008-11: 2.6

Note: CO_2 emissions and fuel economy for all standards normalised to European test cycle (NEDC). The coverage of 'passenger vehicles' differs by country—SUVs are included in the EU, Japan, Korea, China and India, and covered under 'light trucks' in North America. All countries except Korea and India also have targets for light commercial vehicles (or light trucks). GHG is greenhouse gases.

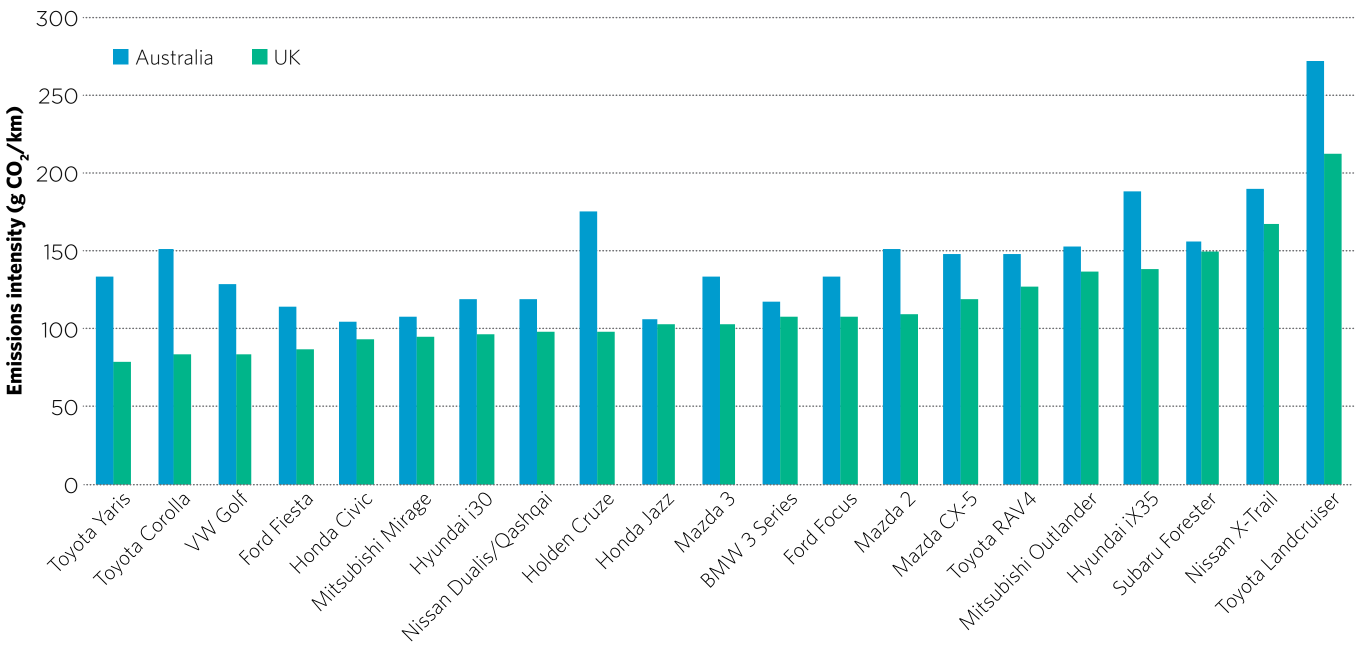
^For current compliance periods, annualised rate of reduction is calculated from 2013; EU 2020 target is calculated from 2013; Japan 2020 target is calculated from 2011; India 2016 target is calculated from 2012.

*This target has a one-year phase-in period; 95 per cent of vehicles must comply by 2020 and 100 per cent by 2021.

**Denotes target proposed or in development; Canada follows the US 2025 target in its proposal, but the final target value would be based on the projected fleet footprints.

Source: Adapted from ICCT 2014 and official sources listed under References

FIGURE 3.1: EMISSIONS INTENSITY OF BEST AVAILABLE VARIANT OF POPULAR VEHICLE MODELS, AUSTRALIA AND THE UK, 2014



Source: Climate Change Authority based on Commonwealth of Australia 2014c and Department for Transport 2014

While Australia will import all of its light vehicles by 2018, this is not expected to make a large difference to the rate of improvement given that imports already make up almost 90 per cent of the new vehicle fleet (FCAI 2013).

There is no evidence to suggest that vehicles are de-specified or re-tuned to be less efficient for Australia. Rather, manufacturers select the vehicles from their range that they believe will sell well and maximise their profit in the Australian market, unconstrained by emissions standards that exist in other markets.

As Australia phases in the Euro 5 vehicle air pollution standards from late 2013 to late 2016, an increasing number of imported models will be compliant with those stronger standards. The markets that have adopted these pollution standards also have CO_2 emissions standards; variants produced for those markets will likely meet both sets of standards. Australia may therefore see fewer emissions-intensive vehicles as an indirect benefit of adopting stronger air pollution standards, although the extent to which the Australian market might benefit is unclear.

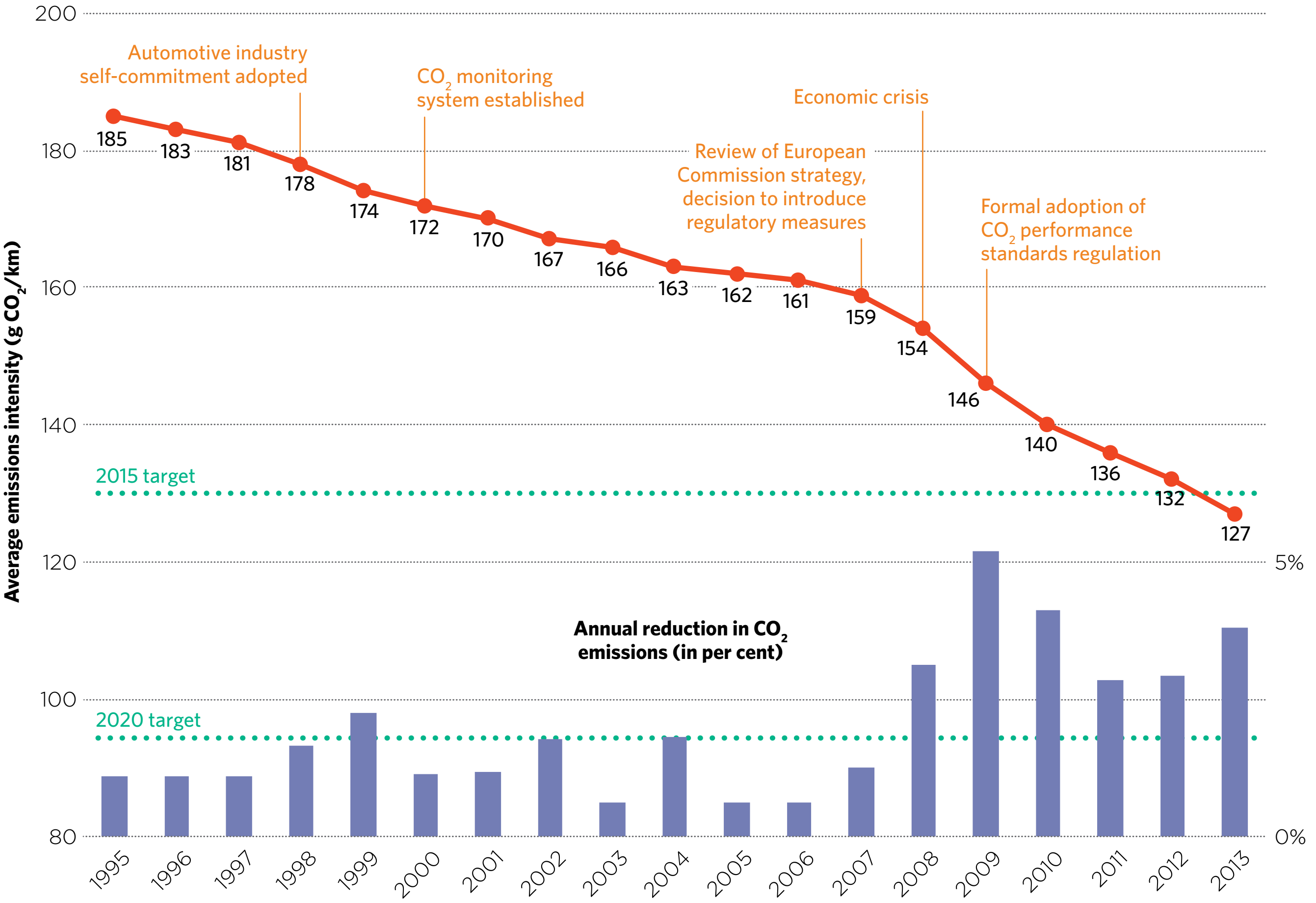
It is reasonable to expect that Australia will continue to realise some of, but not all, the benefits of standards applied in other countries—at least for those models and variants that are also supplied to Australian markets. It is likely, however, that global vehicle manufacturers will continue to allocate their most fuel-efficient vehicles and components to markets with mandatory emissions standards (DIT 2011a).

SELF-REGULATION

Both the identified barriers to improving vehicle efficiency, and Australian and international evidence, suggest that voluntary standards are likely to leave substantial benefits unrealised. If buyers undervalue fuel savings, manufacturers will be unlikely to comply with stronger voluntary standards because they cannot capture increased vehicle manufacturing costs through increased retail prices. This helps explain the failure of voluntary standards to drive significant efficiency improvements. It seems the EU had very modest improvements in vehicle emissions intensity during its period of voluntary standards, but this accelerated rapidly following the decision to introduce mandatory standards from 2009 (Figure 3.2).

The vehicle industry has an incentive to maximise its profits in selling vehicles, not to maximise benefits to motorists or society generally. In the absence of other imperatives, the Authority does not believe a voluntary standard will deliver a socially optimal outcome.

FIGURE 3.2: CO_2 PERFORMANCE STANDARDS IN THE EU, NEW PASSENGER CARS, 1995–2013



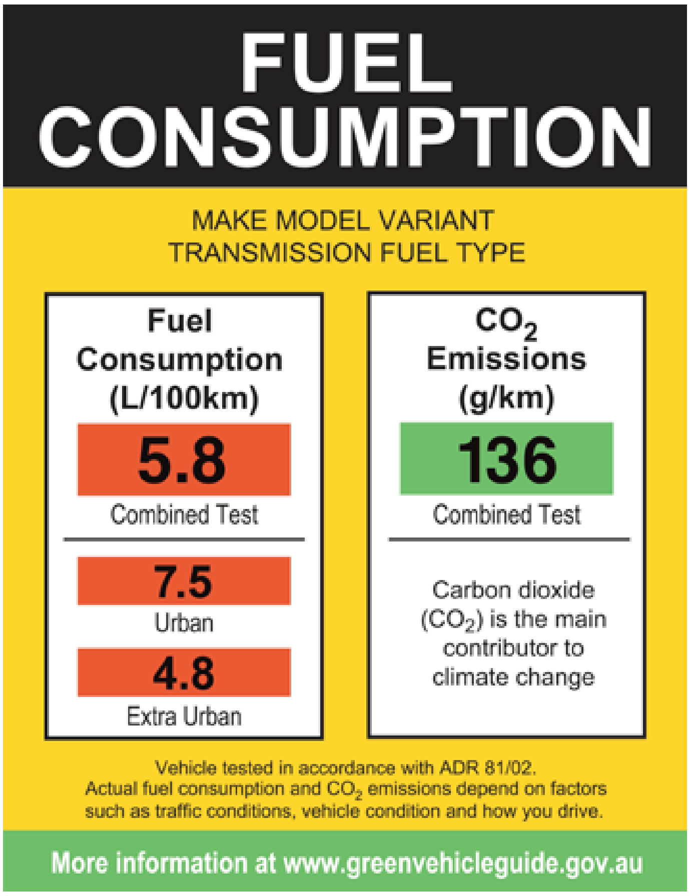
Source: ICCT 2011b

In Australia, voluntary standards for light vehicle fuel economy and, later, emissions intensity were in place from 1978 to 2010. The voluntary standards accompanied improvements in fuel economy, but it is not clear whether these improvements were greater than business-as-usual trends. In 2003, the Commonwealth Government and FCAI agreed a voluntary Code of Practice to reduce the fuel consumption of new petrol vehicles to 6.8 L per 100 km (equivalent to 162 g CO_2/km) by 2010. In 2004, the government and FCAI were unable to agree on an equivalent CO_2-based target covering all light vehicles. Instead, the FCAI adopted a voluntary target of 222 g CO_2/km for all light vehicles by 2010. The Code of Practice fuel economy target was not met, but the weaker emissions intensity target was achieved two years early, in 2008, and not renewed (DCCEE 2010; ATC 2009, p. 16).

INFORMATION AND LABELLING

Labelling is a low-cost way to help consumers make informed purchasing decisions. Australian labelling currently provides 'direct' information about the absolute levels of emissions and fuel economy. All new light vehicles sold in Australia are required to display a fuel consumption label (Figure 3.3) (DIRD 2014b). The online Green Vehicle Guide provides this information in a format that allows comparisons to be made between different cars, along with a star rating that combines a greenhouse rating with an air pollution rating. The Guide also allows consumers to estimate fuel costs and emissions over time (DIRD 2014c).

FIGURE 3.3: AUSTRALIAN FUEL CONSUMPTION LABEL



Source: Commonwealth of Australia 2014c

There is scope to make the information provided to consumers easier to understand. For example, the. The IEA (2012b, p. 21) has suggested that providing both direct and comparative ratings on labels is likely to be the most useful for purchasers. Examples are fuel economy labelling in New Zealand (Figure 3.4), the UK and the US. Australia and New Zealand have a shared labelling system for the energy efficiency of appliances (the E3 program, at www.energyrating.gov.au/). The Commonwealth Government could consider whether to enhance the usefulness of the label by adopting the widely accepted star ratings and including information about operating costs.

FIGURE 3.4: NEW ZEALAND FUEL ECONOMY LABEL

Source: New Zealand Energy Efficiency and Conservation Authority

This type of enhancement is likely to be low-cost (it uses information that suppliers already provide to government). Simply providing better information without further action is, however, unlikely to deliver the large, cost-effective reductions in emissions that Chapter 2 suggests are available as it does not resolve the price and other behavioural barriers to efficient vehicle purchase decisions.

FISCAL MEASURES

Most countries tax vehicle ownership either annually or at time of purchase (or both). While these charges were traditionally based on characteristics such as engine capacity or mass, many countries have recently switched to charges that provide an incentive to purchase more efficient vehicles. Such taxes may have contributed to increasing the share of new lower-emissions vehicles and decreasing the share of new higher-emitting ones (IEA 2012b, pp. 32–4).

In Australia, vehicle ownership and registration charges are levied by states and territories. Registration fees tax the ownership of vehicles, rather than their use, so they do not effectively target the social costs of light vehicles (see, for example, Garnaut 2008, p. 527). States and territories could consider moving from existing registration fees and duties (differentiated according to vehicle value, mass or cylinder count) to differential charges based on emissions intensity. This would be consistent with the report of the Task Group on Energy Efficiency (2010), which concluded that a technology-neutral set of charges based on environmental performance would create better incentives to buy more efficient new light vehicles than the present technology-specific discounts (for example, for electric vehicles).

While vehicle taxes can influence vehicle choice, fuel taxes can influence both vehicle choice and ongoing use. Isolating the impacts of fuel prices is difficult but cross-country comparisons do suggest that countries with higher fuel prices have more efficient vehicles (IEA 2012b, p. 35). Higher fuel taxes, including the government's recent proposal to re-index fuel excise, could increase this influence. This measure, however, would not address the information asymmetry and decision-making limitations discussed above. Further, unless the fuel tax is linked to carbon content of fuels, it also does not directly address the greenhouse gas externality. Given that higher fuel prices alone do not address these important market failures and barriers to improved efficiency, they would likely leave significant efficiency opportunities untapped.

MANDATORY STANDARDS

A mandatory light vehicle emissions standard, possibly in combination with other measures, could increase the supply of lower-emissions vehicles to the Australian market. There is a broad consensus that a well-designed mandatory vehicle standard is an effective policy instrument. To this end:

- International analysis and experience shows that mandatory vehicle emissions standards are the global policy of choice for reducing light vehicle emissions, often in conjunction with information programs and fiscal incentives.
- Over 70 per cent of light vehicles sold in the world today, including those in the largest markets, are subject to mandatory vehicle emissions standards (CCA 2014a, p. 164) (see Table 3.1). Australia is one of only six of the 34 OECD countries without emissions standards. In several countries, including the United States, Japan and China, mandatory standards have been operating for at least a decade. The share of vehicles covered by standards is expected to grow, with emerging markets such as Indonesia and Thailand exploring their introduction. Many governments, including the European Union, United States and China, are accelerating emissions improvement through their successive standards.
- Garnaut (2008, p. 415–6) notes that simply providing more information may not be the answer to information barriers. He concluded that standards can be a cost-effective way of supporting the uptake of low-emissions options. To be cost-effective, standards need to be designed appropriately, with good knowledge of the costs and benefits, and sufficient lead time for industry to respond.
- A paper prepared for the Council of Australian Governments found that measures such as light vehicle emissions standards may be required to address market failures, such as information barriers, that are not adequately addressed by price incentives (ATC 2008, p. 36).

Of course, even an efficiency standard that has net benefits has some costs. The Productivity Commission (2005, p. 187) lists seven costs of minimum performance standards (MEPs) in respect of electrical appliances that could outweigh their benefits:

- administration and compliance costs
- mismeasurement of energy performance
- removing products from the market that are more cost-effective for some consumers
- forcing individuals to forego product features that they value more highly than greater energy efficiency
- reduced competition
- regressive distributional impacts
- increase in embodied energy consumption.

Because fleet average standards are—by design—more flexible than MEPs, not all of these concerns apply, and those that do are manageable through good design. In particular:

- Fleet-average standards do not require even the most emissions-intensive of current vehicles to be removed from the market: product diversity and consumer choice are retained.
- A reduction in competition consequent upon manufacturers withdrawing from the Australian vehicle market because of standards seems most unlikely, given all other major vehicle markets already have similar policies.
- A standard can be designed to maximise benefits, minimise regressive effects and minimise compliance costs.

Two additional objections are sometimes raised about vehicle standards—that they will lead to adverse health impacts because of an increase in diesel vehicles and that improved petrol quality is necessary for their implementation. These are discussed in Box 2.

BOX 2: OBJECTIONS TO VEHICLE EFFICIENCY STANDARDS

Standards will require more diesel vehicles, which will lead to more air pollution

The introduction of light vehicle emissions standards could increase uptake of relatively more efficient light duty diesel vehicles, especially in the passenger vehicle sector. Air pollution standards for diesel vehicles have historically been weaker than those applying to petrol vehicles, leading to concerns that CO_2 standards could inadvertently lead to increased air pollution, primarily particulate matter (which has the greatest health impacts) and oxides of nitrogen (NO_x).

Australia has taken two key steps to mitigate air pollution and health risks from diesel. Firstly, it has enforced diesel fuel standards since 2002 that limit a range of fuel parameters, including sulphur, that contribute to particulate and NO_x emissions. Secondly, it has adopted progressively stronger vehicle emissions standards for diesel vehicles under the Australian Design Rules (ADR). In particular, the more stringent 'Euro 5' air pollution standards being phased in from late 2013 (through ADR 79/03 and ADR 79/04) will drive reductions in allowable emissions of NO_x and particulates from light diesel vehicles by 30 per cent and 80–90 per cent, respectively.

These measures to improve the quality of diesel fuel and control vehicle air pollution in Australia mean that the implementation of CO_2 standards should not increase air pollution.

Better quality petrol is necessary for vehicles to meet CO_2 emissions standards

The maximum allowable sulphur limit in Australian petrol is significantly higher than in other major vehicle markets. Some stakeholders have suggested that this is a barrier to Australia implementing CO_2 emissions standards, but there is no compelling evidence to suggest this is the case.

Sulphur has no impact on vehicle CO_2 emissions or the performance of CO_2 reduction technologies, with the exception of 'lean burn' systems. Even in countries that have low sulphur fuel, however, this technology is rarely employed.

High sulphur levels in petrol do contribute to urban air pollution and can reduce the efficiency of technologies used to meet strong vehicle air pollution standards, such as the 'Euro 6' standards, which have previously been proposed for introduction in Australia from 2017.

Given these issues, government could appropriately assess the costs and benefits of a move to lower sulphur petrol.

CONCLUSION

C3. Both international experience and the principles of good policy design suggest mandatory vehicle emissions standards are a sensible policy for reducing light vehicle emissions. Standards could be complemented by enhancing existing information measures and better targeting taxes and charges to encourage more efficient vehicles.

3.4 INTERACTION OF STANDARDS WITH THE EMISSIONS REDUCTION FUND

The government plans to introduce the Direct Action Plan to replace the carbon pricing mechanism and other elements of the Clean Energy Future Package. The plan's centrepiece is the Emissions Reduction Fund (ERF). The ERF is an example of a 'baseline and credit' scheme–it will credit emissions reductions beyond a baseline of emissions or emissions intensity for a number of sectors, including transport, and may include penalties for emissions above historical levels (Department of Environment 2014).

The ERF will be designed to:

- identify and purchase emissions reductions at the lowest cost
- purchase emissions reductions that are genuine and would not have occurred in the absence of the ERF
- allow efficient business participation.

The Authority has reviewed the performance of baseline and credit schemes in Australia and overseas (CCA 2014b); this suggests light vehicle emissions standards would complement the ERF:

- Of the ERF-type schemes reviewed that do cover transport, large-scale transport emissions reductions were not achieved. Transport accounts for only a small proportion of total reductions achieved by these schemes to date.
- For light vehicle emissions reductions in particular, this is likely due to difficulties in setting credible baselines for private purchasers, which comprise about half of the light vehicle fleet.
- While there is scope for baseline and credit schemes to reduce road transport emissions, this is likely restricted to large private or public vehicle fleets, heavy vehicles and public transport. Each of these modes would appear to have the potential to present emissions reduction opportunities for the ERF additional to those achieved under a standard. This is contingent on sound accounting for interactions between a standard and the ERF.

Consistent with this analysis and the earlier discussion of barriers, the government noted in its ERF White Paper that:

... direct funding approaches may not be the most efficient means of increasing the uptake of more efficient vehicles or appliances because choices are often affected by non-price considerations such as size, colour, function and branding. This means that even relatively large incentives may do little to change consumer preferences. In these circumstances, emissions reductions are likely to be achieved more efficiently through other measures, such as minimum energy performance standards (2014, p. 40).

Overall, the Authority's review suggests that light vehicle standards would likely complement the ERF and raise few new issues. The primary effect of standards on the ERF will be on the determination of baselines:

- A standard would set an effective baseline for changes in new light vehicle emissions across the economy. Any project or methodology baselines in the ERF would need to take this into account, in much the same way as it proposes to take into account the impact of standards such as National Australian Built Environment Rating System (NABERS) and Greenhouse and Energy Minimum Standards (GEMS) (Department of Environment 2014). This would not preclude crediting emissions reductions beyond that effective baseline, as long as reductions were genuinely additional.
- Parties liable under a standard may perform better than the standard. Depending on the Fund's design, it may be possible for these extra reductions to be credited under the ERF. The methodology would need to address matters such as additionality and converting reductions from standards (in units of g CO_2/km) to those purchased by the ERF (possibly t CO_2-e).

These issues are discussed further in Chapter 5.

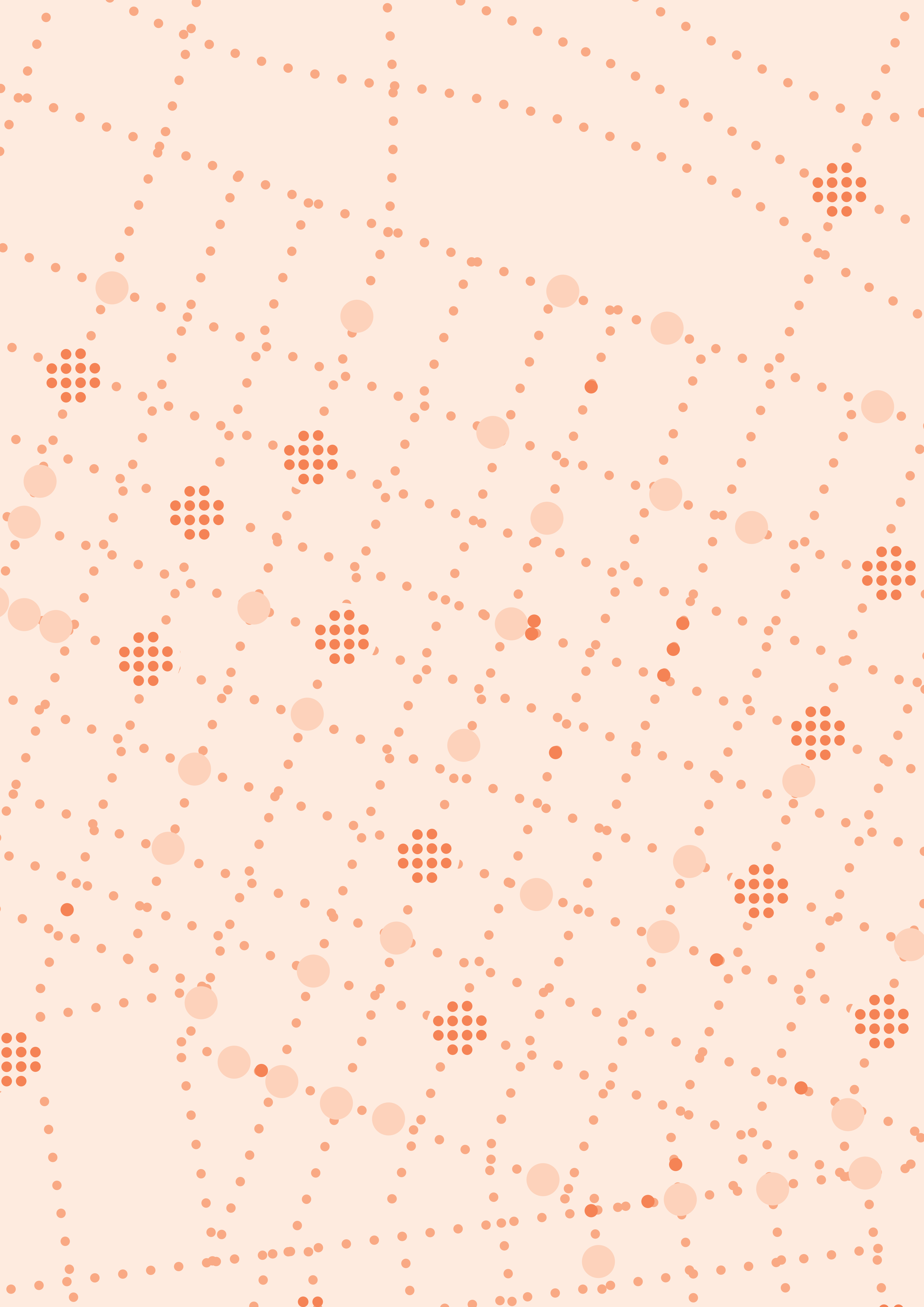
CONCLUSION

C4. A light vehicle emissions standard is likely to complement the Emissions Reduction Fund and other policies to reduce transport sector emissions.

3.5 CONCLUSIONS ON POLICIES FOR REDUCING VEHICLE EMISSIONS INTENSITY

Overall, the Authority's analysis of policy options to reduce emissions from light vehicles indicates that:

- Information programs such as fuel consumption labelling and the Green Vehicle Guide (see section 2.5) are a useful part of any policy package to improve vehicle emissions and there may be scope to enhance the information currently provided.
- Fiscal measures such as differential registration fees may be a useful complement to standards and could be considered further by state and territory road authorities.
- Emissions standards provide an effective policy tool for targeting the identified barriers to vehicle efficiency improvements. Voluntary standards are not considered to be as effective as mandatory standards, in part because of behavioural biases that result in consumers undervaluing vehicle efficiency improvements.



LIGHT VEHICLE EMISSIONS STANDARDS—SETTING THE RIGHT TARGET

4

A fleet-average light vehicle CO_2 emissions standard could deliver net benefits to consumers and Australia as a whole.

The Authority's guiding principles suggest two important considerations in setting the level of a standard—maximising the net benefits from standards and seeking to align Australia's standards with comparable markets.

The Authority has examined three standards that would start in 2018 to identify which would deliver the largest net benefits. The Authority considers the strongest of the three to be a feasible and sensible first step for Australia as it delivers the largest private benefits, both over the life of the vehicle and for its average first owner, along with substantial and cost-effective emissions reductions. It is closely aligned to the US standard (and the EU's, with a lag) and would deliver an achievable annual rate of improvement in Australia's light vehicle fleet.

Chapter 3 showed that both international experience and the principles of good policy design suggest mandatory vehicle emissions standards are a sensible policy for reducing light vehicle emissions. This chapter assesses the costs and benefits of potential Australian standards to identify the best starting point for an Australian standard. It:

- outlines how an emissions standard would work and the kinds of costs and benefits it would have
- identifies guiding considerations for choosing the level of an Australian standard
- assesses three possible standards against these considerations.

4.1 HOW WOULD AN EMISSIONS STANDARD WORK?

As outlined in Chapter 1, a fleet-average light vehicle emissions standard would set a national average target for new vehicles sold in Australia. Vehicle suppliers would have specific obligations, designed to ensure the national average target is met. The Authority has assessed the range of design options available to policy makers and identified an effective and least-cost model that would deliver net benefits with a low regulatory burden. In essence:

- The government would set a national average target for the emissions level of the new light vehicle fleet in Australia in each year in g CO_2/km. The target would relate to the average emissions intensity of the Australian fleet—not individual vehicles.
- The government would translate the national average target into an attribute-based limit curve, using a mathematical relationship between the size (footprint) of vehicles and their emissions. Larger cars would be permitted more emissions than smaller cars under the standard, reflecting the reality that larger cars, which offer different utility to consumers, are often more emissions-intensive.

- Each supplier of new light vehicles to the Australian market would have an obligation to comply with the limit curve and use it to determine the mix of vehicles it intends to supply each year.
- Standards would not ban any particular models from sale; a supplier could sell vehicles above the limit curve provided they were offset by sufficient sales of vehicles under the curve (Figure 4.1 provides a stylised example). A supplier could improve the efficiency of all vehicles in its fleet, or sell more of its highly efficient vehicles and fewer less efficient vehicles. This imposes a more equitable burden across suppliers that specialise in different market segments.
- There would be penalties for non-compliance and flexible compliance arrangements, including banking any credits from surpassing a target in one year for use in later years within the first phase (2018–25).

Chapter 5 outlines the Authority's preferred standard design in further detail.

4.2 CHOOSING THE RIGHT LEVEL FOR STANDARDS

4.2.1 WHAT ARE THE COSTS AND BENEFITS OF STANDARDS?

The principal benefits are lower fuel bills for motorists and low cost CO_2 emissions reductions for Australia.

The principal cost is the higher production cost and retail price of vehicles incorporating fuel savings technologies adopted in response to standards. Vehicle suppliers could meet standards by promoting sales of a different fleet mix, by offering lower emissions variants of current models, or both.

Standards also give rise to changes in 'transfers' between businesses, individuals and the government. In general, these transfers contribute to the impact of the standard on particular groups, but not its overall net benefits. Transfers are discussed in this chapter as they arise. Any distributional issues from standards could be considered further in any subsequent RIS. The Authority has not examined distributional impacts of the proposed standards in detail. There is no reason to expect significant adverse effects. Over time, the substantial fuel savings from standards are likely to benefit low income households, particularly as more efficient vehicles are resold into the second hand market.

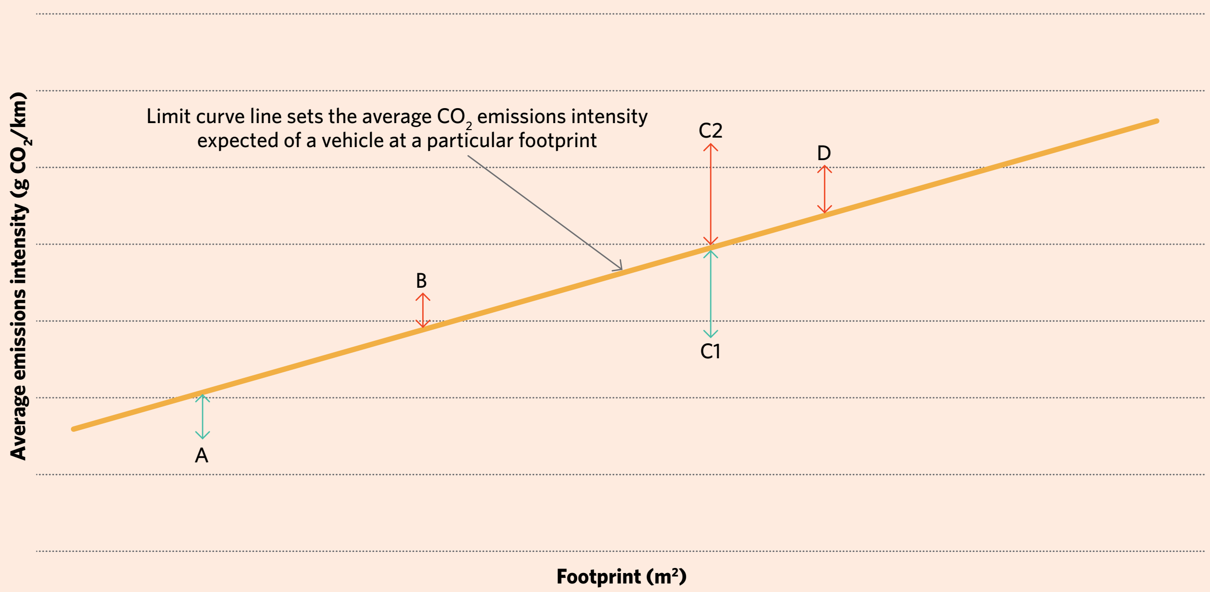
BOX 3. HOW DOES AN ATTRIBUTE-BASED FLEET-AVERAGE STANDARD WORK?

The key feature of an attribute-based fleet-average standard is that it sets a 'limit curve'. Attribute-based targets allow the target for a vehicle to vary with a vehicle attribute—for example, its size or 'footprint'. The limit curve (and underlying mathematical formula) provides the level of CO_2 emissions intensity for each vehicle footprint. It is initially derived from an analysis of the existing light vehicle fleet's CO_2 emissions (or fuel consumption) and footprint. From that analysis, the standards will specify a new limit curve (or set of curves) for each target year. While referred to as a curve, the limit curve is generally a straight line.

The overall target that a manufacturer is required to meet is the annual sales-weighted average of CO_2 emissions intensity, taking account of the footprint of the vehicles sold. This means that each manufacturer's overall target is specific to them; they determine it at the end of the target year (once sales are known). If the initial analysis is robust, the overall fleet target set by the standard will be met if all manufacturers meet their individual targets.

To provide a simplified example, Figure 4.1 shows a stylised limit curve for a footprint-based standard and a manufacturer who supplies four models to the market (with one model having two variants). Models B and D have emissions levels above the expected average for their size (as determined by the limit curve); model A is below; and model C has one variant below (C1) and one above (C2). The required fleet average for this manufacturer will be determined by the point on the limit curve associated with each model or variant, sales-weighted by the number of each supplied to the market. In order for the manufacturer to meet its required target, the total 'excess' emissions of any models above the line (indicated by the red arrows) will need to be offset by the total 'credit' emissions of those below the line (indicated by the green arrows). If these 'excess' emissions are offset, the manufacturer has met its fleet-average target even though vehicles B, C2 and D have emissions above the limit curve.

FIGURE 4.1: STYLISED EXAMPLE OF A LIMIT CURVE



Source: Climate Change Authority

Looking at the principal costs and benefits, it is useful to distinguish between the net 'individual', net 'private' and net 'social' impacts of standards (that is, net impacts for Australia as a whole).

The net individual impact on each owner of a vehicle throughout its life is the net impact of any increase in the purchase price of a vehicle attributable to standards, minus the savings from reduced fuel use over the period of ownership, compared with business-as-usual (BAU). Private benefits include avoided fuel excise. The net private impact is the sum of these impacts across all motorists. If the lifetime fuel savings exceed upfront costs, the standard has 'net private benefits'.

In broad terms, the net social impact of standards is the value of fuel savings and emissions reductions to the public, adjusted for the technology costs and other changes necessary for vehicle suppliers to meet the standards. The value of excise payments is excluded from calculations of social costs and benefits, because they represent transfers of funds between motorists and the government.

Because the Authority suggests a standard commence in 2018 (see Chapter 5), domestic manufacturers in Australia are expected to have closed when the standard starts, so there would be no domestic automotive manufacturing industry impact.

Four other costs and benefits are likely to arise, but these have a significantly smaller effect than the principal costs and benefits:

- Administrative and compliance costs of the scheme. These will depend significantly on the policy design. As discussed in Chapter 5, standards can be designed to have relatively low administration and compliance costs by using existing testing and data collection arrangements, and providing flexibility in compliance to lower costs. While the Authority has not developed detailed monetary estimates of administration and compliance costs, there are good reasons to expect these to be very small relative to technology costs. For example, because vehicle emissions are already tested, the cost of Australia's fuel consumption labelling system, which provides this information on new vehicle labels, was estimated at $7.70 per vehicle (AGO 2002, p. 15).[3] Administration and compliance costs would be specifically investigated by a formal RIS, should one be conducted in future.
- Improved liquid fuel security and energy productivity. The Australian Government's Energy White Paper process is considering a range of issues including security of supply and improved energy productivity (Department of Industry 2013, p. i). Light vehicle emissions standards lower fuel demand for a given transport task. This will improve Australia's liquid fuel security and energy efficiency, if other things are equal. Within the transport sector, road transport is the largest energy user, accounting for 76 per cent of total transport liquid fuel use (BREE 2012a, p. 99). CSIRO modelling commissioned by the Authority (see Section 4.3) projects that the standards modelled would reduce Australia's 2030 petroleum demand by up to 4.1 per cent (Authority calculations based on BREE 2012b, p. 46).
- Broader macroeconomic changes. As described above, increasing vehicle efficiency means that households and businesses spend less money to achieve the same transport task. The savings can be invested or spent on other goods and services.
- Reduced adverse health impacts from air pollution. Standards would complement existing measures to reduce adverse health impacts of air pollution from light vehicles (Chapter 2). The health benefits of standards are expected to be small, given vehicle air pollution controls already in place. Current vehicle air pollution regulations specify a standard for emissions (in emissions per kilometre) that all vehicles must meet regardless of their fuel efficiency. As such, the technologies used meet the air pollution standards independently of vehicle fuel efficiency.

This chapter focuses on the principal costs and benefits; these smaller effects are not considered further.

4.2.2 DETERMINING THE LEVEL OF AN AUSTRALIAN STANDARD

While previous work on the level of standards has not discussed guiding considerations in detail, the Authority considers that this warrants specific consideration—clarifying the aims of the policy highlights the choices between possible levels of ambition. The Authority's guiding principles—requiring that measures responding to climate change should be economically efficient, environmentally effective, equitable and in the public interest—suggest two main considerations for choosing the level of a standard:

- maximising the net benefits from standards
- seeking to align Australia's standards with comparable markets if there are opportunities to do so.

Maximising the benefits helps Australia realise the available efficiency and emissions reduction opportunities, while harmonisation helps to limit costs for industry and gives confidence that the target is achievable.

CONCLUSION

C5. In the first phase of an Australian standard (2018–25), the national average target be set at a level that:

- maximises the net benefit of standards
- aligns Australia's standards with comparable major markets.

3 All monetary values in this report are in real 2012 Australian dollars unless indicated. The AGO used a cost estimate in 1995–96 Australian dollars from BTCE (1996, pp. 164–5), converted by the Authority into 2012 Australian dollars using the Reserve Bank of Australia's inflation calculator (RBA 2014).

4.3 THE AUTHORITY'S APPROACH TO THE COSTS AND BENEFITS OF STANDARDS

There is a direct relationship between the level of a standard and the size of the costs and benefits. A stronger standard delivers more fuel savings and emissions reductions, but involves higher technology costs, relative to BAU. Different standards have different net benefits because benefits and costs increase at different rates as standards become stronger. If costs increase more slowly than benefits, a stronger standard will deliver more net benefits than a weaker one.

The Authority has examined three standards in detail to identify which delivers the largest net private benefits. This analysis draws on modelling by the CSIRO (Reedman and Graham 2013b) as well as international evidence on the costs of fuel-saving technologies necessary to meet the standards (as Australia-specific estimates of the incremental costs are not readily available).

The analysis of social benefits is similar, but adjusts the estimated fuel savings for transfers between motorists and the government. The cost-effectiveness of standards as an emissions reduction policy is also considered by calculating the cost per tonne of emissions reductions achieved, and comparing it with the estimated cost per tonne of alternative emissions reductions measures.

The three standards broadly reflect:

- a lenient standard that makes a relatively small improvement relative to BAU, reaching 135 g CO_2/km in 2025
- a medium standard with a somewhat faster annual improvement rate, reaching 119 g CO_2/km in 2025
- a stronger standard that sees Australia broadly match US targets for 2020 and 2025, reaching 105 g CO_2/km in 2025. This also sees Australia match the EU's target with a lag.[4]

Table 4.1 shows the level of the standards in 2018, 2020 and 2025 relative to the projected BAU. The modelling assumes that, in the absence of standards, the average emissions intensity of new light vehicles falls to 169 g CO_2/km in 2020 and 156 g CO_2/km in 2025 (Graham 2014).This is similar to other recent estimates of emissions intensity levels for Australia.

Further details on the modelling, BAU and the approach to estimating the costs and benefits of standards are in Appendix B.

4 The EU standard is for passenger vehicles only. If Australian passenger vehicles met the EU 2020 target of 95 g CO_2/km while the Australian split between new passenger and light commercial vehicles and their relative efficiencies stayed constant at their current levels, the level of new light vehicle efficiency would be around 100 g CO_2/km. Australia is projected to reach this level just after 2025 if a strong standard prevails from 2018–25 (see Table 4.1).

TABLE 4.1: STANDARDS MODELLED—AVERAGE EMISSIONS INTENSITY LEVELS, NEW LIGHT VEHICLES, SELECTED YEARS FOR STANDARDS STARTING IN 2018

SCENARIO	2018	2020	2025
BAU (2 per cent 2013–20; 1.6 per cent 2021–25)	176	169	156
Lenient (3.5 per cent from 2018)	174	162	135
Medium (5 per cent from 2018)	171	154	119
Strong (6.5 per cent from 2018)	168	147	105

Note: Values are converted to test cycle from the modelled 'measured' emissions intensities. See Appendix B.2 for further details.
Source: Reedman and Graham 2013b; Graham 2014

BOX 4: COMPARING VEHICLE STANDARDS ACROSS COUNTRIES WITH DIFFERENT TESTS

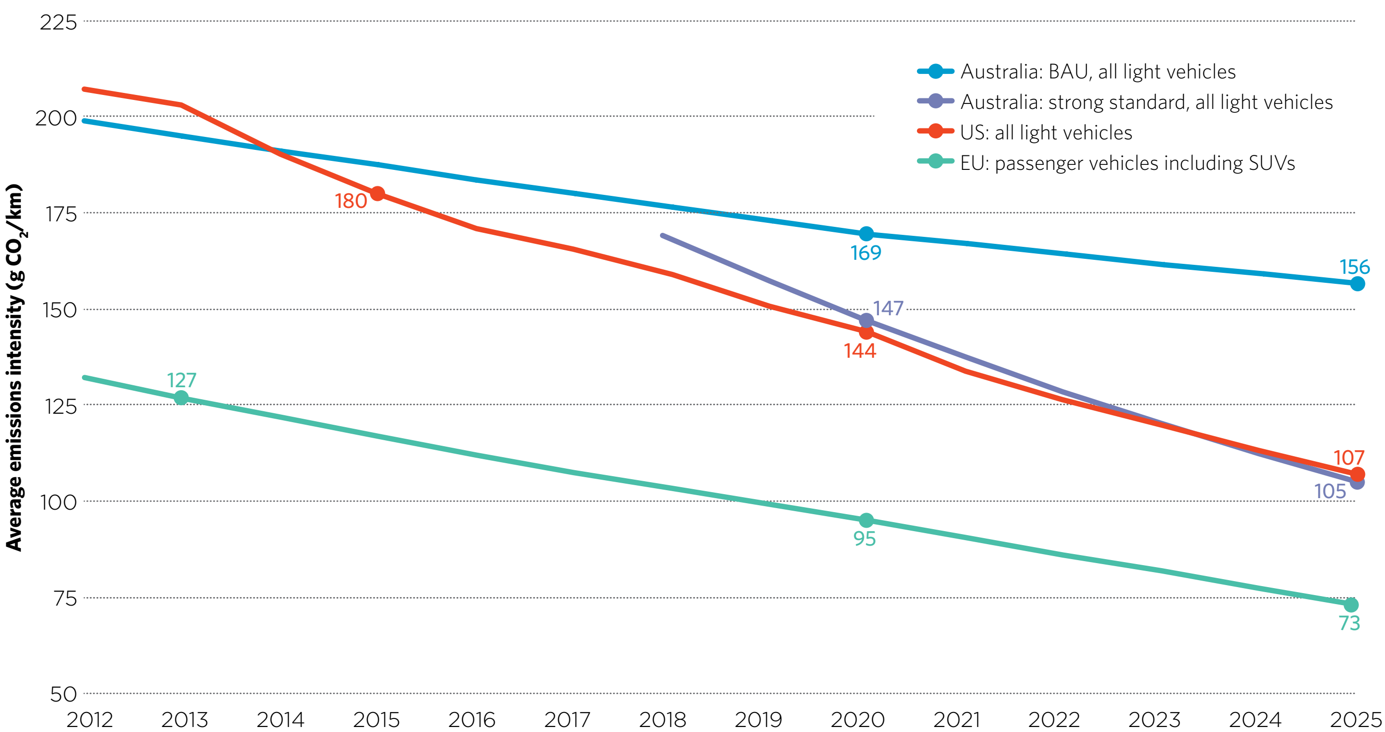
Different countries use different tests to determine vehicle emissions intensity. Nevertheless, it is still possible to compare overall fleet performance around the world.

All test cycles involve simulated urban and highway driving; conversion methodologies use simulation models to map between tests and put all countries on a common scale. Because these conversions are technical and resource-intensive, the International Council on Clean Transportation (ICCT) is the only source covering all major international test cycles. Their conversion tool is publicly available and the results are used by organisations such as the Global Fuel Economy Initiative (a partnership between the ICCT, International Energy Agency, United Nations Environment Programme, International Transport Foundation and FIA Foundation) and the Intergovernmental Panel on Climate Change. While conversions are robust at the overall fleet level, they should not be used for converting the performance of individual vehicles or for setting national regulations. This is because the conversion methodology addresses the main differences between test cycles, but not the smaller procedural differences.

Converting a standard from (say) the US into an Australian-equivalent level does not rely on the two countries having the same mix of vehicles on the road—this would affect how hard a given standard would be to achieve, but not its actual level.

The ICCT continues to refine its methodology and expects to release another update of conversion factors this year. These are not expected to result in large changes to countries' relative positions when measured on a common scale.

FIGURE 4.2: EMISSIONS INTENSITY OF NEW LIGHT VEHICLES IN AUSTRALIA UNDER BAU AND 'STRONG' STANDARD COMPARED TO US AND EU



Note: The EU met its 2015 target in 2013 so the EU trajectory shows actual 2013 new passenger vehicle emissions intensity. The EU 2025 target shown here is the mid-point of two proposed targets (68 and 78 g CO_2/km). The US has separate targets for passenger vehicles and light commercial vehicles, but also reports combined targets; the target shown has been converted to the European test cycle (NEDC) equivalent by the Authority using a conversion tool produced by the ICCT.

Source: Climate Change Authority using Reedman and Graham 2013b; Graham 2014; ICCT 2014 and EC 2014

Figure 4.2 compares the strong standard and projected BAU in Table 4.1 with US and EU standards, showing that, without policy action, Australia falls further behind over time. These comparisons are complicated by differences across jurisdictions. The EU standard is for passenger vehicles only, so would be somewhat harder to meet if it applied to light vehicles as a whole. The US standard shown covers all light vehicles, but uses a different test procedure from Australia and the EU. The comparison here draws on international analysis to put the standards in a common metric (the measure used in Australia and the EU). Further details on this comparison process are provided in Box 4.

Other standards have been proposed for Australia in recent years. For example, ClimateWorks (2014) analysed a range of standards and called on the government to introduce light vehicle standards starting in 2015–16 that matched EU levels for passenger vehicles with a four-year delay (that is, 130 g CO_2/km in 2020 and 95 g CO_2/km in 2024). In a 2011 discussion paper, the Department of Infrastructure and Transport proposed considering the impact of a range of different standards requiring average annual reductions of between 4 and 5 per cent per year from 2015 to 20; these would imply 2020 levels similar to either the medium or strong standards modelled here (DIT 2011a, p. 14).

4.4 NET BENEFITS OF STANDARDS FOR MOTORISTS

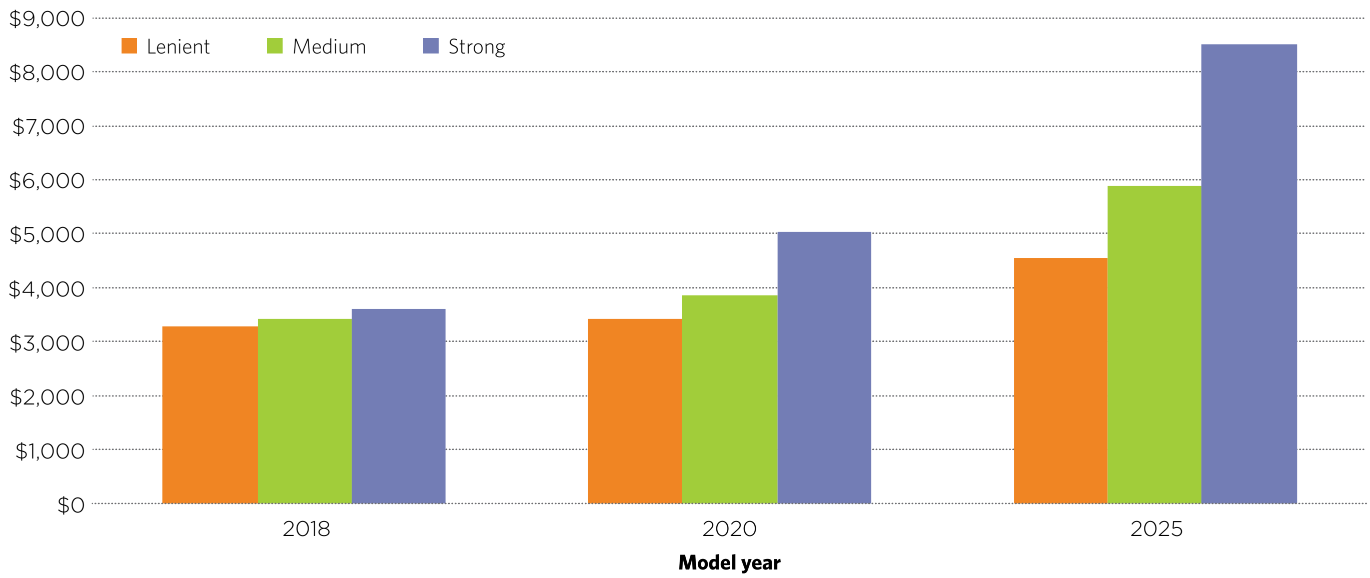
4.4.1 FUEL SAVINGS FROM LIGHT VEHICLE EMISSIONS STANDARDS

In broad terms, the value of fuel savings from standards depends on fuel prices, distances travelled and the level of the standard. Higher real fuel prices (including through any excise increases) and larger distances travelled increase the savings, if other things are equal. The Authority has calculated fuel savings over the life of an average new vehicle and to the first vehicle owner. This second measure of fuel savings helps to illustrate the likely impact on buyers of new vehicles.

The Authority has estimated both measures of fuel savings for each of the modelled standards. Figure 4.3 shows the present value of fuel savings over the life of new vehicles, relative to BAU, for model years 2018, 2020 and 2025. In 2018, the average present value of fuel savings attributable to standards is between $3,200 and $3,600 for all three possible standards. These represent the present value of fuel savings from 2018 model vehicles over their assumed average vehicle life of 15 years; they are savings to motorists so include savings from avoided excise. The savings are initially similar because in the first year the levels of the standards are quite similar (see Table 4.1). The present value of fuel savings rises with successive model years, reaching about $8,500 for a 2025 vehicle subject to the strong standard.

In the years to 2025, projected fuel savings largely come from the deployment of more efficient conventional petrol and diesel vehicles. All standards modelled see some deployment of alternative vehicles; these become more important from about 2025 onwards (Reedman and Graham 2013b, p. 16).

FIGURE 4.3: PRESENT VALUE OF FUEL SAVINGS RESULTING FROM STANDARDS RELATIVE TO BAU



Note: Assumed average vehicle life of 15 years. For further details on method see Appendix B.
Source: Climate Change Authority calculations using Reedman and Graham 2013b

About half of new vehicles purchased in Australia are for fleets and half are purchased by households (NTC 2014); anecdotal evidence suggests that the average new fleet vehicle is held for three years and the average new household vehicle for five. The present value of fuel savings over the first three or five years indicates the value captured by the first owner of the vehicle, under the conservative assumption that cars with greater fuel economy (or lower emissions intensity) will not attract a higher resale price. For the modelled standards, the present value of fuel savings in the first three years would be about $1,000 for all three standards, rising to over $2,300 for a 2025 model year vehicle under the strongest standard (Figure 4.4). For an average household buyer holding a vehicle for five years, the present value of fuel savings start at about $1,500 for a 2018 model year vehicle, and rise to about $3,700 for a 2025 model under the strongest standard (Figure 4.5).

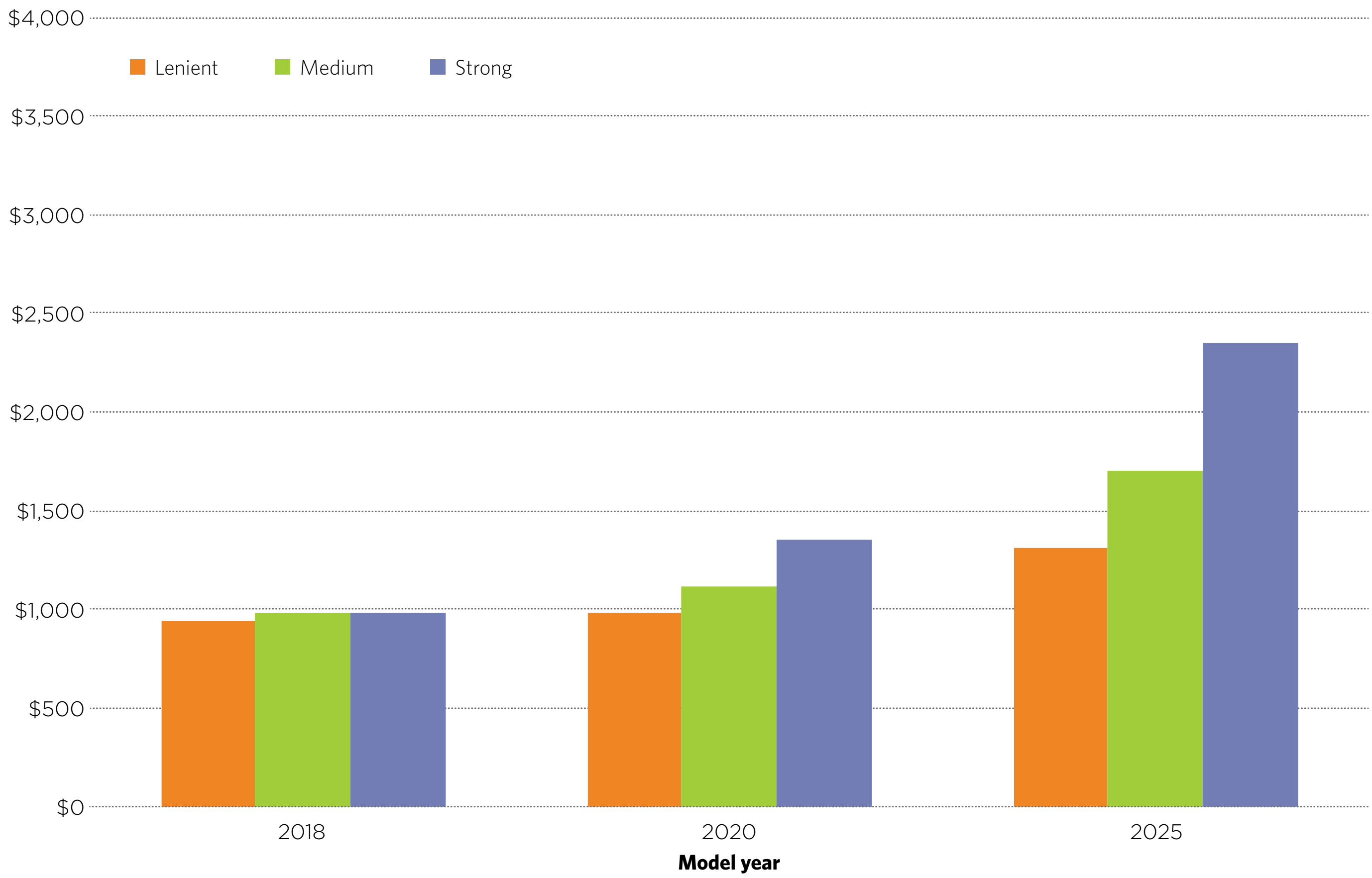
Comparing lifetime savings with the fuel savings for first buyers implies that the majority of savings accrue to later owners. This suggests that it is unlikely that standards will have a regressive effect. If greater fuel economy does not increase a vehicle's resale value, purchasers of used vehicles will capture the majority of the benefits from standards without the increase in upfront costs.

4.4.2 IMPACT OF STANDARDS ON VEHICLE COSTS

To estimate the net private benefits of standards, the estimated fuel savings need to be adjusted for the incremental vehicle costs. Estimates of incremental vehicle costs isolate the costs of additional fuel saving technologies from other vehicle features that contribute to driver utility (for example, premium seating and advanced navigation technologies).

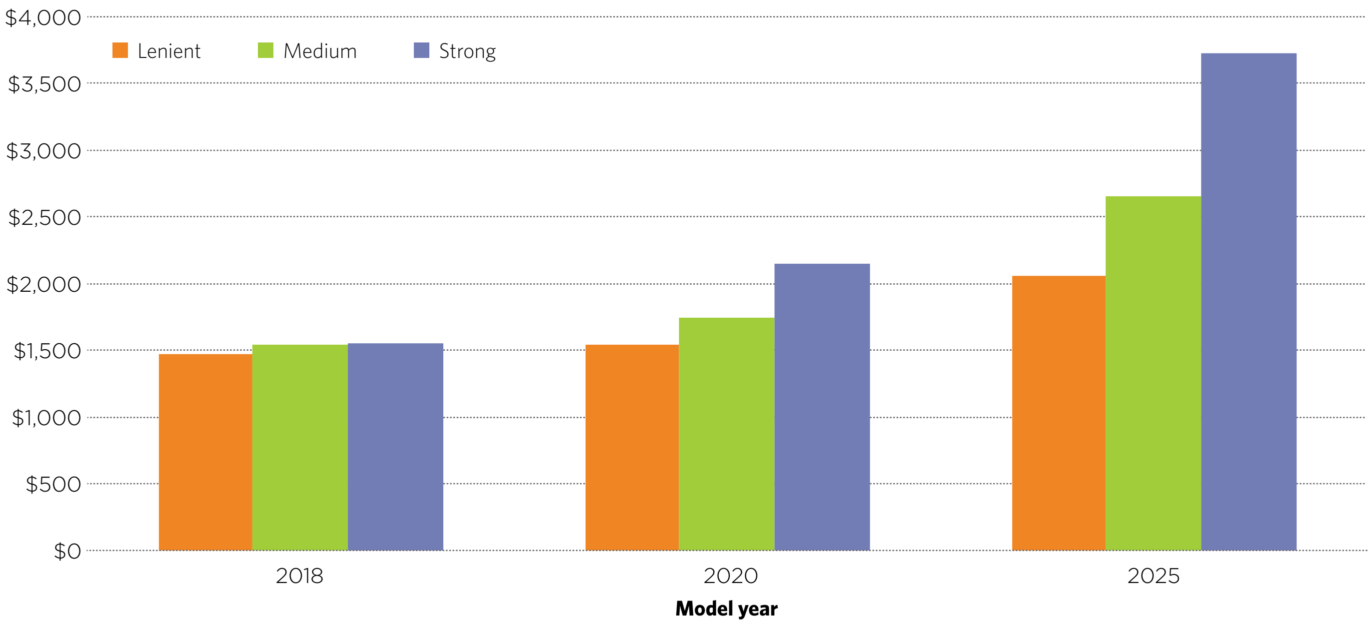
There is no published work on these costs specifically for Australia. The most relevant information on incremental technology costs is from countries that are targeting a similar level of emissions intensity and improvement over a similar time horizon as the modelled Australian standards. Reedman and Graham (2013b) drew on international costs estimates from 2007 (see Appendix B). Technology costs can fall over time and newer estimates from countries targeting similar standards are available, so the Authority has made use of these more recent estimates in this assessment. The Australian standards modelled for the Authority are weaker or similar to the US standards over the period 2020–25 (see Table 4.1 and Figure 4.2), and significantly weaker than the EU standards. This means that compliance with the EU standards will likely require more costly technologies; the US cost estimates are therefore considered the better indicator of technology costs in Australia.

FIGURE 4.4: PRESENT VALUE OF FUEL SAVINGS TO FIRST VEHICLE OWNER RESULTING FROM STANDARDS, THREE-YEAR OWNERSHIP, RELATIVE TO BAU



Source: Climate Change Authority calculations using Reedman and Graham 2013b

FIGURE 4.5: PRESENT VALUE OF FUEL SAVINGS TO FIRST VEHICLE OWNER RESULTING FROM STANDARDS, FIVE-YEAR OWNERSHIP, RELATIVE TO BAU



Source: Climate Change Authority calculations using Reedman and Graham 2013b

One reason to treat estimates of incremental costs with care is that, while the cost of individual technologies to improve efficiency can be estimated, it is harder to establish estimates of the total cost of meeting a standard. There are a number of existing and new technologies that can be used in different combinations in different vehicles. The combination will determine the overall effect on cost and vehicle fuel efficiency.

US and EU cost estimates are summarised in Table 4.2; the modelled Australian standards are included for comparison. Overall, US evidence suggests Australia could meet the strong standard modelled at an average increased retail cost of less than $1,000 per vehicle in the earlier years of the standard, rising to about $1,500 per vehicle by 2025. In addition to the increased retail price of vehicles attributable to increased production costs, there will also be some costs for suppliers of complying with the standards. Given the very modest additional reporting requirements, these costs are expected to be small (see Chapter 5). It is possible that these could be offset by lower per vehicle costs than those indicated here if pass-through of increased production costs into Australian dollar vehicle prices is somewhat less than 100 per cent (see Appendix B). For this reason, the Authority considers the increase in production costs per vehicle presented here are a reasonable estimate of the likely increase in average retail vehicle prices. A formal RIS would be needed to establish the regulatory burden of standards in more detail.

TABLE 4.2: ESTIMATES OF INCREMENTAL VEHICLE COSTS TO MEET FUTURE US AND EU VEHICLE EMISSIONS STANDARDS

JURISDICTION (SCOPE OF STANDARD IN BRACKETS)	2020 TARGET (g CO_2/km)	2025 TARGET (g CO_2/km)	ESTIMATED ADDITIONAL VEHICLE COST TO MEET 2020/2025 TARGETS (2012 AUD)
US (all light vehicles)	144	107	$810 (2020) $1,450 (2025)
EU (passenger cars including SUVs)	95	73	$1,500–$1,650 (2020)
Australia (all light vehicles)	162 (lenient) 154 (medium) 147 (strong)	135 (lenient) 119 (medium) 105 (strong)	Not assessed

Note: The US has separate targets for passenger vehicles and light commercial vehicles but also reports combined targets; the target shown has been converted to the European test cycle (NEDC) equivalent by the Authority using a conversion tool produced by the ICCT. The costs are the Authority's weighted average of the estimated incremental costs for passenger vehicles and light trucks combined using a weight of 70 per cent for passenger vehicles. The EU 2025 target is the mid-point of the current proposed 2025 target range. For further details on sources and methods see Appendix B.

Source: Climate Change Authority based on NHSTA 2012, pp. 978–9; Cambridge Economics and Ricardo-AEA 2013; ICCT 2014

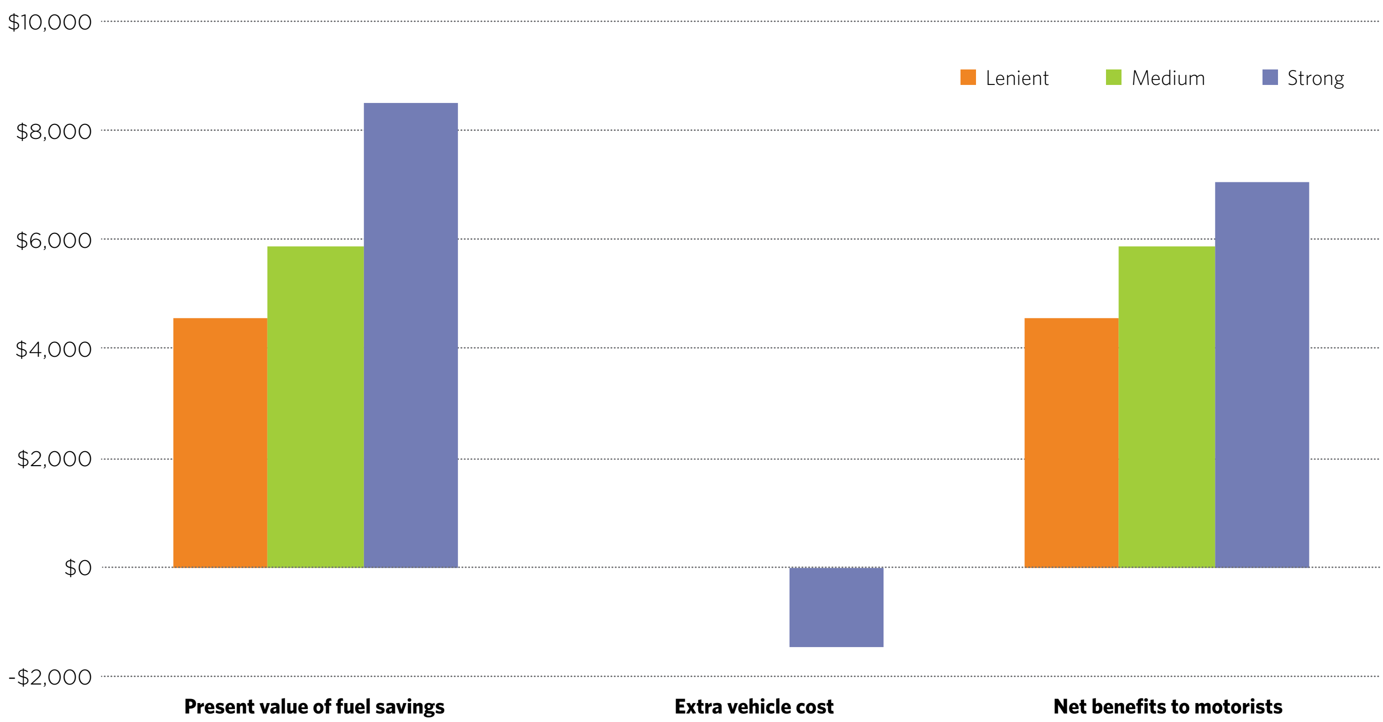
4.4.3 COMPARING THE NET BENEFITS TO MOTORISTS ACROSS THE MODELLED STANDARDS

All the standards modelled are likely to deliver net financial benefits to motorists but the strongest standard modelled is expected to have the largest private benefits. Figure 4.6 shows estimates of the net private benefits by standard for a 2025 model year vehicle. In the absence of incremental cost estimates for lenient and medium standards, they have been assigned a value of zero. This is a conservative assumption, as it will tend to overestimate the net benefits of these two standards, relative to the strong standard. The fact that, even with this assumption, the strong standard still delivers the greatest net benefits and provides more confidence that this is the best approach for Australia. Net benefits rise to at least $7,000 over the vehicle's life (assumed to be 15 years). The strongest standard is also expected to deliver the largest net benefits across earlier model years. All of these private benefits are prior to placing any value on emissions reductions (see Section 4.5).

The strongest standard modelled also gives the largest expected net benefits to first owners. Figures 4.4 and 4.5 show that first owners holding 2025 model year vehicles for three or five years accrue fuel savings of about $2,300 and $3,700, respectively. In both cases, this exceeds the estimated incremental capital cost for a 2025 model-year vehicle (about $1,500), and delivers the largest net benefit of the modelled standards.

Removing or further lowering import duties on vehicles could help reduce some of the upfront cost impact of standards for motorists. As discussed in Chapter 2, a tariff based on vehicle import prices is currently levied on vehicles imported from some countries, including the EU and Japan (levied at 5 per cent) and the Republic of Korea (4 per cent). The policy rationale for these duties would appear to end in 2017 when domestic vehicle manufacturing is expected to cease. In any case, under recent agreements cars from Japan and Korea will become exempt from tariffs (Australian Government 2014a and 2014b). The Authority estimates that the average impact of tariffs on the purchase price of vehicles in 2012 was about $1,200 per vehicle subject to tariffs (Climate Change Authority based on PC 2012, Department of Industry 2012 and NTC 2013). This is the same order of magnitude as the indicative estimates of upfront costs under strong standards. For some vehicles, removing tariffs at the same time as introducing standards could result in no net change in retail vehicle prices.

FIGURE 4.6: BENEFITS, INCREMENTAL COSTS AND NET PRIVATE BENEFITS BY STANDARD, OVER VEHICLE LIFE, 2025 MODEL YEAR



Note: In the absence of incremental cost estimates for lenient and medium standards they have been assigned a value of zero. This is conservative as it tends to overestimate the net benefits of these two standards, relative to the strong standard (see discussion in text). Assumed average vehicle life of 15 years. For further details of approach see Appendix B.
Source: Climate Change Authority based on Reedman and Graham 2013b and NHSTA 2012, pp. 978–9

4.5 SOCIAL BENEFITS OF STANDARDS

4.5.1 EMISSIONS REDUCTIONS FROM STANDARDS

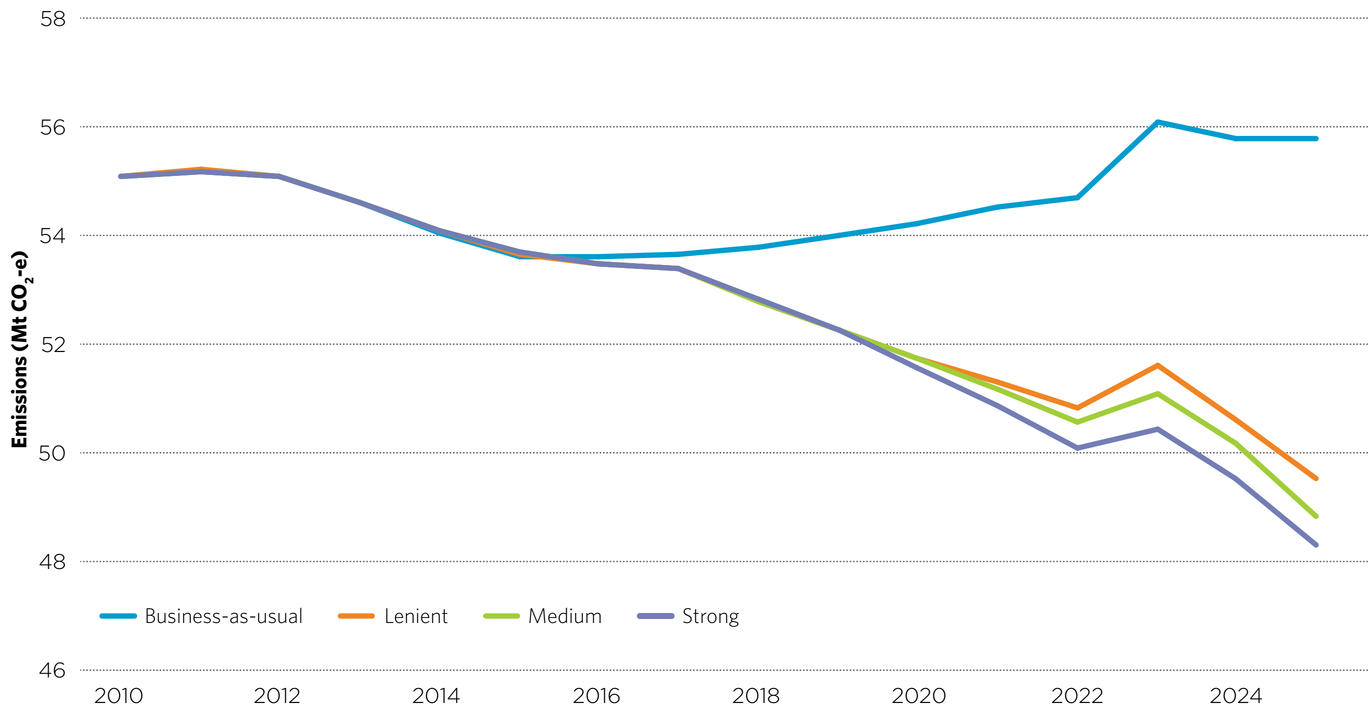
Having discussed the private costs and benefits of standards, this section discusses the social benefits, including the benefits of lower emissions, achieved at lower cost than alternative emissions reduction opportunities.

Standards can make a substantial contribution to achieving Australia's emissions reduction goals—especially over time. Figure 4.7 shows projected emissions from light vehicles with and without standards, and Figure 4.8 shows the cumulative emissions reductions from standards over the period to 2030.

They show that:

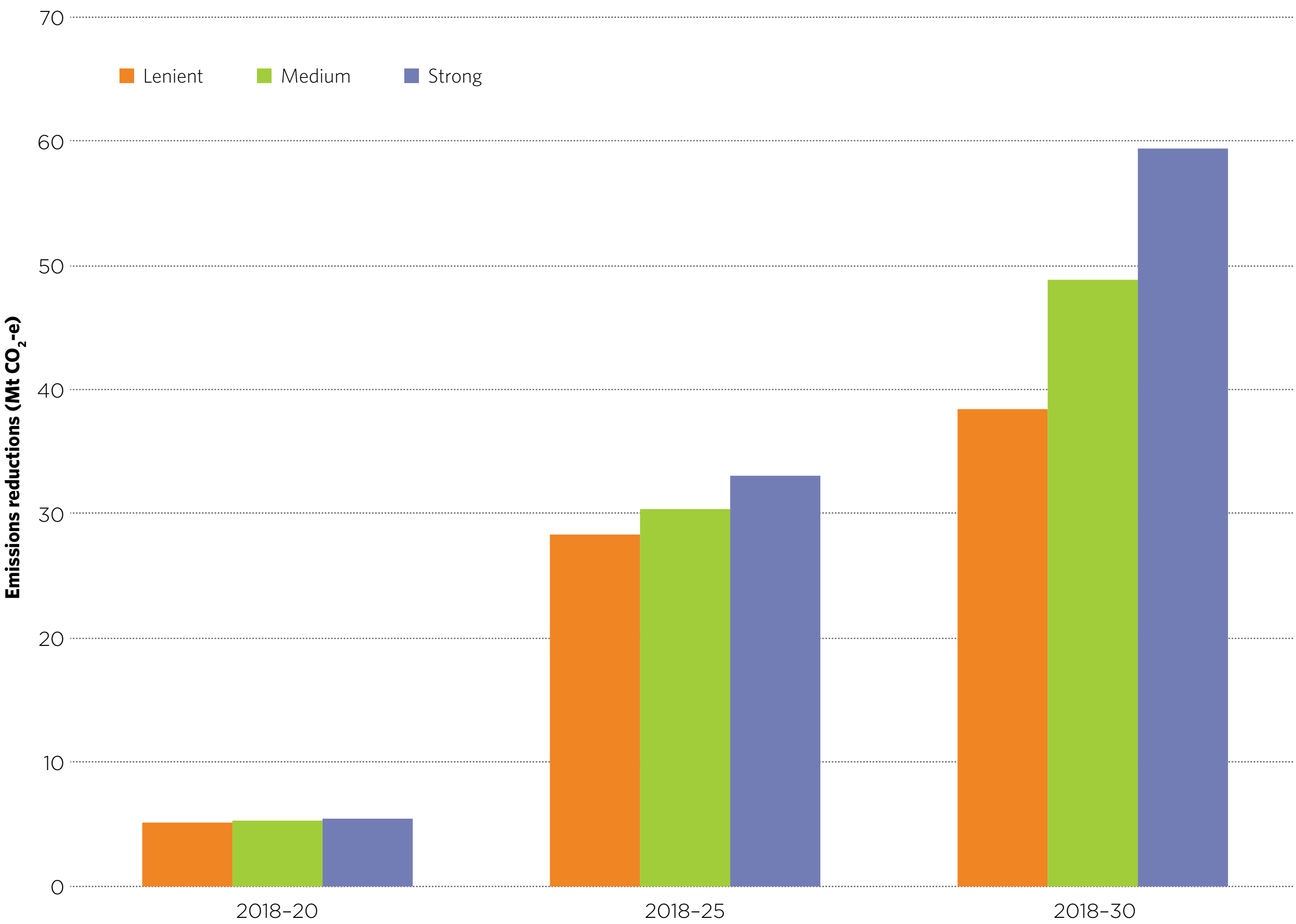
- With standards in the range modelled by the Authority, overall emissions from light vehicles fall over time. Without standards, increases in activity from population growth and rising incomes offset light vehicle efficiency improvements, so that overall emissions are projected to be roughly steady. With standards, light vehicle emissions are projected to be up to 13 per cent lower than BAU by 2025.
- Emissions reductions from standards become substantial over time. While standards starting in 2018 will not make a large contribution to meeting Australia's 2020 emissions reduction goals, by 2030 the cumulative reductions are projected to be about 59 Mt CO_2-e. This is roughly the same as Australia's entire current annual light vehicle emissions. The difference between the strong and more lenient standards also builds over time, as the gap between the different standards grows.

FIGURE 4.7: TOTAL EMISSIONS FROM LIGHT VEHICLES TO 2025 WITH AND WITHOUT STANDARDS



Note: The spike in emissions at 2023 in all scenarios is driven by a projected increase in the use of synthetic diesel fuels around 2023. The vast bulk of greenhouse gas emissions from light vehicles are carbon dioxide; the modelling includes other greenhouse gases from light vehicles, converted to carbon dioxide equivalent (the amount of carbon dioxide that would result in the same amount of global warming).
Source: Reedman and Graham 2013b

FIGURE 4.8: CUMULATIVE EMISSIONS REDUCTIONS FROM STANDARDS, SELECTED YEARS



Note: The vast bulk of greenhouse gas emissions from light vehicles are carbon dioxide; the modelling includes other greenhouse gases from light vehicles, converted to carbon dioxide equivalent.
Source: Climate Change Authority calculations using results from Reedman and Graham 2013b

In reality, if Australia did implement standards the emissions reductions to 2030 would almost certainly be larger than those projected here. The estimates here are for emissions reductions from the proposed first phase of standards (2018–25). If standards continued (perhaps in a stronger form) after 2025, they would deliver additional emissions reductions to 2030.

Emissions savings per vehicle grow over time. The strong standard is projected to save five tonnes of emissions per vehicle for the 2020 model year (on average, over the vehicle's life). This grows to 12 tonnes per vehicle for the 2025 model year. Over the lifetime of all 2018–25 model-year vehicles, strong standards are projected to deliver 79 Mt CO_2-e of emissions reductions, roughly the same as Australia's entire current annual transport emissions.

4.5.2 ARE EMISSIONS REDUCTIONS FROM STANDARDS COST-EFFECTIVE?

The next question is whether these substantial emissions reductions are cost-effective.

Fuel savings from more efficient vehicles are not just relevant to motorists—they create benefits for society as a whole. The net social benefit of a strong standard grows over time: it is projected to be about $2,400 for a 2020 model year vehicle and $5,300 for a 2025 model year vehicle. This represents the net present value of fuel savings over the life of each vehicle. The social value is lower than the private value of fuel savings, as it excludes fuel excise (see Appendix B.3).

Aggregating these up to the economy-wide level, strong standards would deliver net social savings of an estimated $4.2 billion for 2020 model year vehicles, and $9.5 billion for 2025 model year vehicles.

This means light vehicle standards would reduce Australia's emissions and deliver net savings at an economy-wide level.

Standards thus deliver 'negative cost' emissions reductions; Australia saves money for each tonne of emissions avoided. Overall, the cost of reducing emissions from a strong standard, averaged over model years, is around –$580 per tonne of carbon dioxide equivalent. This estimate is consistent with other Australian and international research, which shows that light vehicle efficiency is among the least-cost emissions reductions opportunities in Australia. In elaboration of this view:

- The Authority's Renewable Energy Target Review (2012) estimated the cost of emissions reductions from the Large-scale Renewable Energy Target at $40 per tonne over the period 2012–13 to 2030–31.
- The Authority's Targets and Progress Review (2014, p. 141) estimated that it would cost up to $65 per tonne to achieve Australia's minimum commitment of a 5 per cent 2020 emissions reduction target through domestic reductions alone.
- While the government has not provided detailed estimates of the cost of emissions reductions under the ERF, other research (for example, SKM MMA 2013 cited in TCI 2013; Reputex 2013) suggests a range of costs of $30–58 per tonne in 2020.
- International emissions reductions units are available for about $0.50 to $2.00 per tonne (CCA 2014a, p. 186).

The gap between these costs and the $580 per tonne saving is so large as to make standards a standout among cost-effective contributions to Australia's emissions reduction efforts.

4.6 CONCLUSION—THE TARGET LEVEL OF AN AUSTRALIAN STANDARD

The analysis in this chapter shows that, of the standards assessed, the strongest delivers the largest net benefits, and has the benefit of being closely aligned with the US standard. Having regard to the guiding considerations noted in section 4.2, this suggests that this standard would be an easy and sensible first step for Australia to take. National average targets in phase one would start at 168 grams of carbon dioxide per kilometre in 2018 and decline steadily each year to 105 grams per kilometre in 2025. This standard would require annual reductions of 6.5 per cent per year over 2018–25.

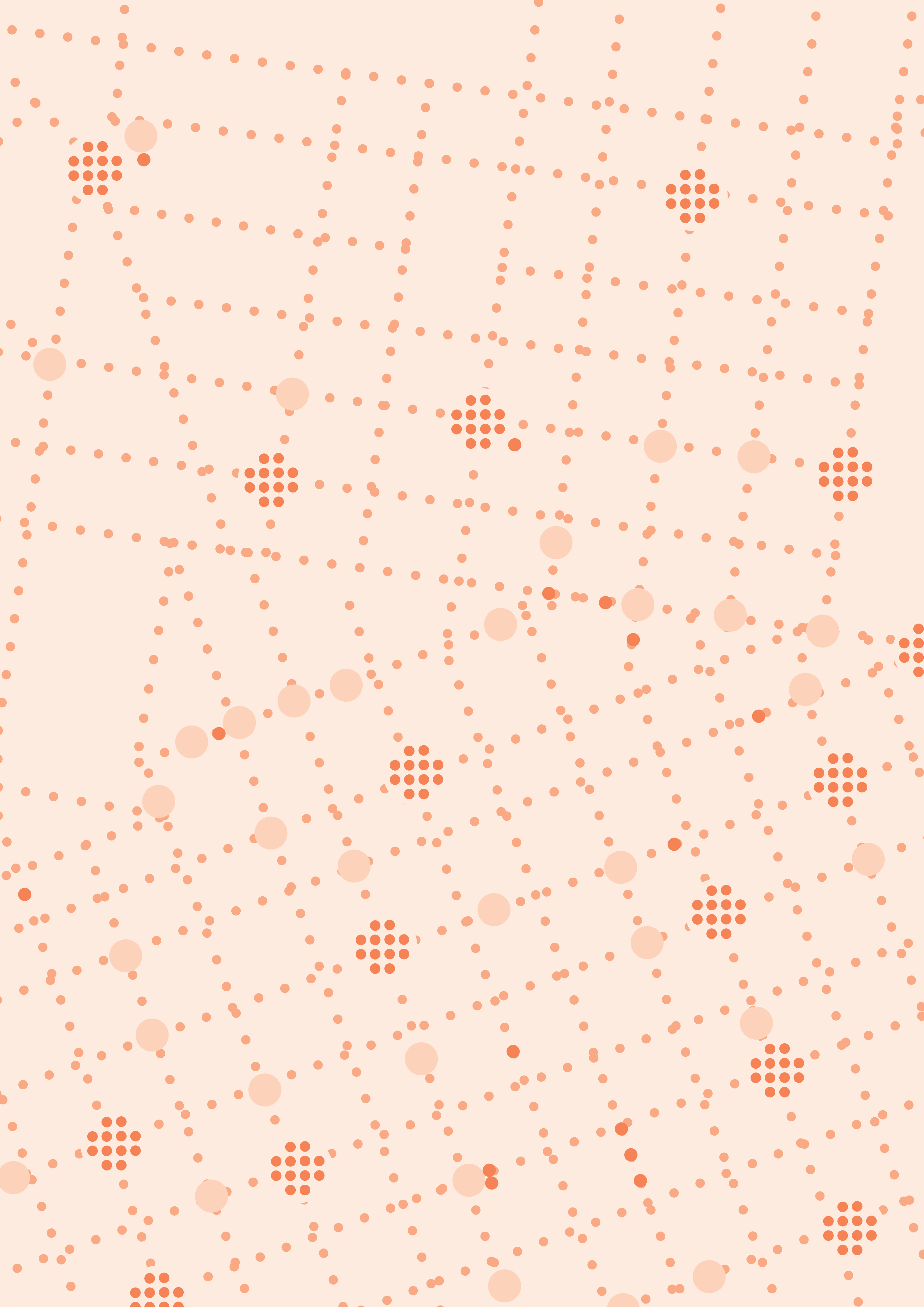
This represents a faster rate of improvement than that achieved in recent years but is considered feasible. Over this period, all new vehicles will be imported and the standard would be similar to or weaker than those prevailing in the US, the EU and Japan. Businesses supplying the Australian market would need only to adjust their selection of imported vehicles—the standards do not require that new technologies be developed in the exporting countries or that manufacturing facilities be re-tooled. With reasonable lead time prior to the introduction of standards, relatively rapid annual reductions would seem manageable. A start date of 2018 preceded by a policy decision and announcement in 2015 would provide a three-year lead time to the start of the first phase. This should be sufficient time for adequate consultation and an orderly phase-in (see Chapter 5).

CONCLUSIONS

C6. A new light vehicle emissions standard, starting at 168 grams of carbon dioxide per kilometre in 2018 and declining to 105 grams per kilometre in 2025, would deliver substantial net benefits for motorists and Australia. The standard would:

- reduce fuel bills, with average net savings of $7,000 per vehicle by 2025, after accounting for potential increases in vehicle costs
- reduce Australia's emissions by 59 Mt CO_2-e by 2030, at a net saving to Australia of about $580 per tonne of emissions reductions.

C7. Of the standards examined by the Authority, this would deliver the largest net benefits and put Australia in line with US standards. The Authority believes this would represent a good start which could be built upon with stronger standards in phase two; if it was so inclined, however, the government might wish to consider whether stronger standards in phase one would deliver even larger net social benefits.



DESIGNING AN EMISSIONS STANDARD FOR AUSTRALIA

5

The Authority proposes a standard that would apply from 2018 and be designed with a simple set of features to promote environmental effectiveness, policy stability and equity, and minimise the regulatory burden.

This chapter considers how an Australian standard for emissions from new light vehicles should be designed. Broadly, it concludes that a sensible approach would be a simple, 'no-frills' standard that:

- minimises the compliance burden on industry
- uses existing regulatory frameworks and processes where possible
- could be implemented in a straightforward manner in the proposed time frame.

In the second phase of the standard, this basic design could be augmented with additional features.

This chapter steps through the key elements of a light vehicle emissions standard in Australia and makes findings on the preferred approach. Appendix A outlines international experience of standards and Appendix C provides more detailed analysis and evaluation of design options.

5.1 FRAMEWORK FOR DESIGN OF AN AUSTRALIAN STANDARD

In considering how to evaluate options and identify a preferred design, the Authority has used a simple framework that draws on the statutory principles governing all the Authority's work (Section 1.1), principles of good regulatory design and lessons from similar policies overseas.

The framework for evaluating design choices focuses on the following four elements:

- *Environmental effectiveness*—the standard should ensure that the emissions intensity of new light and commercial vehicles is reduced. The standard should contribute to the overall reduction of Australian emissions.
- *Administrative and regulatory burden*—the standard should be low cost, and simple for government to administer and for industry to comply with. It should draw on existing governance and regulatory structures where possible.
- *Equity*—the standard should ensure, to the extent possible, equity in the compliance burden placed on manufacturers given their diverse product mix.
- *Policy stability and credibility*—the standard should minimise opportunities for gaming, avoidance and market distortions. Participants and the wider public should have confidence in the standard.

BOX 5: MINIMISING COMPLIANCE COSTS THROUGH DESIGN CHOICES

As noted in Chapter 4, utilising a fleet-average, footprint-based design for an Australian standard would provide maximum flexibility for suppliers and preserve consumer choice.

The standard outlined in this chapter is designed to take advantage of existing frameworks and processes to minimise the compliance burden on both the vehicle industry and the regulator. As a result, administrative and regulatory costs to industry and the government will largely be limited to the implementation of IT systems to collate, submit and assess data.

The key element of this approach is using ADR81/02 *Fuel Consumption Labelling for Light Vehicles* as the source of model-specific CO_2 data. ADR81/02 is a mandatory standard that applies to all new light vehicles supplied to the Australian market and is fully harmonised with the relevant UN regulation (R101). Basing the proposed CO_2 emissions standard on ADR81/02 data means the standard does not require manufacturers to undertake any additional vehicle testing. ADRs are subject to regular review to ensure continued harmonisation with the UN regulations on which they are based. This ensures Australia's standards are consistent with those being met internationally.

In addition, vehicle manufacturers are subject to a range of compliance measures under the framework of the *Motor Vehicle Standards Act 1989*, including risk-based audits, to ensure that new vehicles entering Australia comply with all relevant ADRs, including ADR81/02. This system provides a level of assurance that the CO_2 data provided has been obtained from validly conducted tests and collected in accordance with the provisions of ADR81/02.

Most other data elements required for the new CO_2 standard, including model-specific sales data, are already collected from manufacturers by the FCAI. While vehicle footprint data are not currently collected, manufacturers possess this information for all their models, so it is largely a matter of making this a mandatory reporting element.

While further industry consultation would be required, it appears that manufacturers are in a position to provide all the required data for the proposed standard without any additional testing, measurement or analysis. From the vehicle manufacturer's perspective, some IT design work and ongoing staffing resources may be required to collate the required data and establish systems to monitor the company's compliance over the course of each year. The regulator will need to provide an electronic gateway to enable manufacturers to submit the data. It will also need to establish IT systems, with an appropriate level of ongoing staffing, to manage the data, assess compliance and publish annual reports.

5.2 SCHEME DESIGN CHOICES

In designing a standard, several choices need to be made, including, but not limited to, who should be covered by the standard, how it should be measured and enforced, and when it should commence.

In assessing options, the Authority has looked at international experience and considered the views of industry and non-government organisations, particularly as expressed in submissions to the 2011 Department of Infrastructure and Transport *Light Vehicle CO_2 Emissions Standards* discussion paper and the Authority's own consultation in preparing this report.

A summary of the Authority's proposed design features is set out below. Further detail is provided at Appendix C.

5.2.1 A FLEET-AVERAGE, FOOTPRINT-BASED APPROACH

A single, fleet-average standard should apply to all new passenger and light commercial vehicles supplied to the Australian market. The standard would apply to the new vehicle fleet as a whole, not to individual vehicles.

A fleet-average approach preserves consumer choice, reduces the regulatory burden, and offers the greatest flexibility and cost-effectiveness for liable entities. This approach has been widely used in other jurisdictions, including the US and EU, and is broadly supported by industry.

The standard should differentiate obligations based on the size (footprint) of the vehicle, ensuring equity across suppliers while maintaining consumer choice and maximising flexibility. This approach ensures that the option to lightweight vehicles, a major emissions reduction strategy in new vehicle design, is maintained. While mass is more strongly correlated to fuel consumption, footprint is considered to better relate to consumer utility, and facilitates a more technology-neutral approach to compliance.

The footprint approach is used in the US, Canada and Mexico, while mass is adopted in the EU, China, Japan and the Republic of Korea. While both can work effectively, international evidence favours the footprint approach.

5.2.2 A FIRST PHASE OF THE STANDARD FROM 2018 TO 2025

The new light vehicle emissions standard should commence no later than 2018, with a first phase from 2018 to 2025. An early start maximises the benefits of the standard, as it takes time for changes to new vehicles to improve the overall fleet. A strong standard starting in 2018 generates the greatest emissions reductions and the greatest financial benefits to Australian motorists. This needs to be balanced against providing an appropriate lead time for industry consultation and implementation of the scheme. Internationally, lead times of around three years for the initial introduction of vehicle emissions standards are common.

A first phase from 2018 to 2025 is long enough to allow liable entities sufficient time and flexibility to adjust their business operations, and short enough to not 'lock in' standards too far into the future that may become less appropriate with technology developments, market changes or other factors. Aligning the first Australian target standards to those applying in major jurisdictions, such as the US and EU, could assist with future global alignment and assessment of targets in other key economies, possibly simplifying the compliance process for suppliers.

5.2.3 A SINGLE STANDARD FOR ALL NEW LIGHT VEHICLES

A single standard for both passenger and light commercial vehicles should apply. International evidence suggests that the most effective vehicle emissions standards have broad coverage and the majority of light vehicle emissions standards in other countries, including the US, cover both passenger and light commercial vehicles.

Covering all new light vehicles with a single standard reduces complexity and the risk of gaming, with all liable entities facing similar obligations. With a fleet-average, footprint-based standard, the liable entity can use both technology and vehicle improvements and variations in the product mix of vehicles supplied to achieve compliance, thus minimising the greater challenge often posed by light commercial vehicles. Further, a single standard is unlikely to impose an unfair burden on light commercial vehicle manufacturers in the Australian market, as they tend to supply both light commercial and passenger vehicles.

Second-hand imports do not need to be covered under the standard at this stage. These currently represent a very small segment of the Australian 'new' vehicle market; excluding them will reduce the complexity of the scheme with minimal impact on environmental effectiveness. Any changes to current restrictions limiting second-hand imports should be monitored and, if necessary, the issue could be reconsidered.

5.2.4 LIABLE ENTITY AND THRESHOLD FOR LIABILITY

Conceptually, the liable entity under the standard should be the same entity as that responsible for Australian certification of a vehicle under the *Motor Vehicle Standards Act.* It would seem to make sense for liability for the standard to lie with the entity that has most control over the mix of vehicles supplied to the market. This would help limit the number of liable entities, which in most cases will be the vehicle manufacturer, and which have the capacity to comply with reporting obligations. The legislative framework for implementing the light vehicles emissions standard itself will need further consideration as the *Motor Vehicles Standard Act* may not be the appropriate Act.

Consultations with industry should be held to confirm the appropriate point of liability, and to consider the implications of any associated decisions to set a threshold for liability.

Subject to such consultations and consideration of how the point of liability will be determined, a threshold for liability of annual sales of 2,500 vehicles is suggested. This threshold would appear to provide an appropriate balance between maximising coverage and minimising compliance costs on entities responsible for small sales volumes, provided it does not trigger significant disaggregation by corporate groups. This threshold would be reviewed prior to considering a second phase of the standard.

5.2.5 A CO_2 EMISSIONS STANDARD USING EXISTING TESTING PROCEDURES

The proposed standard should be based on CO_2 emissions. Internationally, standards based on both fuel economy and CO_2 emissions are common, but an emissions-based standard reflects the primary objective of the scheme and offers a straightforward measure that is relevant across all fuel types. Other greenhouse gases should not be included in the scheme, as the small gain in environmental effectiveness is unlikely to warrant the extra effort, cost and complexity of their inclusion.

The standard should use the CO_2 emissions value collected under ADR81/02 *Fuel Consumption Labelling for Light Vehicles.* This data is collected as part of the existing vehicle type approval certification process under the *Motor Vehicle Standards Act,* which applies to all new vehicles to be sold in the Australian market. It uses an internationally recognised test to measure CO_2 emissions for each model (and its variants). Using ADR81/02 as the data source minimises administrative complexity and reduces compliance costs for suppliers, as the standard would not require any additional vehicle testing.

5.2.6 ANNUAL COMPLIANCE AND EARLY REPORTING

The standard should set annual compliance obligations for liable entities. Annual compliance requires suppliers to meet a set target each year during the first phase of the standard, and thus drives early efforts to reduce emissions, as well as guaranteeing annual improvements. While annual targets may increase compliance costs, the administrative burden imposed is likely to be very small given the reliance on existing procedures and routinely collected data, and outweighed by the benefit of driving early and consistent emissions reductions. In addition, mechanisms such as banking and borrowing (discussed below) allow for normal business ebbs and flows, enhancing flexibility for liable entities.

By 2016, liable entities should be required to report annually on sales and vehicle data needed to underpin the standard. While CO_2 emissions, fuel consumption and other data is already legally required for all new vehicles entering the Australian market under the ADR81/02, the government does not currently collect annual vehicle sales data or vehicle footprint data, which will be required to determine individual emissions targets for liable entities.

Introducing reporting obligations before the standard begins will benefit both industry and scheme administrators. It will help liable entities track their position prior to needing to meet formal compliance obligations, and allow them to make any necessary changes to their business operations. It also allows entities and administrators to refine reporting and monitoring systems.

5.2.7 FLEXIBLE COMPLIANCE MECHANISMS

Banking and limited borrowing should be allowed within phase one of the standard. If Australia adopts standards aligned to other major markets, banking could also be allowed across compliance phases.

Flexible compliance mechanisms, such as banking, borrowing and trading, can give liable entities a range of options to cost-effectively comply with a given standard. They can improve the pace of progress in meeting given standards and help drive emissions improvements, while allowing flexibility in year-to-year performance. Internationally, different schemes use different combinations of these mechanisms, depending on other design features, such as the frequency of required compliance.

Trading is not necessary to the functioning of a vehicle emissions standard. Establishing appropriately robust trading mechanisms for such a small likely market is highly unlikely to be cost-effective and does not appear warranted at this time. While trading can reduce compliance costs and encourage innovation, it also increases complexity and is likely to be a small component of the market. It might, however, be worth exploring opportunities to trade excess credits within existing domestic mechanisms, such as the ERF to provide some additional flexibility for liable entities and possibly drive further reductions beyond the standard.

Multipliers and off-cycle credits are not necessary to the functioning of a vehicle emissions standard and are not proposed at this time. The Authority recognises the potential merit of these options as they can encourage innovation and early adoption and deployment of low-emissions technologies, which can often be high-cost, and can also assist liable entities to comply with a standard. Many countries, including the US and EU, allow liable entities to reduce their reported average emissions by using multipliers and off-cycle credits. These would, however, mean it is more administratively complex to design, implement and verify a standard. A fleet-average standard already creates a direct incentive for innovation—very low-emissions vehicles make it much easier for manufacturers to meet the fleet average. Other incentives for early innovation and outperformance of the minimum standard, such as banking, are proposed.

Well-designed multiplier and off-cycle credit measures could be considered for inclusion in later phases of the scheme.

5.2.8 A FINANCIAL PENALTY FOR NON-COMPLIANCE SHOULD APPLY

A financial penalty should apply to liable entities who do not comply with the standard. Penalties are a critical component of any regulatory scheme and are used as a compliance mechanism in international standards. The form and level of a penalty must be sufficient to encourage manufacturers to comply.

Financial penalties protect the environmental integrity of the scheme, preserve equity and ensure credibility. They are widely accepted as a deterrent for non-compliance and, if set at an appropriate level, have a direct impact on manufacturers' decision-making processes. Further analysis by government will be required to determine the appropriate penalty level.

5.3 SCHEME REVIEW

Good regulatory practice and the government's deregulation agenda require periodic review of regulation to ensure it continues to meet its objectives in a cost-effective way and that unnecessary regulatory burdens are removed. Regular review is particularly important for a standard that is designed to mobilise technology to reduce emissions over time. The standard will need to be reviewed, and presumably strengthened, at regular periods, to ensure that Australia's light vehicle fleet becomes increasingly efficient. The importance of this process can be seen in the US experience, where standards have been in place since the 1970s, but were not adjusted for 20 years, suggesting that opportunities to reduce emissions and fuel usage were missed.

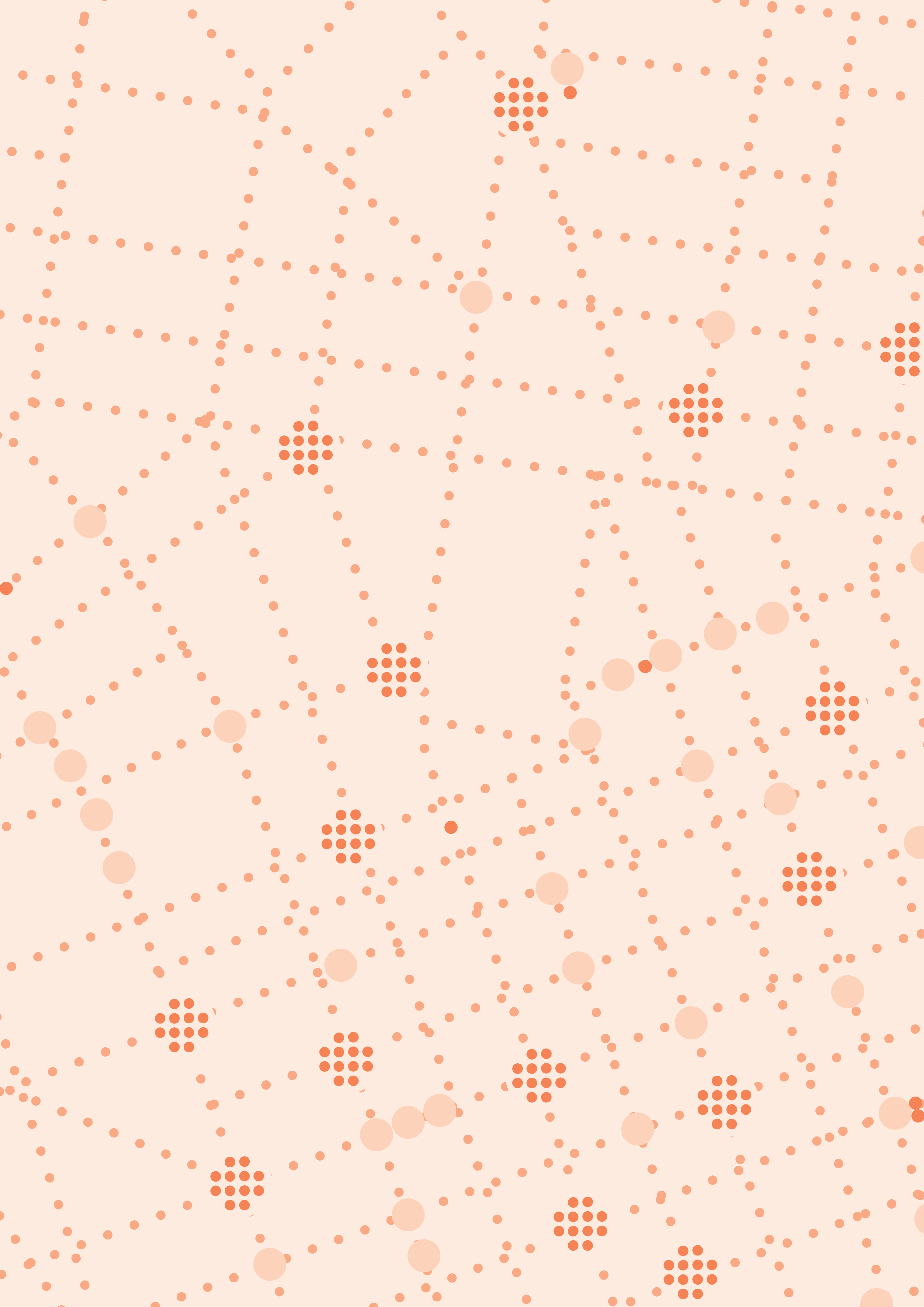
A review of the scheme should commence no later than 2021 to recommend new national average targets for the post-2025 period. The review should aim to set new targets by 2022 for phase two to provide certainty for industry. The review should also take into account the experience of the first three years of the scheme and explicitly revisit design options not implemented in the first phase.

The review should analyse evidence and stakeholder feedback to consider:

- the effectiveness of the standard in meeting the national average target for light vehicle emissions intensity
- the costs and benefits of the policy for vehicle owners and suppliers, the administrative costs of operating the scheme and any unanticipated costs or benefits of the policy
- progress in harmonised testing procedures through the United Nations vehicle standards process, to which Australia is committed
- other international developments and technological progress in light vehicle efficiency, and opportunities for future emissions reductions.

BOX 6: PROPOSED DESIGN OF THE STANDARD

- A single, fleet-average standard should apply to all new passenger and light commercial vehicles.
- The new light vehicle emissions standard should commence no later than 2018 with a first phase from 2018 to 2025.
- Second-hand imports should not be covered under the standard at this stage.
- Subject to further consultation with industry, the liable entity under the standard should be the same entity responsible for Australian certification of a vehicle under the *Motor Vehicle Standards Act 1989* (Cth).
- Subject to further consultation and consideration of how the point of liability will be determined, the threshold for liability should be annual sales of 2,500 vehicles.
- The proposed standard should be based on CO_2 emissions.
- The standard should use the CO_2 emissions value collected under ADR81/02 *Fuel Consumption Labelling for Light Vehicles.*
- The standard should set annual compliance obligations for liable entities.
- By 2016, liable entities should be required to report annually on sales and vehicle data needed to underpin the standard.
- Banking and limited borrowing should be allowed within phase one of the standard.
- Trading is not necessary to the functioning of a vehicle emissions standard.
- Multipliers and off-cycle credits are not necessary to the functioning of a vehicle emissions standard and are not proposed at this time.
- A financial penalty should apply to liable entities who do not comply with the standard.
- A review of the scheme should commence no later than 2021 to recommend new national average targets for the post-2025 period.



6

IMPLEMENTATION

The Authority is convinced that an emissions standard for new light vehicles sold in Australia would deliver significant financial benefits to motorists and realise one of the lowest-cost emissions reductions opportunities available to Australia. Compared with other possible initiatives, its implementation would be relatively straightforward.

Around 70 per cent of the light vehicles sold in the world today are covered by a CO_2 emissions standard, including in the major markets of the US, Europe and China. Standards have proved over a long period—and in a variety of markets—to be effective in delivering benefits to consumers as well as environmental gains. With good design, they can preserve marketplace diversity and consumer choice, and drive technological innovation.

Despite a long history of policy discussion and moderate improvements in vehicle fuel efficiency and emissions, Australia lags behind many other countries. This is unlikely to change in the absence of government action, despite the closure of domestic manufacturing and the importation of all vehicles by 2018. Without regulatory intervention to address market failures and other behavioural barriers, Australia risks continuing to lag behind and to miss opportunities to improve its energy productivity, reduce emissions and permit motorists to save on their fuel bills.

The early introduction of a light vehicle emissions standard for Australia is both achievable and desirable, and the benefits demonstrably outweigh the costs at whatever levels they are assessed.

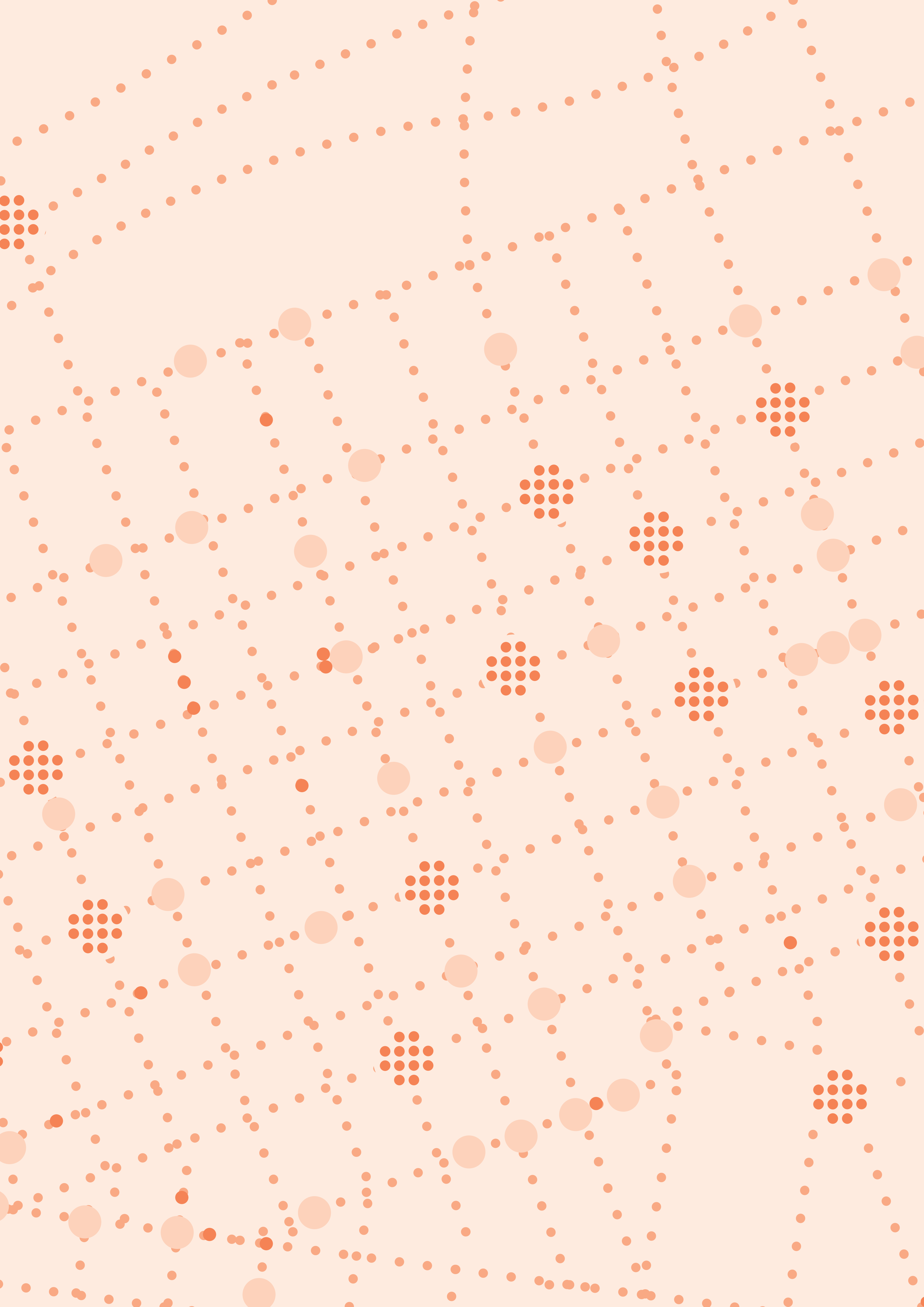
The Authority proposes a standard that would apply from 2018 and:

- set a target to reduce the average emissions intensity of the Australian light vehicle fleet from its current level of 192 g CO_2/km to 105 g CO_2/km in 2025
- oblige vehicle suppliers to improve the emissions intensity of the fleet offered to Australian motorists, with financial penalties for non-compliance
- be designed with a simple set of features to promote environmental effectiveness, policy stability and equity, and minimise the regulatory burden.

As with any new regulatory proposal, the next step would be for government to develop a formal RIS, which would involve extensive consultation with industry and other relevant parties. The Authority believes this report could provide a starting point for that work, although a number of implementation issues reach beyond the scope of this report, including the best legislative framework for introducing a standard and the associated governance arrangements to implement it. Other features that require detailed market analysis and industry consultation, such as determining the point of liability under the standard, require further process. International developments in the proposed harmonisation of testing procedures would also need to be monitored.

A standard commencing in 2018, with the first phase spanning 2018 to 2025, would seem to allow ample time for a RIS to be completed, and for the detail of the standard to be finalised, before industry was required to start complying.

The Authority has proposed a review of the standard in 2021 to consider the operation and design of the scheme and recommend new national average targets for phase two, after 2025.



INTERNATIONAL IMPLEMENTATION OF VEHICLE EMISSIONS STANDARDS

A

Mandatory vehicle emissions or fuel economy standards have been operating for at least a decade in the US, Japan and China. Many countries are accelerating their rate of emissions intensity improvement with successive standards.

All countries allow varied targets across the light vehicle fleet that are based on an attribute such as vehicle mass or size. None applies a flat standard to which all vehicles must comply regardless of size or weight. In addition, soon all four major markets (the US, the EU, China and Japan) will take a flexible, corporate-average approach to standards, with Japan switching to fleet averaging for its 2020 target.

The detail of standard design varies across developed and emerging markets. The US and EU have more flexible yet more administratively complex designs, including trading or pooling arrangements, and have financial penalties for non-compliance. All major markets have at least some flexibility mechanisms (such as banking and borrowing arrangements) that lower the costs to suppliers of meeting targets.

A.1 INTRODUCTION

This appendix provides an overview of the implementation of vehicle emissions standards in other jurisdictions, including the approaches other countries have taken to each of the key design issues for standards. Understanding how standards have been implemented elsewhere provides a useful input into standard design for Australia.

Over 70 per cent of light vehicles sold in the world today are subject to vehicle emissions standards (CCA 2014a, p. 164). In several cases, including the US, Japan and China, mandatory standards have been operating for at least a decade. The share of vehicles covered by standards is expected to grow, with standards currently under investigation in emerging markets such as Indonesia and Thailand (ICCT 2014).

Standards have been introduced around the world to contribute to energy affordability, energy security and emissions reduction objectives. The US first introduced light vehicle fuel economy standards in the 1970s as part of its response to oil price shocks. After an initial period of improvement, the standards were static for decades, but were reinvigorated in 2012 with the joint objectives of improving fuel economy and reducing CO_2 emissions. The EU has focused on reducing emissions as part of a broader climate change strategy and introduced mandatory targets in 2009 after previous voluntary targets were not met (EC 2009, L 140/2).

The countries analysed in this appendix account for the majority of the global vehicle market and have implemented, or committed to implement, mandatory vehicle emissions standards. The analysis focuses on the top four markets—the EU, the US, Japan and China—which together make up about 68 per cent of global vehicle sales (OICA 2014). Other countries are discussed where relevant.

The rest of this appendix:

- provides an overview of standards in other countries
- discusses the design choices other countries have made and the reasons for their choices.

A.2 OVERVIEW OF STANDARD DESIGN AND AMBITION IN OTHER COUNTRIES

Table A.1 and Figure A.1 summarise passenger vehicle emissions standards in major countries. They show:

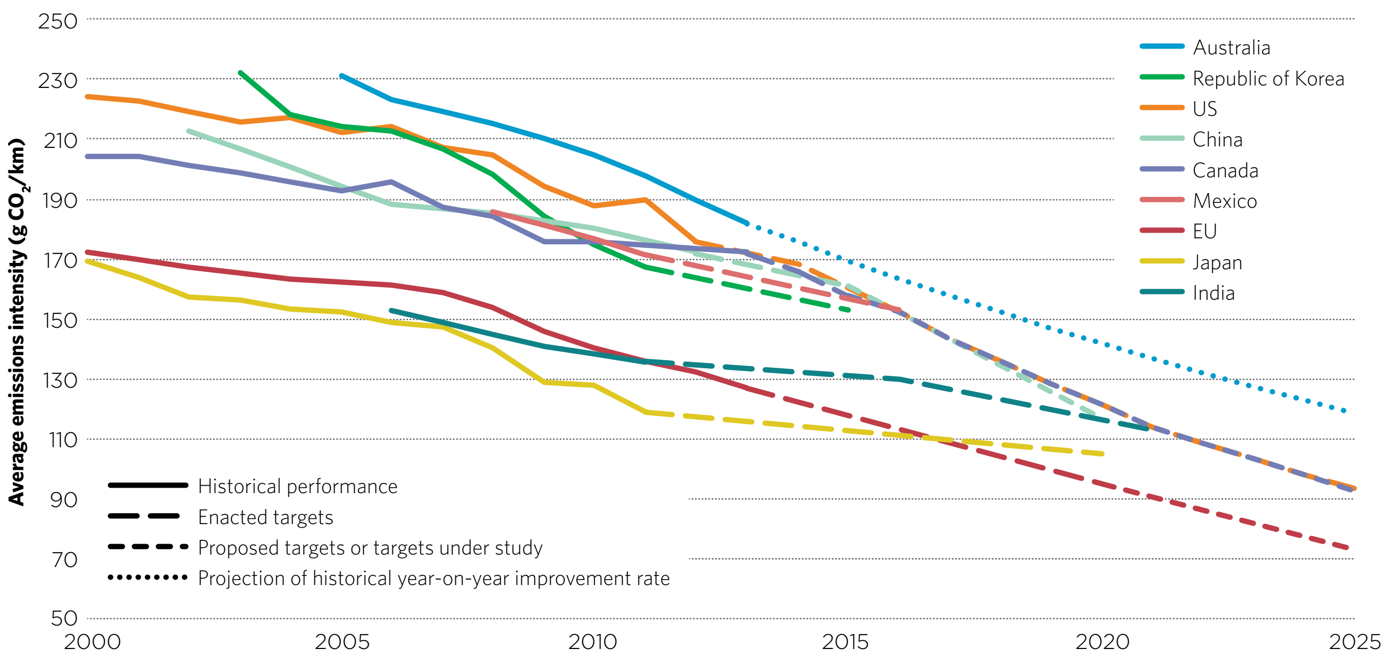
- The EU, the US, Japan and India have targets to at least 2020, with the US and EU having legislated and proposed targets to 2025, respectively. China has legislated targets to 2015 and proposed a 2020 target. Canada has a target for 2016 and has proposed regulations that more or less mirror the US's 2025 target, although they have not yet been adopted.
- The legislated basis of the standard differs between countries. Standards are applied in two forms—as a limit on either greenhouse gas emissions (GHGs) per distanced travelled or fuel consumption per distanced travelled. Some countries are motivated to implement standards to reduce fuel use, some CO_2 emissions, and some both. The direct physical relationship between the two means that both will be achieved regardless.
- Over the period to 2020, the EU and Japan have the most ambitious standards in absolute terms. Standards in China and the US capitalise on the faster rates of reduction possible when starting with a less efficient fleet; their 2020 standards are expected to take these nations from efficiency levels similar to Australia's to levels much closer to the global leaders.
- Countries with the largest vehicle markets, including the US and China, will have to accelerate their average improvement to meet their 2020 targets. The US will need to more than double its historical rate of improvement of 1.9 per cent per year to meet its 2020 target, and China will have to almost triple its historical rate of 2.1 per cent to meet its proposed 2020 target. The EU achieved its 2015 target two years early (EC 2014a); it will still have to improve by 4.1 per cent per year to meet its 2020 target, stepping up to 6.5 per cent per year to meet its proposed 2025 goal. Japan achieved its 2015 target four years early and thus requires a much lower annual reduction rate of 1.4 per cent to meet its 2020 target.
- This general increase in global ambition means that the gap between Australia and others could widen. Between 2009 and 2013, Australia's new passenger vehicle emissions fell at an annualised rate of 3.5 per cent per year—faster than some other major countries. As discussed in Chapter 3, it is difficult to project the extent to which more ambitious standards elsewhere will raise the rate of improvement of Australia's new light vehicle emissions in the absence of standards here. It is reasonable to expect Australia will benefit to some extent, given it already imports almost all its light vehicles, and will become a full importer after 2017. However in the absence of standards, Australia could continue to miss out on the most efficient models and not keep pace with improvements elsewhere. Even if Australia's new passenger vehicle efficiency continued to improve at the rate of the past five years, it would still lag behind other major countries (Figure A.1).

TABLE A.1: GLOBAL COMPARISON OF STANDARDS FOR PASSENGER VEHICLES

JURISDICTION AND FIRST COMPLIANCE YEAR	BASIS FOR STANDARD	FUTURE TARGET YEAR/S	EQUIVALENT CO_2 TARGET (g CO_2/km)	EQUIVALENT FUEL ECONOMY TARGET (L/100km)	ANNUALISED PERCENTAGE REDUCTION (DURING EACH COMPLIANCE PERIOD)^	ANNUALISED PERCENTAGE REDUCTIONS (VARIOUS HISTORICAL PERIODS)
EU 2009	CO_2 emissions	2015 2020* 2025**	130 95 68-78**	5.6 4.1 2.9-3.3	Achieved in 2013 4.1 3.9-6.5	2000-09: 1.8 2009-13: 3.4
United States 1975	Fuel economy and GHG	2020 2025	121 93	5.2 4.0	5.1 5.1	2000-13: 1.9
Japan 1985	Fuel economy	2015 2020	125 105	5.3 4.5	Achieved in 2011 1.4	2000-11: 3.2
Republic of Korea 2006	Fuel economy and GHG	2015	153	6.5	2.2	2003-11: 4.0
China 2004	Fuel economy	2015 2020**	161 117**	6.9 5.0	2.3 6.2	2002-12: 2.1
India 2016	CO_2 emissions	2016 2021	130 113	5.6 4.8	1.2 2.8	2006-12: 1.9
Canada 2011	GHG	2016 2025**	147 93**	6.3 4.0	5.2 5.0	2000-13: 1.3
Mexico 2012	Fuel economy and GHG	2016	153	6.5	3.8	2008-11: 2.6

Note: CO_2 emissions and fuel economy for all standards normalised to European test cycle (NEDC). The coverage of 'passenger vehicles' differs by country—SUVs are included in the EU, Japan, Korea, China and India, and covered under 'light trucks' in North America. All countries except Korea and India also have targets for light commercial vehicles (or light trucks). ^For current compliance periods, annualised rate of reduction is calculated from 2013; EU 2020 target is calculated from 2013; Japan 2020 target is calculated from 2011; India 2016 target is calculated from 2012. *This target has a one-year phase-in period; 95 per cent of vehicles must comply by 2020 and 100 per cent by 2021. **Denotes target proposed or in development; Canada follows the US 2025 target in its proposal, but the final target value would be based on the projected fleet footprints. GHG is greenhouse gases.
Source: Adapted from ICCT 2014 and official sources listed under References

FIGURE A.1: PASSENGER VEHICLE CO_2 EMISSIONS INTENSITY, SELECTED COUNTRIES, 2000–25



Note: CO_2 emissions and fuel economy for all standards normalised to European test cycle (NEDC). The coverage of 'passenger vehicles' differs by country; SUVs are included in the EU, Japan, Republic of Korea, China and India, and covered under 'light trucks' in North America and Mexico. The EU met its 2015 target in 2013, so the EU trajectory to its next target year (2020) is a straight line from actual 2013 new passenger vehicle emissions intensity to the 2020 target; Japan, which met its 2015 target in 2011, has a similar approach. EU 2025 target is a mid-point between proposed targets of between 68 and 78 g CO_2/km. The BAU projection for Australia is the rate of passenger vehicle improvement recorded from 2009–13 (3.5 per cent).
Source: Adapted from ICCT 2014 and, for Australia, NTC 2014

A.3 DESIGN FEATURES FOR VEHICLE EMISSIONS STANDARDS—INTERNATIONAL PRACTICE

Chapter 5 set out the design choices that Australia must make to implement a standard. This section summarises the practices in other jurisdictions to help inform Australia's choices. There is some variation in the design of vehicle emissions standards in other countries, and both the similarities and differences between countries are informative for Australia. As standards are implemented in both developed and emerging markets, much of the variation reflects different appetites for more flexible but potentially more administratively complex designs; there is also evidence of convergence across countries on some major issues such as a fleet-average approach to standards. Table A.2 at the end of this appendix provides a detailed comparison between the top four light vehicle markets of each of these design choices.

A.3.1 COVERAGE AND LIABILITY

A.3.1.1 COVERAGE

All light vehicle emissions standards applied in other countries cover passenger vehicles at a minimum; most also cover light commercial vehicles. Upper weight limits are usually set to differentiate passenger vehicles and light commercial vehicles from heavy trucks and coaches. The classification and delineation of vehicle boundaries differs between countries. For example, larger vehicles such as four-wheel drive and sports utility vehicles (SUVs) are classified as passenger vehicles in some countries and as light trucks or light commercial vehicles in others.

All countries analysed that have targets for both passenger vehicles and light commercial vehicles (or light duty trucks) have 'split' targets. Under split targets, the light commercial vehicle category, which is usually larger and/or heavier, has a higher emissions intensity level target than passenger vehicles. Other countries regulate passenger vehicles only and have an upper weight limit. While split targets recognise the practical differences between different vehicles, the same outcome can be achieved under a single target (see Chapter 5 for further discussion).

A.3.1.2 LIABILITY AND EXEMPTIONS

Vehicle manufacturers are generally vertically integrated global businesses and, in each of the schemes analysed, liability rests with the domestic parent company, or manufacturer's agent, rather than (say) distributors, individual factories or sales offices. The EU permits suppliers to 'pool' their fleets to meet a combined target. Many countries have exemptions for small manufacturers and some exempt particular types of low-emissions vehicles.

In the EU and US, weaker targets are available for manufacturers producing small volumes of cars, which are applied upon application. In addition, in the US, those with fewer than 1,000 employees are automatically exempt from liability.

A.3.2 STANDARD DESIGN AND MEASUREMENT

A.3.2.1 ATTRIBUTE OPTIONS

All countries analysed have adopted an attribute-based approach, where the target for a vehicle is defined relative to a vehicle attribute. The two types of attribute used are vehicle mass (the weight of the vehicle) or vehicle size (usually measured as 'footprint'). While mass is more strongly correlated to fuel consumption, footprint is considered to better relate to consumer utility, and facilitates a more technology-neutral approach to compliance (see Chapter 5).

The EU, the US and China have implemented corporate average targets, so a manufacturer can produce new vehicles that fall short of the standard if they also produce models that surpass it. Japan will move to a corporate average approach for its 2020 target.

- The EU uses a mass-based corporate average target for each supplier. The EU did consider a footprint approach for its 2020 targets, but continued with the mass attribute due to limited availability of footprint data at the time the standard was set. It recommended that the footprint attribute should be considered in a future review (EC 2014b, L 103/15).
- North American countries have adopted a footprint-based approach to corporate average targets.
- Japan currently uses an approach that sets mass targets by class, but is shifting to mass-based corporate average targets for its 2020 target (Government of Japan 2011). The current system identifies the most fuel-efficient automobile in each weight class and designates it the 'top runner'. Fuel consumption targets are then set at the level of the top runner. All other vehicles are required to surpass the new target values for their weight class within three to 10 years.
- China has corporate average mass-based targets. It adopted a corporate average approach in 2012 for its Phase III standards to 2015, and is expected to use the same approach for its 2020 target. The IEA has reported concerns that a shift to heavier vehicles is occurring under the current approach (IEA 2012b, p. 26). As discussed in Chapter 5, mass-based standards can remove the incentive to reduce vehicle weight to comply with standards.

A.3.2.2 BASIS OF STANDARD AND CO_2 EMISSIONS AND FUEL CONSUMPTION TESTING

The major countries with standards in place use the data from laboratory testing of CO_2 emissions and fuel consumption to underpin the standards. Varying types of laboratory testing are used around the world, but in each country a single test is used for CO_2 emissions and fuel economy standards, as well as for testing compliance with air quality standards. The two main test types are the New European Drive Cycle (NEDC) and the US Federal Test Procedure (FTP-75). The EU, Australia, China and India use the EU test; the US, Korea, Canada and Mexico use the US test. Both are 'combined cycle' tests; that is, CO_2 emissions and fuel consumption of each model are measured under simulated urban and non-urban conditions and the results are combined.

A.3.3 TIMING AND COMPLIANCE

A.3.3.1 TIMING

There are a number of different options for compliance, with a spectrum ranging from annual to periodic compliance; other variations, such as cumulative compliance over a number of years, are also possible. The US requires annual compliance with its targets, and China set specific interim targets between 2012 and 2015 under its Phase III standards. The EU and Japan do not have interim targets for their 2015 and 2020 targets, although the EU recently announced a one-year phase-in period for its 2020 target (EC 2014b). The periodic approach does not mandate an annual rate of improvement. The US approach has provisions for banking and trading (see below) that assist in allowing annual targets to be met at least cost.

A.3.3.2 FLEXIBILITY MECHANISMS—BANKING, BORROWING AND TRADING

All major markets have some flexibility mechanisms that lower the costs to suppliers of meeting targets:

- The US permits liable parties to bank previously accrued credits and trade excess credits with other parties (within specified time frames). It also allows liable parties to borrow from future years to meet compliance obligations.
- The EU standards allow manufacturers to 'pool' their emissions under certain conditions, which in effect is like a trading system.
- Under its Phase III standards, China allows banking of excess credits achieved in a compliance year and they can be used within the phase period (2012–15).
- Japan currently allows manufacturers to 'pass' credits between their own models in different weight classes. For example, credit given for a model that surpasses its weight-class target can be passed to a model in another weight class to help meet its target.

Additional incentives are used in other countries to encourage the supply of more efficient vehicles.

'Multipliers' are awarded to vehicles that satisfy low-emissions benchmarks or use specific technologies or fuels claimed to reduce CO_2 emissions relative to conventional vehicles. Technology or fuel-specific adjustments apply in the US, China and the EU. In the US, multipliers for specified alternative drivetrains start at 2.0 in 2017 and decline to 1.5 by 2021. In the EU, the target for vehicles capable of using 85 per cent ethanol (E85) is reduced by 5 per cent. Multipliers for vehicles below a specific low-emissions benchmark are given to vehicles in the EU and China. For example, the EU awards 'super-credits' for sub-50 g CO_2/km vehicles. These started at 3.5 in 2012 and decline each year to zero additional credit by 2016; they will start again at 2.0 in 2020, declining to zero additional credit in 2023.

'Off-cycle' credits are awarded for emissions-reducing technologies whose contributions are measurable but not covered by test cycles. The EU and US award off-cycle credits for technologies such as efficient lights, solar panel charging and active aerodynamics. The US also awards credits for improvements to air-conditioning systems. The emissions intensity of eligible models is effectively reduced by the number of credits they receive, making the standard easier to achieve. Limits are applied in both the EU and US, largely because of limited data about, and difficulties in testing, the emissions performance of these technologies.

A.3.3.3 PENALTIES

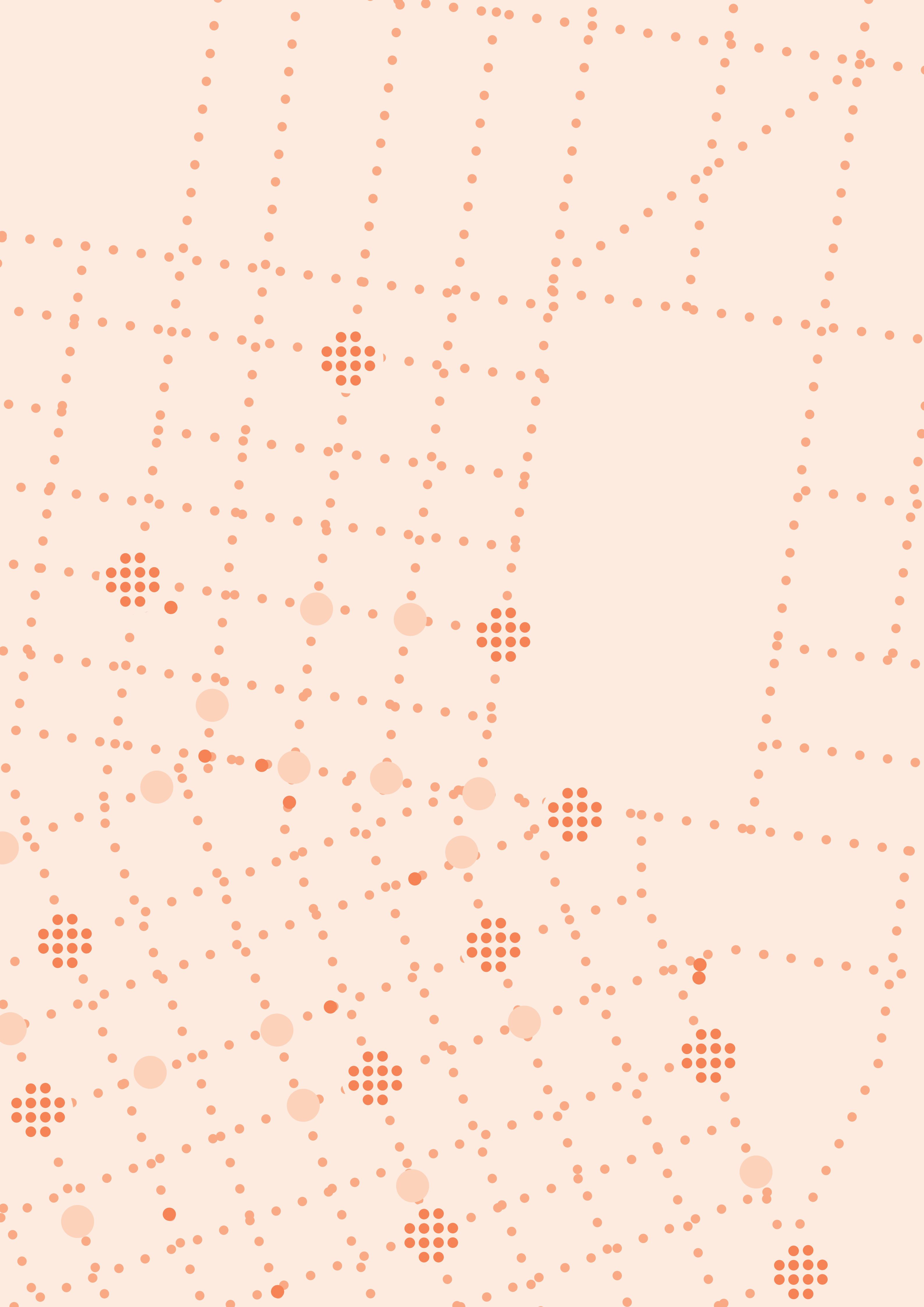
All countries with standards employ some type of penalty for non-compliance, with the form and stringency of penalties varying across countries.

- In the US and EU, a financial penalty applies and is based on each unit (g CO_2 per km or mile) over the target, multiplied by every non-compliant model sold by a manufacturer (in the US) or all models sold by a manufacturer (in the EU).
- Financial penalties are lower in Japan with a penalty of ¥1 million (about AUD$10,800), which is not tied to the extent of non-compliance. Suppliers are also required to announce publicly that they have failed to meet the target.
- There are no financial penalties in China; manufacturers are punished through a large loss of flexibility in future compliance. If a manufacturer does not achieve its corporate-average target in a given year, models that do not meet their individual weight-based target cannot be sold the next year. In addition, as in Japan, suppliers are required to publicly announce non-compliance.

TABLE A.2: COMPARISON OF VEHICLE EMISSIONS STANDARD DESIGN FEATURES IN TOP FOUR MARKETS

COUNTRY	BASIS OF STANDARD	COVERAGE	LIABILITY	TARGET; APPROACH	TEST PROCEDURE	TIMING	FLEXIBILITY—BANKING, BORROWING AND TRADING	PENALTIES	ADDITIONAL CREDITS AND OTHER INCENTIVES
EU	CO_2	Passenger (includes SUVs), light commercial vehicles	• <10,000 vehicles produced can apply for a derogation (partial or full exemption) • 5% higher target for E85 vehicles • Manufacturer pooling allowed	Split; vehicle mass	NEDC	Periodic	Manufacturers are allowed to pool together to meet a combined target	€95 for each gram above target multiplied by all models sold. Called 'excess emissions premium'	• Multipliers for vehicles under 50 g CO_2/km of 3.5 down to 1 between 2012 and 2016, and 2 down to 1 between 2020 and 2023 • Can apply for 'eco-innovations' up to 7 g CO_2/km—e.g., LEDs, advanced alternators, improved battery systems
United States	Fuel economy and GHG	Passenger, Light-duty trucks (includes SUVs)	• <50,000 vehicles can apply for less stringent targets until 2016, and transitional leniency until 2021 • <5,000 vehicles produced can be exempt at least until 2017 • <1,000 employees default exemption	Split; vehicle footprint	US combined	Annual	Credits may be carried forward or banked up to 5 years, or carried back 3 years to cover a deficit (see 'penalties')	US$5.50 for each 10th of a mpg of each new vehicle sold above target. The ability to 'carry back' credits (see 'banking') effectively means penalties can be avoided if deficits are made up within 3 years	• Plug-in hybrid electric vehicles (PHEVs) zero carbon-rated • Multiplier for alternative drivetrain vehicles of 2 down to 1.5 between 2017 and 2021 • Additional credit for improvements to AC systems • Off-cycle credits given for solar panel charging, engine start-stop or active aerodynamics. Pre-approved list for 2014 and later
Japan	Fuel economy	Passenger		Split; vehicle mass	JC08	Periodic	Suppliers can 'pass' credits between their own models in different weight classes	Public announcement and single penalty of up to ¥1 million	• PHEVs zero carbon rated
China	Fuel economy	Passenger and SUVs		Fleet-wide, vehicle mass	NEDC	Annual	Banking: excess credits achieved in a compliance year can be used within the phase period (2012–15)	Models that do not meet their category target cannot be sold the following year. Public announcement also required	• Electric vehicles (EVs), PHEVs and fuel cell vehicles (FCVs) with at least 50 km electric range are zero fuel consumption-rated and counted 5 times • Multiplier of 3 for 'super-efficient vehicles' (not including EVs and FCVs) less than 2.8L/100 km fuel consumption

Source: Adapted from ICCT 2014 and official sources listed under References



B

MODELLING AND APPROACH TO COSTS AND BENEFITS OF STANDARDS

B.1 INTRODUCTION

This appendix outlines the Authority's approach to assessing the benefits and costs of implementing fleet-average CO_2 emission standards for light vehicles in Australia. It includes an overview of the modelling commissioned from the CSIRO to investigate the impacts of standards. The results are used in Chapter 4.

The Authority has conducted an indicative assessment of the net private and net social benefits of these standards using a combination of commissioned modelling and additional economic evidence. This work aims to provide a good starting point for a full cost-benefit analysis required for any regulatory impact statement.

The Authority has not developed an Australia-specific estimate of the incremental cost of different standards. Instead, the cost estimate is based on international studies of the costs of fuel-saving technologies necessary to meet similar standards. These international estimates isolate the incremental costs of fuel-saving technologies from other vehicle features that contribute to driver utility. The estimates of fuel savings and emissions reductions from the standards have been calculated directly by the Authority using the modelling discussed here. These estimates necessarily involve making assumptions about a range of inputs, informed by the available evidence. Where a clear central estimate is not available, the Authority has attempted to err on the side of choices that would underestimate the benefits available from standards.

This appendix outlines:

- the modelling commissioned to analyse standards, and the BAU and standards scenarios analysed (B.2)
- details of the approach to estimating fuel savings and the impact on vehicle costs (B.3)
- details of the approach to estimating the cost of emissions reductions from standards (B.4).

B.2 CSIRO MODELLING AND SCENARIOS

The Authority commissioned modelling from the CSIRO (Reedman and Graham 2013b) to explore the potential benefits of standards; in particular, fuel savings and emissions reductions. The starting point for the modelling is the BAU projection describing what would happen in the absence of standards. Six different standards scenarios are then modelled—a lenient, medium and strong standard starting in either 2018 or 2025. The results are compared with BAU to identify the benefit of each standard.

B.2.1 CSIRO MODELLING OF LIGHT VEHICLE EMISSIONS STANDARDS

Reedman and Graham use the CSIRO's Energy Sector Model (ESM) to investigate the impacts of standards. The ESM (see Box B.1) determines the least-cost fuel and vehicle mix to meet a given transport demand, subject to constraints such as policy, vehicle class preferences and vehicle stock turnover.

The analysis of standards forms part of a larger transport emissions projections exercise (Reedman and Graham 2013a) conducted for the Authority's Targets and Progress Review, the assumptions for which were subject to public consultation at the start of 2013.

When interpreting the modelling results, the Authority has taken into account the difference between actual and 'tested' new light vehicle emissions intensity, which make the CSIRO projections for new light vehicle emissions intensity appear higher than in some other sources.

The CSIRO model estimates actual new light vehicle emissions intensity, calculated from public data on fuel consumption, vehicle sales and emissions intensity of fuels (Graham 2014). In contrast, 'test cycle' readings of new light vehicle emissions intensity, such as those published by the National Transport Commission, are the result of laboratory testing of new vehicles' emissions intensity. The CSIRO's analysis of the difference between its estimates and those measured by the test cycle over the last decade indicates the CSIRO's estimates are, on average, about 5 per cent higher than test cycle intensity.

Because a mandatory standard would set a target level for test cycle rather than actual emissions intensity, the Authority has incorporated this adjustment when making findings on the level of a light vehicle emissions standard for Australia (Chapter 4). Throughout the report, the unadjusted CSIRO estimates of actual new light vehicle emissions intensity are described as 'measured,' and projections for new light vehicle emissions intensity intended to correspond to the results of vehicle testing are described as 'tested'.

In this analysis, the Authority focuses on the projected impacts of standards to 2030. The CSIRO modelling contains projections of the impacts of standards commencing in 2018 and 2025 over the period to 2050. Over longer time horizons, it is increasingly difficult to project what technologies might exist, their rate of deployment in new vehicles, the relative cost and emissions performance of those technologies, and fuel prices that may influence fuel consumption and emissions outcomes.

For a full account of the modelling, see Reedman and Graham (2013b).

BOX B.1: THE CSIRO'S ENERGY SECTOR MODEL

To model the emissions reduction potential of light vehicle emissions standards, the CSIRO uses its Energy Sector Model (ESM). The ESM assumes vehicle owners make the least-cost vehicle choices to meet a given transport task. Consumers are assumed to purchase alternative fuel or engine vehicle technology if the discounted payback from the fuel savings offsets any additional upfront costs within five years. Inputs include projected rates of improvement in the fuel efficiency of internal combustion engines and consumer preferences about vehicle sizes. Outputs include the fuels consumed (such as petrol, diesel and LPG, and their associated spark or compression ignition engines types), and the drivetrains chosen, including internal combustion engine, hybrid, electric and fuel cell drive. In addition to the cost of alternative fuels and vehicles, ESM incorporates detailed fuel and vehicle technical performance characterisations such as fuel efficiencies and emission factors by vehicle type, engine type and age.

For this exercise, demand for road transport in the BAU scenario was determined in the Monash Multi-Regional Forecasting Model, taking into account population growth, projected output of industries and changes in the cost structure of road transport.

Demand in the standards cases was determined in the ESM by allowing changes in the overall cost of travel due to standards to affect the level of travel demand (that is, by incorporating a 'rebound effect'). The value of the rebound in the ESM is 0.2, meaning that there is a 0.2 per cent increase in demand for every 1 per cent fall in the overall cost of travel. Estimates of the value of the rebound effect in road transport vary; the value used in the ESM is broadly equivalent to the mean of international estimates (NHTSA 2012, p. 853).

Fuel prices are the same across the BAU and standards scenarios. Australian retail prices are projected by applying a method for translating oil and gas paths into retail fuel prices, which includes assumptions about future excise rates by fuel (see Reedman and Graham 2013a, pp. 28–31). The oil price path is based on the IEA's *2012 World Energy Outlook*, which grows in real terms by 61 per cent over 2013–30 (Treasury and DIICCSRTE 2013, p. 59). Consistent with this outlook for oil prices, retail petrol prices are projected to increase by 24 per cent in real terms over the same period (Reedman and Graham 2013a, p. 30), taking into account the outlook for other components of the retail price, including fuel excise. The excise rates do not reflect the increases announced in the 2014–15 Budget. With higher real excise, fuel prices would be higher in all scenarios, and the fuel savings for consumers from standards would most likely be larger than the estimates provided here.

The ESM assumes a linear change in fuel consumption in response to changes in activity. There is an assumption that average activity per vehicle plateaus after 2030, after which demand for passenger transport grows in response to population growth. This approach implicitly accounts for a typical vehicle in Australian traffic conditions over time.

As with all models, there are limitations, including to assumptions for parameters that are in reality uncertain and in some cases evolving rapidly (for example, advanced biofuels and the cost and driving range of future electric vehicles). As the ESM considers cost as the only driver of consumer choice, it cannot capture behaviour driven by other factors. This could result in either underestimating or overestimating rates of adoption of some new technologies or fuels, depending on whether these non-price factors encourage or discourage adoption.

The way in which standards are introduced in the ESM is described in B.3.3. Further information on the ESM is provided in Reedman and Graham (2013a).

B.2.2 ASSUMPTIONS ABOUT BAU REDUCTIONS IN EMISSIONS INTENSITY

Projected emissions under BAU depend on the rate of improvement in new light vehicle fuel efficiency that would occur without standards. As discussed in Chapter 3, two factors complicate the projection of BAU improvements in new Australian light vehicles:

- Recent rates of improvement have been rapid relative to Australia's earlier history, but it is unclear whether these rates will be sustained.
- Mandatory vehicle emissions standards in other countries will become increasingly ambitious over the period to 2025; this will likely make new light Australian vehicles more efficient but the extent of this influence is unclear.

The modelling assumes the BAU rate of reduction in the average emissions intensity of new light vehicles slows from the 2.8 per cent per year observed over the last eight years to 2.0 per cent per year over the period to 2020, and reduces further to 1.6 per cent per year to 2025. This results in average measured emissions intensity of approximately 197 g CO_2/km in 2015, 178 g CO_2/km in 2020 and 164 g CO_2/km in 2025 (Graham 2014).

This projected annual improvement rate is similar to other recent estimates of BAU.

- In 2010, the FCAI commissioned estimates of the BAU of the light vehicle fleet (PWC 2010). The work was based on confidential consultations with vehicle manufacturers operating in Australia to assess both the rate of technology uptake and consumer preferences. It projected that the change in average light vehicle CO_2 emissions intensity would slow from the average of 2.1 per cent (4.3 g CO_2/km per year) achieved from 2002–10 to about 1.9 per cent per year (2.3 g CO_2/km per year) from 2010–20. The average tested emissions intensity of the new light vehicle fleet was projected to be about 195 g CO_2/km in 2015 and 176 g CO_2/km in 2020 under BAU.
- More recently, ClimateWorks's 2014 Briefing Paper *Improving Australia's Light Vehicle Fuel Efficiency* drew on unpublished analysis by Rare Consulting. This used the same path for improvement as the FCAI/PWC analysis, and extended its projection to 2024. With the inclusion of 2011 data, a slightly higher historical rate of improvement of 2.2 per cent was assumed by Rare, and it projected this would slow to about 1.8 per cent per year from 2011–24. The average tested emissions intensity of the new light vehicle fleet was projected to be about 175 g CO_2/km in 2020 and 165 g CO_2/km in 2024 under BAU.
- In its 2011 discussion paper on light vehicle standards, the Department of Infrastructure and Transport proposed a BAU annual improvement of 2.1 per cent or 2.5 per cent over the period to 2015 as a basis for analysing the effects of standards starting in that year.

Table B.1 and Figure B.1 compare the CSIRO, PWC and ClimateWorks projections. The rate of emissions intensity improvement in the CSIRO modelling is similar to the other sources, and all projections are slower than the rate achieved in the past decade.

In this analysis, the Authority has estimated the benefits of standards relative to the BAU rates of reduction in the CSIRO modelling. If BAU rates of improvement are faster than 2 per cent per year, the modelling will overestimate emissions and fuel savings from standards, but will also overstate the effort necessary to achieve any given standard. If BAU rates of improvement are slower than projected, the opposite will be true.

B.2.3 STANDARDS MODELLED FOR THE AUTHORITY

The CSIRO modelled a total of six standards scenarios with three different stringencies—lenient, medium and strong—and two different start years—2018 and 2025 (Reedman and Graham 2013b). These standard scenarios are implemented in the ESM by:

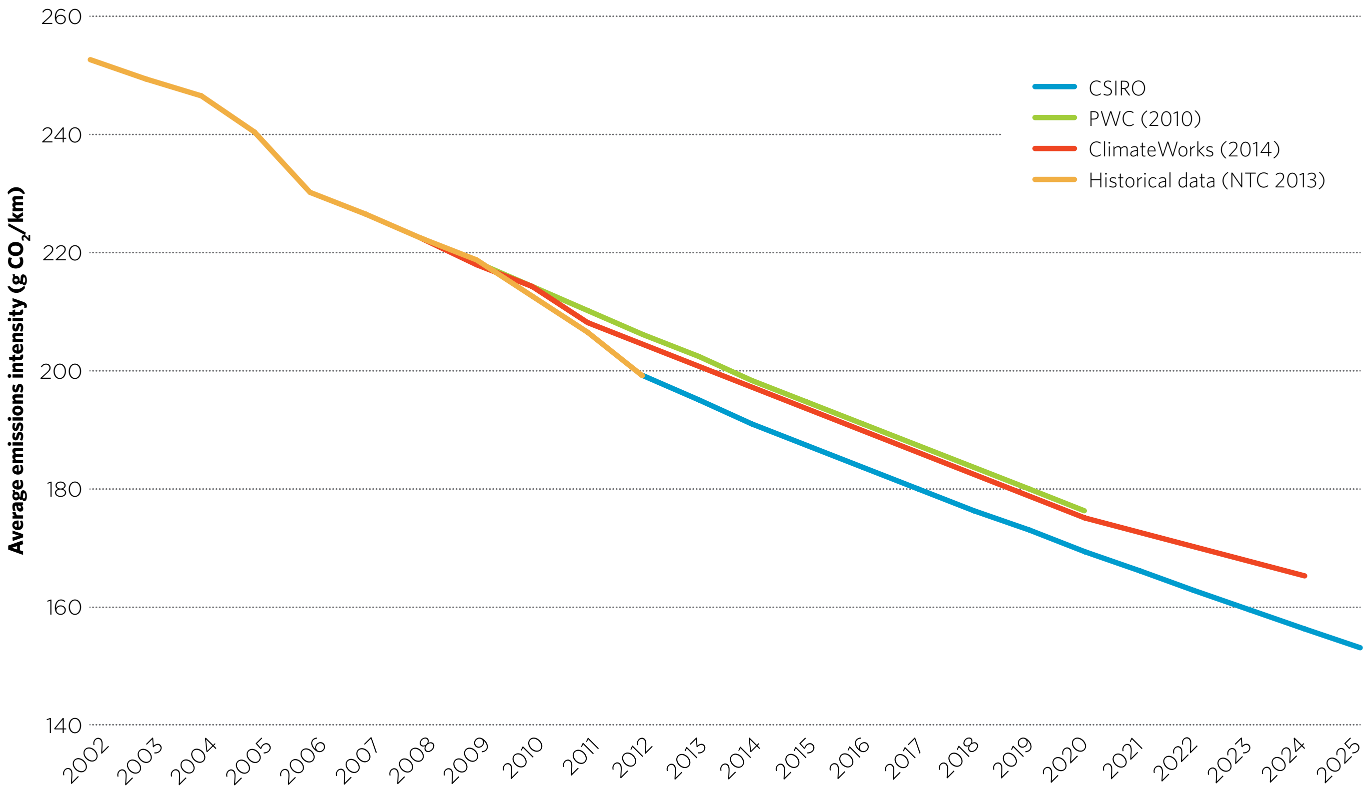
1. Imposing an additional, fixed amount of improvement in the efficiency of petrol internal combustion engine efficiency (3.3 per cent a year, up from 1.3 per cent under BAU). This is assumed to be available with no additional upfront cost to vehicles. Reedman and Graham (2013b, p. 6) draw on analysis in the *2007 King Review* for their assumption that there is a set of fuel-saving changes available to the mass market in the range of $150 to $1,000 for new vehicles using internal combustion engines. Assuming these lower cost fuel savings innovations are introduced in a gradual manner and as a priority over other product features, they conclude that real vehicle prices are not likely to be significantly changed.

TABLE B.1: COMPARISON OF PROJECTED RATES OF LIGHT VEHICLE EMISSIONS INTENSITY IMPROVEMENT, THREE BAU SCENARIOS

SOURCE (YEAR)	ANNUALISED RATE OF CHANGE	TIME PERIOD	RATIONALE
PWC (2010)	-1.9%	2010-20	Industry consultation on technology uptake and consumer preferences
ClimateWorks (2014)	-1.8%	2011-24	Builds on the PWC estimate with updated 2011 data and extended to 2024
CSIRO (2013)	-1.8%	2013-25	Driven by projected improvements in petrol internal combustion engines; some projected changes in preferences

Source: Climate Change Authority based on sources listed in table

FIGURE B.1: HISTORICAL AND PROJECTED RATES OF IMPROVEMENT IN LIGHT VEHICLE EMISSIONS INTENSITY, THREE BAU SCENARIOS



Note: CSIRO-projected BAU levels are converted to test cycle from measured emissions; other sources project test cycle emissions intensity. See Section B.2.1 for further discussion.
Source: Climate Change Authority (from sources listed in legend)

2. Allowing the most cost-effective deployment of alternative drivetrains and use of diesel vehicles to achieve the remainder of the emissions standard. To meet the required standards, the model ensures consumers adopt vehicles, even if the payback period is longer than the five years typically specified in the model as the basis for consumer choice.

The modelling assumes that standards have no effect on consumer preferences for vehicle size. Under both BAU and standards scenarios, smaller vehicles increase their share of the passenger vehicle market at the expense of larger and, to a lesser extent, medium vehicles (Reedman and Graham 2013b, p. 5).

Table B.2 shows average annual light vehicle emissions intensity associated with the BAU scenario and standards starting in 2018, along with the approximate corresponding test cycle level of emissions intensity.

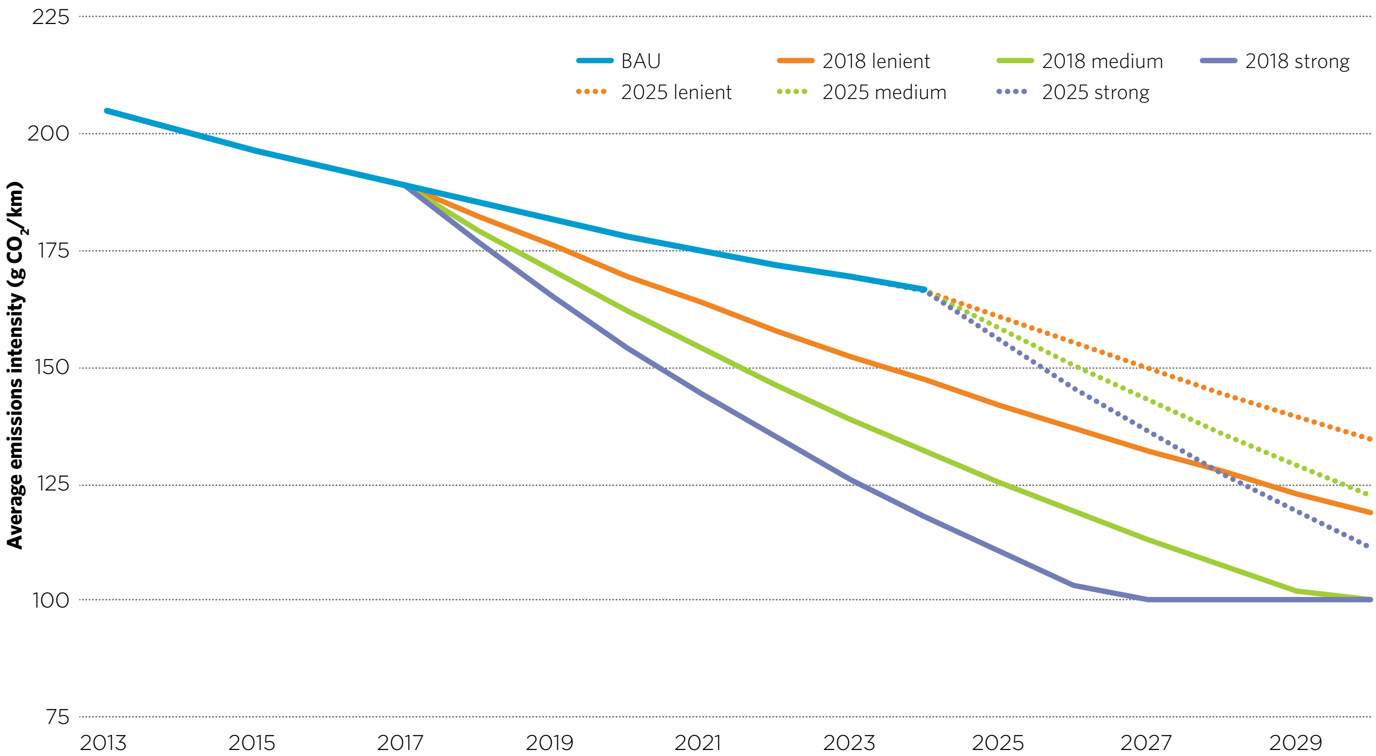
All standards modelled by the CSIRO are illustrated in Figure B.2. The figure shows that all of the standards assume sustained improvement until the average measured emissions intensity of new light vehicles reaches 100 g CO_2/km, after which no further reductions in emissions intensity occur. While it has no practical impact on the modelling, this may be a conservative limit—it is equivalent to a tested target of around 95 g CO_2/km, which is the 2020 EU target for passenger vehicles. While it would be more difficult to meet this target for all light vehicles (rather than just passenger vehicles), the EU is considering a 2025 passenger vehicle target of between 68 and 78 g CO_2/km (ICCT 2013c), suggesting average new light vehicle limits below 100 g CO_2/km are feasible.

TABLE B.2: STANDARDS MODELLED STARTING IN 2018—AVERAGE MEASURED (AND APPROXIMATE TEST CYCLE) EMISSIONS INTENSITY LEVELS, NEW LIGHT VEHICLES, SELECTED YEARS

SCENARIO	2018	2020	2025
BAU (2 per cent 2013–20; 1.6 per cent 2021–25)	185 (176)	178 (169)	164 (156)
Lenient (3.5 per cent from 2018)	182 (174)	170 (162)	142 (135)
Medium (5 per cent from 2018)	179 (171)	162 (154)	125 (119)
Strong (6.5 per cent from 2018)	177 (168)	154 (147)	110 (105)

Note: Measured new light vehicle emissions intensities are estimated to be about 5 per cent higher than test cycle emissions intensities. See Section B.2.1 for further details.
Source: Reedman and Graham 2013b

FIGURE B.2: STANDARDS MODELLED—AVERAGE MEASURED EMISSIONS INTENSITY LEVELS FROM NEW LIGHT VEHICLES, STANDARDS STARTING IN 2018 OR 2025



Note: This graph differs from Figure 2.2 in Reedman and Graham 2013b; this version corrects the BAU rate of new light vehicle emissions intensity and levels for the standards cases. This figure shows measured new light vehicle emissions intensities that are estimated to be about 5 per cent higher than test cycle emissions intensities. See Section B.2.1 for further details.
Source: Climate Change Authority based on Reedman and Graham 2013b and Graham 2014

B.3 ESTIMATING THE NET IMPACTS OF STANDARDS

B.3.1 FUEL SAVINGS FROM LIGHT VEHICLE EMISSIONS STANDARDS

The estimates of fuel savings in Chapter 4 for each standards scenario are calculated as follows:

1. Determine total fuel savings each year by calculating the difference between the modelled total fuel spend under standards and BAU.
2. Calculate the amount of total fuel savings in (1) that come from new vehicles of each model year subject to standards, by subtracting total fuel savings in the current year from the previous year. Note that if vehicles have an average life of 15 years in the stock, the first vehicles subject to standards would exit the fleet in 2033 on average, which is beyond the end of the first phase of standards. This means that it is acceptable to ascribe all of the annual change in fuel savings to the new vehicles subject to standards that entered the fleet that year, rather than to a combination of entry and exit.
3. Calculate the average annual savings from the first year of ownership for vehicles from each model year by dividing the results in (2) by the number of new light vehicles purchased in each year.
4. Calculate the present value of fuel savings for the first owner and the vehicle's life for a vehicle bought in each year under standards, by:
   a. Growing average annual savings in (3) by the rate of real fuel price growth in each scenario (to adjust the fuel savings for rising real fuel prices over time).
   b. Taking the present value by discounting the stream of annual fuel savings in (a), and summing the discounted savings over three or five years (for the first vehicle owner) or 15 years (for the vehicle's life).

For private net benefits, the calculations use the full retail fuel prices including excise; for social net benefits, these calculations exclude excise because this is a transfer at the economy-wide level (from consumers to government).

While vehicles may spend longer in the stock, the assumption of 15 years provides a conservative estimate of the fuel savings from standards; longer vehicle lives would mean higher fuel savings, if other things were equal. The discount rate of 7 per cent per year is the default discount rate for discounting private benefits in Commonwealth assessments of regulatory impacts (OBPR 2013).

The fuel spending in Reedman and Graham is in 2010 Australian dollars (Graham 2014). Along with all other monetary values in this report, fuel savings are in real 2012 Australian dollars unless indicated. The fuel savings were inflated to 2012 values using the RBA's inflation calculator (inflation over the two years of 5.1 per cent (RBA 2014)).

B.3.2 IMPACT OF STANDARDS ON VEHICLE COSTS

The estimates of the incremental costs of US standards in Table 4.2 are the estimated incremental costs for passenger vehicles and light trucks (NHSTA 2012), weighted by the Authority to create an estimate of incremental costs for all light vehicles.

In the US, SUVs are classified as 'light trucks' (light commercial vehicles) while in Australia they are classified as passenger vehicles. Because the US incremental costs are used as an estimate of the incremental cost of meeting a similar standard in Australia, they are combined using weights that make some adjustment for this difference in classification—passenger vehicles receive a weight of 70 per cent, rather than their share of the Australian market according to Australian classifications (about 80 per cent). While SUVs make up about 30 per cent of the Australian market (Chapter 2), NHSTA estimates indicate costs for light trucks are lower than for passenger vehicles, so the Authority's weights err on the side of overestimating the incremental costs.

The additional vehicle costs for the US and EU in Table 4.2 were converted to Australian dollars in two steps:

1. Both the EU and US sources reported incremental costs in 2010 units of their respective currencies. These costs were converted to 2010 AUD using the average annual exchange rate for 2010 reported by the RBA: AUD$1=US$0.92 and AUD$1=€0.70.
2. The converted figures were inflated to 2012 values using RBA 2014, and rounded to the nearest $10.

These US costs were then weighted as described above to generate the estimated incremental cost for all light vehicles. These costs are estimates of the incremental production costs associated with meeting standards and do not include smaller components of the overall cost of owning a new vehicle that might rise with higher vehicle purchase prices, such as insurance premiums.

As mentioned in Chapter 4, the increase in retail prices may be lower if not all of the cost of the increase in vehicle production costs resulting from production changes to meet the standard is passed through to consumers. Vehicle suppliers might absorb some of the increase over the short term to gain market share, or over the longer term if competition in vehicle markets was imperfect and suppliers could 'price to market' by adjusting vehicle prices in separate geographical markets to maximise overall profits. The proportion passed through to consumers in Australia would depend on a range of factors, including competition in the market and the extent to which a rise in vehicle prices will affect consumers' purchasing decisions. In this context, it is worth noting that by international standards, the Australian new vehicle market offers a large number of models to consumers, increasing competitive pressure on suppliers. The RBA's analysis of cost pass-through following changes in the exchange rate provides some evidence of pricing to market for Australian imports as a whole. While the proposition of full pass-through was not always rejected in statistical tests, the analysis suggests that exchange rate changes are passed through rapidly and, to a large but incomplete extent, into import prices. An estimated 80 per cent of a change in exchange rates is passed through, with the total effect occurring within one quarter (Cheung et al. 2011, pp. 10–11).

B.4 EMISSIONS REDUCTIONS FROM STANDARDS

B.4.1 EMISSIONS REDUCTIONS FROM 2018–25 STANDARDS

The cumulative emissions reductions in Figure 4.8 are for reductions from vehicles subject to the first phase of standards proposed by the Authority (2018–25). They are reported in carbon dioxide equivalent (Mt CO_2-e) and include CO_2, methane and nitrous oxide emissions. The CSIRO modelling assumes that standards continue past 2025 (see Figure B.2). The Authority has therefore calculated cumulative emissions reductions to 2030 from the first phase of standards by summing the cumulative emissions reductions from standards over 2018–25 and the average annual emissions reductions that vehicles from those model years would deliver over the period 2026–30.

B.4.2 APPROACH TO ESTIMATING THE VALUE OF EMISSIONS REDUCTIONS

The cost per tonne of emissions reductions from standards discussed in Chapter 4 were determined using the Authority's general approach to calculating the cost per tonne of emissions reductions—dividing the net present value of the incremental resource cost by the stream of resulting emissions reductions. In the case of vehicle standards this becomes:

> Cost per tonne of emissions reductions for each model year ($/t) =
>
> net present value of incremental costs from standards for model year ($) / stream of (undiscounted) emissions reductions from vehicles of model year over their life (t)

The net present value of the incremental costs from standards are equal to the incremental capital costs minus the present value of the fuel savings (excluding excise); these are taken from international evidence and the Authority's calculations as described in B.3.1 and B.3.2, respectively. The incremental costs and fuel savings per vehicle calculated above are multiplied by the number of vehicles sold in each model year to obtain economy-wide costs for each year per model year.

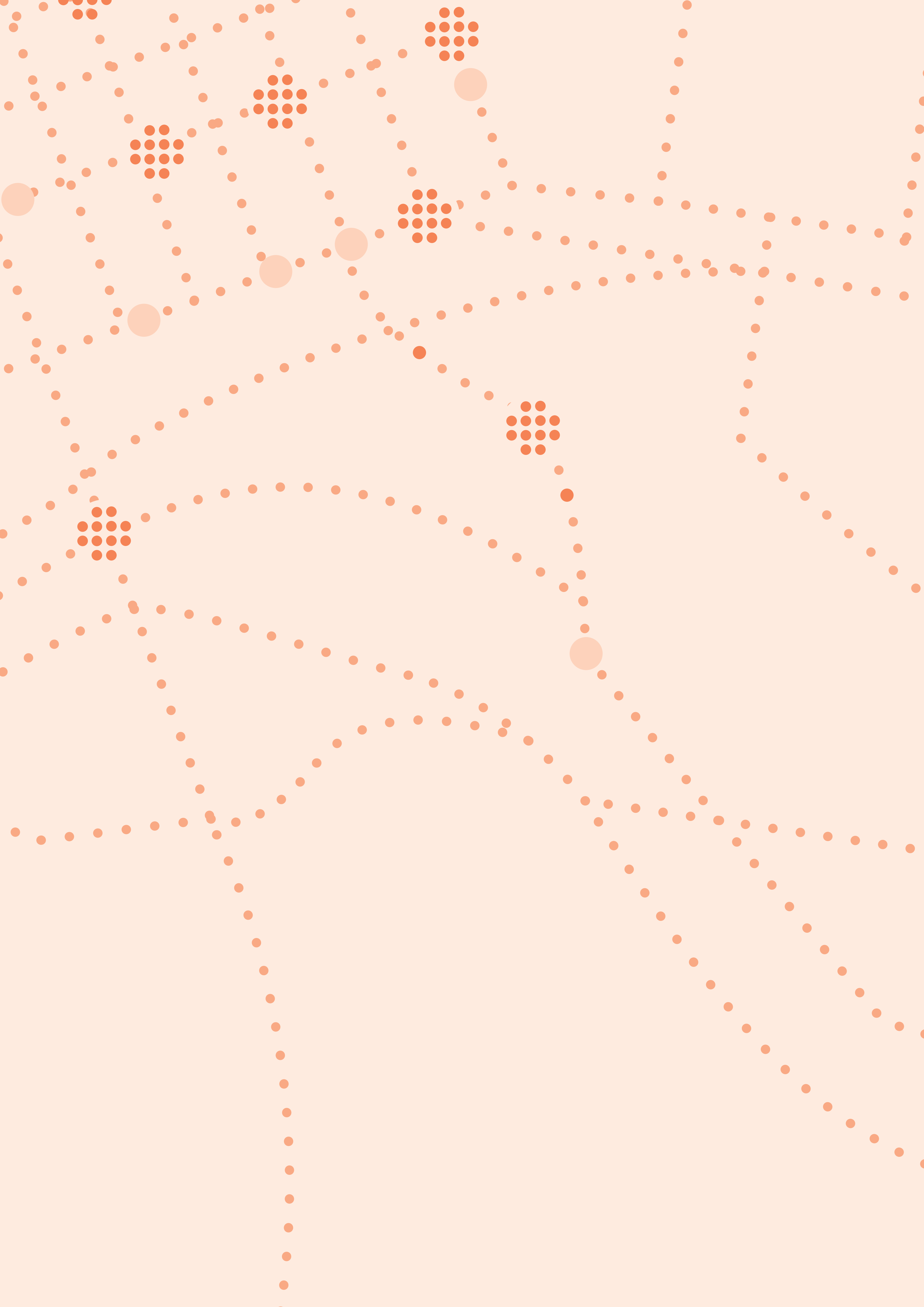
The stream of undiscounted emissions reductions are Authority calculations from the CSIRO modelling. These are the product of:

- the difference in new light vehicle emissions intensity between standards and BAU for each model year (g CO_2/km)
- the weighted average distance travelled per vehicle per year (vehicle kilometres per year)
- vehicle life (assumed to be 15 years)
- the number of vehicles sold each year.

The resulting estimate of –$580 per tonne of avoided emissions is the average of the cost per tonne over the model years 2020–25. Model years 2018 and 2019 are excluded from this average because the incremental capital costs are sourced from the US, and the Authority's strong standard starting in 2018 is most similar to the US standard from 2020 onwards (see Figure 4.1.)

The Authority's approach is conceptually similar to that of ClimateWorks in its cost curve analysis, with the difference that ClimateWorks looks at a particular year rather than computing net present values of the stream of costs and benefits. Its estimate of a –$350 per tonne private cost provides a 'snapshot' of the cost of emissions reductions in 2020 by dividing the net cost in 2020 by the emissions reductions in 2020 (ClimateWorks 2014).

There are some published estimates of higher positive costs of emissions reductions from standards. These are generally not estimates of the cost-effectiveness for society as a whole. For example, Frondel, Schmidt and Vance (2008, pp .8–9; cited by FCAI 2011c, p. 14) calculate the cost per tonne of emissions reductions from the EU standard as €100 to €200 per tonne for the standards to 2015, and €475 to €900 per tonne after 2015. The approach attempts to calculate the cost-effectiveness of standards for society as a whole from the cost per tonne to liable parties for non-compliance. In fact, the result is neither an upper bound on the compliance cost per tonne for liable parties, nor an estimate of the net benefit per tonne to society as a whole. It is therefore not informative about the potential costs of emissions reductions from vehicle standards in Australia.



C

DESIGN CHOICES

Chapter 5 sets out the Authority's analysis of the design of a light vehicle emissions standard for Australia. This appendix outlines the underlying analysis and evaluation of the policy design options:

- C.1—Coverage and liability
- C.2—Standard design and measurement
- C.3—Timing and compliance.

As outlined in Section 5.1, the Authority used a simple framework to evaluate the design options:

Environmental effectiveness—the standard should ensure that the emissions intensity of new light and commercial vehicles is reduced. The standard should contribute to the overall reduction of transport emissions intensity.

Administrative and regulatory burden—the standard should be low cost, and simple for government to administer and for industry to comply with. It should draw on existing governance and regulatory structures where possible.

Equity—the standard should ensure, to the extent possible, equity in the compliance burden placed on manufacturers with a diverse product mix.

Policy stability and credibility—the standard should minimise opportunities for gaming, avoidance and market distortions. Participants and the wider public should have confidence in the standard.

C.1 COVERAGE AND LIABILITY

C.1.1 COVERAGE

There are three key design questions about the application of the emissions standard to the light vehicles class:

- Will the standard apply to all light vehicles or only passenger vehicles?
- If it applies to all light vehicles, will there be a single standard or split standards for passenger vehicles and light commercial vehicles?
- Will the standard cover second-hand vehicles imported into Australia?

C.1.1.1 TYPE OF LIGHT VEHICLES

As discussed in Section 2.3, the light vehicles class includes both passenger vehicles (cars, sports utility vehicles, light buses) and light commercial (goods-carrying) vehicles (utilities, light trucks, vans).

Passenger vehicles account for 80 per cent of new light vehicles in Australia and are responsible for the majority of CO_2 emissions (see Chapter 2). Light commercial vehicles comprise the remaining 20 per cent of new vehicle sales. Light commercial vehicles travel greater distances than passenger vehicles, estimated to be 28 per cent more on average (ABS 2013), with vehicle kilometres travelled projected to grow more than twice as fast as passenger vehicles to 2020 (BITRE 2009).

Light commercial vehicles typically represent a larger, heavier and more powerful segment of the vehicle market and have, on average, higher rates of fuel consumption than passenger vehicles. In some circumstances, light commercial vehicles may face greater challenges to deliver better fuel economy and lower emissions than passenger vehicles. For example, the functional requirements of light commercial vehicles (particularly light trucks) may limit the incorporation of fuel-saving technologies such as drag reduction. Converting vehicles to diesel is an emissions reduction opportunity but most light commercial vehicles already use diesel—82 per cent of light commercial vehicles sold in Australia in 2012 were diesel (FCAI 2013).

All light vehicle emissions standards applied in other countries cover passenger vehicles at the minimum, and most also cover light commercial vehicles. International evidence suggests that the most effective vehicle emissions standards have broad coverage (ICCT 2011a).

Limiting standards to passenger vehicles alone would reduce environmental effectiveness, compared to a standard with wider coverage. While light commercial vehicles comprise a significantly smaller proportion of new vehicle sales, their higher emissions profile and travel distances suggest that they should be covered by a standard.

There are no obvious barriers to implementing a light vehicle emissions standard for both passenger and light commercial vehicles. Emissions data on all new light vehicles—passenger and light commercial—is currently collected under the Australian Design Rule (ADR) 81/02 *Fuel Consumption Labelling for Light Vehicles.*

CONCLUSION
The standard should cover both passenger and light commercial vehicles.

C.1.1.2 SINGLE OR SPLIT STANDARD

If all light vehicles are covered, a secondary question is whether to set a single standard encompassing all light vehicles, or to split the standard into two parts, with separate levels applying to passenger and light commercial vehicles.

In the EU, the US, China, Japan, Mexico and Canada, separate standards apply to passenger vehicles and light commercial vehicles, with the latter category having a higher (less stringent) numerical standard to meet than passenger vehicles. In part, this split is due to the history of the introduction of standards in these jurisdictions, where standards were initially applied to the largest group (passenger vehicles) and only later applied to light commercial vehicles.

The strongest argument for setting split standards for passenger and light commercial vehicles is to avoid a disproportionate burden on light commercial vehicle manufacturers. The weight of this burden largely depends on the product mix provided by the manufacturer, as the standard is for the average level of performance across all of a manufacturer's sales mix of new vehicles.

- The manufacturers of the 10 highest-selling Australian pick-up truck models in 2012, and of the five van or light truck models selling over 1,000 vehicles a year, all produce a significant number of passenger vehicles (NTC 2014). They can therefore meet a single standard by varying the relative mix of passenger and light commercial vehicles sold, as well as by improving performance of their light commercial vehicles.
- The choice of size thresholds for the application of the standard will also have an influence (see C.1.2.2). In 2013, there was only one specialised light commercial vehicle manufacturer that sold over 2,500 vehicles that did not also manufacture passenger vehicles (NTC 2014).

This suggests that, with the proposed standard, light commercial vehicle manufacturers in the current Australian market would not be unduly burdened.

On the other hand, split standards increase administrative complexity (especially as the majority of manufacturers would have to meet two separate standards, rather than one), and potentially create an incentive for manufacturers to market light commercial vehicles (subject to a less stringent standard) into the passenger vehicle market.

A 2012 analysis recommended the continued separation of standards for passenger vehicles and light commercial vehicles in Europe for a range of reasons, but acknowledged that the split does increase the risk of manufacturers 'gaming' the system by marketing certain light commercial vehicles as passenger vehicle substitutes (TNO et al. 2012).

In responses to the 2011 DIT discussion paper, most respondents (including the vehicle industry) favoured a single standard covering all vehicles (DIT 2011b). The FCAI (2011a) noted that there is some substitution between commercial and passenger vehicles, that a single standard provides a consistent policy objective for both and that separate standards could increase the regulatory burden.

CONCLUSION
A single standard for both passenger and light commercial vehicles should apply.

C.1.1.3 SECOND-HAND IMPORTS

A third question is whether standards should extend to imports of second-hand vehicles.

Second-hand imports are currently a very small segment of the Australian 'new' vehicle market, estimated to be less than three per cent of new vehicle sales (DIRD 2014d). Situations in which vehicles may be imported into Australia are tightly prescribed to ensure that vehicles meet safety and environmental standards, and current legislation appears to prevent large-scale imports. The *Motor Vehicle Standards Act* provides that applications for licence plates, or to supply an imported vehicle without licence plates, can only be made for a single used imported vehicle (sections 13C(2), 16(3)). Importers of second-hand vehicles thus tend to be individuals and small businesses, licensed automotive workshops restricted to fewer than 100 cars annually, and immigrants and returning expatriates importing personal vehicles.

No other vehicle efficiency standards currently apply to second-hand imports. This may reflect relatively limited importation of second hand cars in most jurisdictions. New Zealand includes second-hand imports in its fuel efficiency-labelling scheme.

Applying vehicle emissions standards to second-hand imports would marginally increase environmental effectiveness through increased coverage but could also significantly increase administration and compliance costs. In part, this is because existing fuel efficiency values for those imported cars that are derived from non-European test cycles could not simply be adopted into an Australian standard. Calculated fuel efficiency per kilometre differs between standards in separate jurisdictions, reflecting the different testing methodologies used. In New Zealand, where a significant proportion of imported vehicles are second-hand, a conversion formula is applied to second-hand Japanese imports that are pre-2008 models for the purpose of vehicle fuel efficiency labelling.

Even if second-hand imports were covered under the standard, it is very unlikely that individual suppliers would be liable due to low numbers of annual sales under the current import restrictions (see C.1.2.2 on threshold for liability).

The Productivity Commission has suggested that restrictions on large-scale second-hand imports be removed (PC 2014, pp. 100–102). If adopted, this change could potentially lead to a large increase in second-hand vehicle imports. In that case, both equity across suppliers and environmental effectiveness would suggest second-hand vehicles should be covered.

On balance, the very small increase in coverage from including second-hand imports does not appear to warrant the extra administrative costs of including them in the scheme at this stage. In the event that circumstances change and there is a significant increase in the quantity of vehicles imported, this issue should be reconsidered. Coverage could also be reassessed as part of the proposed 2021 review (section 5.3), taking account of market developments.

CONCLUSION

Second-hand imports should not be covered under the standard at this stage.

C.1.2 LIABILITY

The liable entity is responsible for compliance with the light vehicle emissions standard, including reporting performance and paying any penalties for non-compliance.

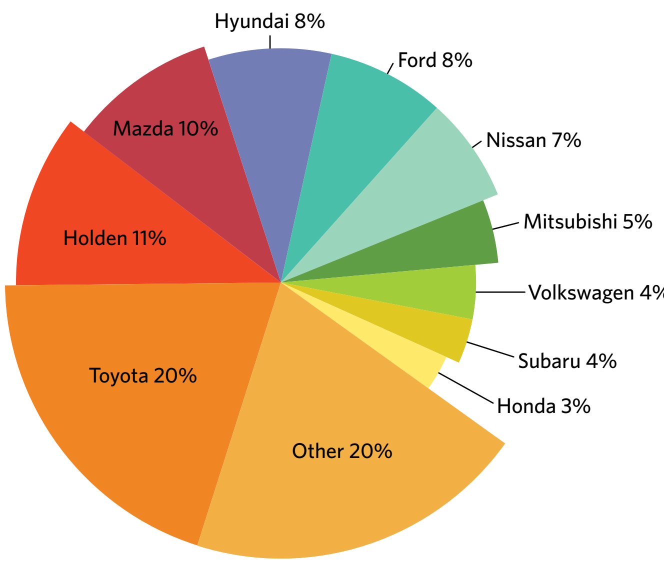
The key design questions for determining the point of liability are:

- Where in the vehicle supply chain (from manufacturer to retailer) should liability be placed?
- What size threshold (defined by annual sales) for imposing liability should be applied?

C.1.2.1 CHOICE OF LIABLE ENTITY

The Australian new vehicle market is dominated by a relatively small number of large vehicle manufacturers, with the top 10 manufacturers responsible for approximately 80 per cent of new vehicle sales in 2012. A further 37 manufacturers accounted for the remaining 20 per cent of vehicle sales (see Figure C.1). As noted in Chapter 3, it is expected that there will be no vehicle manufacturing operations in Australia by 2018, with all new cars imported. As only around 10 per cent of vehicles sold are currently domestically manufactured, there is no reason to expect that this will fundamentally alter the broad market structure.

FIGURE C.1: LIGHT MOTOR VEHICLE SALES BY MANUFACTURER 2012



Source: Climate Change Authority based on NTC 2013

The larger vehicle manufacturers responsible for the bulk of vehicle sales use integrated supply chains, which encompass manufacture, import and retail sale. Business models for other vehicle suppliers are more varied. In some instances, authorised importers supply independent retailers; in others, independent retailers directly import vehicles. All importers must comply with government requirements under the *Motor Vehicle Standards Act.*

Practical considerations are important. The liable entity should be able to comply with the standard reporting requirements (and be penalised in the case of non-compliance) and be the entity able to respond to standards by altering its vehicle mix. For this reason, retailers are clearly not an appropriate point of liability—they are far more numerous and varied in structure than large manufacturers and, importantly, less able to respond to the standard by controlling product mix. Accordingly, manufacturers (or their importing agents) are likely to be a better choice for point of liability.

Several submissions to the 2011 DIT discussion paper suggested the entity responsible for certifying new vehicles for the Australian market under the *Motor Vehicle Standards Act* (the MVSA certifying entity) should be the point of liability (see, for instance, the Australian Automobile Association 2011, Ford Australia 2011 and Honda Australia 2011). This is broadly consistent with US and EU standards, which both hold either the domestic manufacturer or a licensed importer responsible for ensuring compliance with relevant environmental and safety regulations.

The MVSA certifying entity already has a legal relationship with the Commonwealth, and is required to submit detailed technical information on vehicle design and safety as part of the approval process for new vehicles entering the Australian market. In the case of larger manufacturers, the certifying entity is likely to be either the manufacturer or closely related to the manufacturer, so obligations could be effectively passed through by contractual or other arrangements.

Smaller manufacturers may contract independent agents for certification, and have less of a business presence in Australia, making it less clear that the licensing entity will be able to influence the vehicle sales mix. These arrangements could be considered further as part of a RIS process.

At this stage, the MVSA certifying entity appears to be an appropriate point of liability for vehicle emissions standards. This should lead to a relatively small number of liable entities, which in most cases will be closely related to the vehicle manufacturer and have the technical capacity to comply with reporting obligations.

CONCLUSION

Subject to further consultation with industry, the liable entity under the standard should be the same entity responsible for Australian certification of a vehicle under the *Motor Vehicle Standards Act 1989* (Cth).

C.1.2.2 THRESHOLD FOR LIABILITY

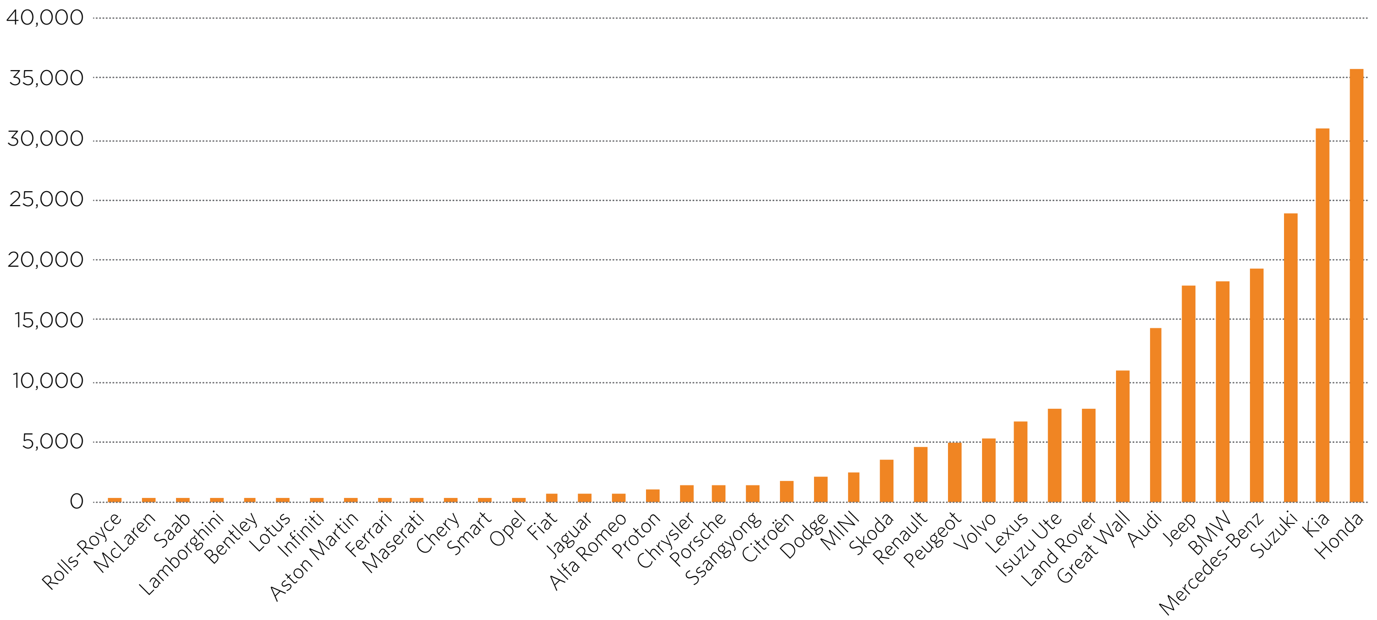
A threshold for liability is an important design feature to reduce compliance and administration costs. Some form of size threshold is used in all overseas schemes; direct comparisons are complicated by differences in the overall size of new vehicle markets. The US applies less stringent transitional standards to manufacturers with fewer than 50,000 annual sales, and manufacturers with fewer than 5,000 sales worldwide can apply for firm-specific standards. The EU also applies several threshold levels, with those with under 1,000 annual sales exempted altogether, and those between 1,000 and 10,000 able to apply for firm-specific standards.

Selecting a size threshold requires balancing the improved environmental effectiveness and improved equity of a lower threshold against the increased regulatory burden of imposing liability on more and smaller entities. Any threshold will invariably raise boundary issues, with the potential for entities near the threshold to alter activity levels to avoid liability. A more limited liability could be imposed on smaller entities to reduce costs and risks of gaming, although this would increase regulatory complexity.

An important consideration is the market structure of liable entities and how the point of liability is determined (discussed in C.1.2.1). Many vehicle brands may be linked into a larger corporate group, and may or may not operate as distinct legal entities. The practical implications of the threshold level therefore interact with selection of the point of liability.

Figure C.2 sets out the distribution of Australian car sales by make under 40,000 annual vehicle sales and Table C.1 sets out the implications of different thresholds, based on 2012 sales volumes.

FIGURE C.2: LIGHT VEHICLE SALES UNDER 40,000 VEHICLES BY MAKE IN 2012



Source: Climate Change Authority based on NTC 2013

TABLE C.1: IMPLICATIONS OF SELECTED THRESHOLDS (BASED ON 2012 LIGHT VEHICLE SALES)

THRESHOLD (VEHICLES SOLD)	NUMBER OF VEHICLES NOT COVERED	PERCENTAGE OF VEHICLES NOT COVERED	NUMBER OF UNCOVERED MAKES (OUT OF 47 TOTAL)
100	524	>0.01	9
500	923	0.09	12
1,000	3,784	0.4	16
2,500	7,521	1.2	23
5,000	23,317	2.1	25
10,000	56,313	5.2	30

Note: This assumes each make operates as a separate liable entity. In practice, some small makes may be part of a larger corporate group; this would reduce the number and percentage of vehicles excluded by the threshold.
Source: Climate Change Authority based on NTC 2013

Figure C.2 shows that there is a long 'tail' of smaller makes that account for a very small proportion of sales. As set out in Table C.1, thresholds could be set to eliminate a large number of makes with minimal effect on coverage. A 500-vehicle threshold would exclude about a quarter of makes from liability while diminishing coverage by less than a 10th of one per cent; a 1,000 vehicle threshold would exclude about one-third of makes at the expense of 0.4 per cent of coverage; a 2,500 vehicle threshold would exclude about half of the makes and reduce coverage by 1.2 per cent.

Ideally, the threshold would be set at a level that minimises the number of makes near to the threshold (which might offer an incentive to 'game' it to avoid liability, including through disaggregating brands covered by a corporate group that might otherwise operate as a single entity for the purposes of the standards). The distribution of sales is, however, relatively uniform with no obvious gaps.

On balance, a threshold of 2,500 vehicles would appear to provide an appropriate balance between compliance costs and coverage. Based on current sales, this threshold would exclude about half of the makes but only reduce coverage by about 1.2 per cent. This threshold could be reviewed when considering the second phase of the standard, to address any distortionary market responses if they emerge.

CONCLUSION
Subject to further consultation and consideration of how the point of liability will be determined, the threshold for liability should be annual sales of 2,500 vehicles.

C.2 STANDARD DESIGN AND MEASUREMENT

Determining how the standard applies to manufacturers of new light vehicles raises two related design choices:

- Should a flat or attribute-based standard be applied?
- If an attribute-based standard is favoured, which is the most appropriate attribute to adopt?

This section also discusses a number of measurement and scope issues for how emissions will be measured under the standard:

- whether the standard should be based on fuel consumption or CO_2 emissions
- what test procedure should be used
- whether multipliers, which recognise specific low-emissions technologies or fuels, should be part of the scheme
- whether off-cycle credits, which recognise emissions reductions not captured by the standard test, should be part of the scheme.

C.2.1 FORM OF STANDARD

The most common forms of light vehicle emissions standards that have been evaluated internationally are:

- a flat standard for the fleet (or sections of it), usually an absolute cap or uniform percentage reduction of emissions intensity, which applies to every manufacturer
- an attribute-based fleet-average standard, where the level of the standard varies with an attribute of the vehicle (typically vehicle mass or size).

In determining the best option, a reasonable starting point is to consider the simplest model possible that delivers significant emissions reductions, is cost-effective to administer and is equitable across manufacturers. The selected approach also needs to be objective and transparent so that liable entities clearly understand their obligations.

The simplest approach—to set a flat (absolute) target(s) for the fleet, or categories of the fleet, or to apply a uniform percentage reduction on emissions—imposes the same requirements on every manufacturer, regardless of their mix of vehicles. While this may appear fair, a 'one-size-fits-all' approach can disadvantage manufacturers at both ends of the emissions spectrum and reduce consumer choice. Different manufacturers produce a heterogeneous mix of models and have different starting positions linked to previous investments in fuel economy and reducing emissions. Applying a uniform percentage reduction target to a manufacturer who has already invested heavily in emissions or fuel consumption reductions will put it at a competitive disadvantage relative to a company that has not previously focused on this aspect. Conversely, applying the same flat standard to all manufacturers could force one with larger vehicles sitting above the standard to remove certain models from its range (even if such models are relatively efficient for their size or are important for their commercial viability and are strongly favoured by consumers).

The alternative approach is to implement a sales-weighted fleet-average standard. The target emission level varies across manufacturers, in light of their product mix. The standard is defined by the relationship between the CO_2 emissions or fuel consumption of a vehicle and an objective attribute of the vehicle such as mass or size. Attribute-based standards enable manufacturers to supply vehicles above the target level of the standard, provided they are offset by sufficient sales of vehicles that are below the target. The International Council on Clean Transportation (ICCT) notes that such standards enable a manufacturer to market vehicles that '... remain diverse in terms of vehicle shape, size and functionality and to improve efficiency without compromising vehicle functionality' (Mock 2011).

International assessments in both the US and EU have strongly favoured attribute-based standards. Benefits include encouraging emissions improvements across the full range of vehicle types, spreading the regulatory burden across all manufacturers and respecting consumer choice (US EPA and NHSTA 2011b). A useful overview of the EU's assessment of the various approaches is summarised in the 2011 DIT discussion paper (DIT 2011a). Similarly, a US EPA and NHTSA evaluation in support of the US 2017–25 standards also identified multiple benefits from attribute-based standards (compared to class-based caps or uniform percentage reductions).

All countries that have adopted mandatory fuel consumption or CO_2 standards have included an attribute adjustment, but not all have included fleet-averaging. For example, China applies the averaging across specified categories of vehicles, not the fleet as a whole. However, soon all four major markets (the US, the EU, China and Japan) will take a flexible corporate-average approach to standards, with Japan switching to fleet-averaging for its 2020 target. In submissions to the 2011 DIT discussion paper, there was overwhelming support for attribute-based fleet-average standards, including from the vehicle industry.

If an attribute-based standard is favoured, a decision needs to be made on the most appropriate attribute to adopt. To date, the attributes used internationally are mass or vehicle size, usually measured as the 'footprint' of the vehicle (the size of the vehicle determined by the product of the vehicle track width and the wheelbase—which is the distance between the two axles).

Footprint is used in the US, Canada and Mexico, with mass adopted in the EU, China, Japan and Korea. International assessments conclude both can work effectively and impose similar costs but, on balance, the evidence favours footprint as the best option (TNO 2011; German & Lutsey 2011; US EPA and NHSTA 2011b).

The key advantage of footprint is that it encourages manufacturers to improve efficiency by reducing vehicle mass ('light weighting'). Light weighting is a major emissions reduction strategy in new vehicle design, and vehicles can be light-weighted without compromising vehicle functionality from the consumer's perspective. Mass-based standards discourage light weighting, as they require lighter vehicles to meet more stringent average emissions targets. A recent ICCT assessment (2011a) argues strongly against mass-based standards, which typically shift fleets towards bigger or heavier models. In addition, size-based standards tend to encourage better safety design than weight-based standards. This was one of the key factors in NHTSA's decision to adopt footprint-based standards instead of weight-based standards for the US 2008–11 light truck Corporate Average Fuel Economy rule (US EPA and NHTSA 2011a).

In submissions to the 2011 DIT discussion paper, there was broad support for footprint-based standards. However, vehicle manufacturers at the time were split on the issue, with most favouring mass-based standards because they were used more frequently in the standards applying in source countries.

There is good evidence, and widespread support, for the adoption of attribute-based fleet-average standards compared to any alternative approach. Such standards maximise equity and flexibility for manufacturers and preserve consumer choice. While attribute-based standards using either mass or footprint can be effective, the balance of the evidence supports a footprint-based standard. There is no evidence to indicate that this would disadvantage suppliers from markets where mass-based standards (including the EU, Japan, Korea and China) are in place.

CONCLUSION

The standard should apply to fleet-average emissions and be based on vehicle footprint.

C.2.2 MEASUREMENT AND SCOPE

C.2.2.1 BASIS FOR MEASUREMENT—FUEL CONSUMPTION OR EMISSIONS

Standards can be based on fuel consumption per kilometre travelled or on CO_2 emissions per kilometre travelled. These metrics are directly related; combustion of fuel leads to emissions of CO_2 (noting that different types of fuel have different emissions profiles). Reducing consumption of fuel per kilometre will therefore lead to corresponding decreases in emissions per kilometre.

Internationally, the US and Republic of Korea use both fuel economy and CO_2 emissions standards. The EU uses CO_2 emissions standards. Japan and China use fuel economy. In Australia, the existing ADR81/02 collects both CO_2 emissions and fuel consumption data at a model-specific level (see C.2.2.2).

An emissions-based standard is preferable where the primary objective is to reduce emissions. Fuel economy improvements do not always give an equal emissions intensity improvement, as emissions rates from different fuels vary. For instance, depending on driving conditions and engine performance, diesel engine vehicles can be up to 30 per cent more fuel-efficient than comparable petrol vehicles. However, diesel consumption results in about 15 per cent more CO_2 being emitted per litre of fuel (calculated based on NTC 2012, p. 3). Overall, a shift to diesel reduces emissions by about 15 per cent relative to petrol.

However, consumers could more easily understand a fuel economy standard than an emissions-based standard, and it provides a better basis for aiding consumer purchasing decisions. Vehicle fuel economy labelling schemes, including in both the US and EU, tend to include both emissions and fuel economy data.

A further question is whether to base the standard on CO_2 emissions only or to include emissions of other greenhouse gases from vehicles. These could include nitrous oxide exhaust emissions from the combustion of fuel and emissions of hydrofluorocarbons (HFCs) from vehicle air conditioning systems. Overseas schemes do not generally include these emissions directly, although they may be considered in the calculation of off-cycle credits (see C.2.2.4).

The primary objective of the standard suggests that it should be based on CO_2 emissions rather than fuel economy. Emissions of other greenhouse gases are very small compared with CO_2 emissions from a vehicle over its lifetime, and are unlikely to warrant the extra effort and complexity of inclusion. In addition, the inclusion of other gases would require every vehicle model to undergo additional Australia-specific testing (CO_2 is the only greenhouse gas directly measured in the standard emissions test that underpins ADR81/02).

CONCLUSION
The standard should be based on CO_2 emissions. Other greenhouse gases should not be included in the standard.

C.2.2.2 TEST PROCEDURE

To minimise administrative complexity and reduce compliance costs, existing testing procedures, if appropriate, should be used wherever possible. In Australia, the CO_2 emissions value for each vehicle model (and its variants) is already collected under ADR81/02 as part of the vehicle type approval certification process under the *Motor Vehicle Standards Act*. This applies to all new vehicles to be sold in the Australian market. This test can supply the basic data for calculating the CO_2 emissions targets under vehicle emissions standards—the tailpipe CO_2 emissions produced by the vehicle (in grams of CO_2 per kilometre travelled) is combined with annual sales data to determine the liable entity's compliance requirement.

The ADR81/02 data does not represent all 'real-world' driving and does not take into account the non-road CO_2 emissions from the production and supply of various transport fuels (including electricity for electric vehicles). International research on testing procedures that provide robust data for life-cycle emissions for all fuel types is currently underway, but remains at an early stage.

The data currently collected under ADR81/02 is robust, verifiable and comparable, and is the only such data available at the individual model or variant level for all light vehicles. It is internationally recognised and already used for Australia's CO_2 labelling requirements. The CO_2 standard would not require any additional vehicle testing if ADR81/02 is accepted as the data source.

There was broad support for this approach in submissions to the 2011 DIT discussion paper (DIT 2011a).

Australia is committed to matching United Nations regulations, through which a new harmonised testing procedure is being developed. This test may help to reduce the gap between real-world and tested performance, and is likely to be adopted in the EU from 2020 onwards (ICCT 2013a). Developments in the adoption of this procedure will need to be monitored and any transition arrangements considered in setting the first phase of the standard.

CONCLUSION
The standard should use the CO_2 emissions value collected under ADR81/02 *Fuel Consumption Labelling for Light Vehicles*.

C.2.2.3 MULTIPLIERS

Many countries allow manufacturers to reduce their reported average emissions by using 'multipliers'. Multipliers can be awarded to vehicles that satisfy low-emissions benchmarks or utilise specific technologies or fuels claimed to reduce CO_2 emissions relative to conventional vehicles.

The principal rationale for multipliers is to encourage innovation and early deployment of advanced (often high-cost) low-emissions technologies such as electric vehicles (EVs). Multipliers can act as an additional incentive to innovate and outperform standards.

Crediting arrangements such as multipliers can contribute to the environmental effectiveness of the scheme over the medium term. While multipliers will lead to an increase in overall fleet CO_2 emissions in the short term (as more credits are awarded for the same amount of emissions reductions), if carefully designed they may have beneficial effects in the longer term as lower emissions technologies are more rapidly deployed. Multipliers are likely to involve a minor increase in administrative effort to design as an element of the scheme and, on an ongoing basis, to assess for each liable entity choosing to utilise them.

Multipliers can be implemented in two ways. The first is to provide multipliers for specific technologies or fuels that are claimed to reduce CO_2 emissions relative to conventional vehicles. This requires governments to choose particular technologies or fuels for eligibility at a certain point in time.

The second approach provides for more equitable treatment of technologies by setting an emissions performance benchmark. This provides multipliers for vehicles below a specific emissions intensity level, regardless of the technology or fuel used. Benchmarks of 50 g/km and 100 g/km were raised by industry in response to the 2011 DIT discussion paper (DIT 2011a).

On balance, multipliers are not considered a necessary option to pursue at this stage. A fleet-average standard already creates a direct incentive for innovation—producing very low-emissions vehicles makes it easier for manufacturers to meet the fleet average. Other options to encourage innovation and performance beyond the standard are discussed in C.3. This could be considered for later phases of the standard.

CONCLUSION
Multipliers are not necessary to the functioning of a vehicle emissions standard and are not proposed at this time.

C.2.2.4 OFF-CYCLE CREDITS

Off-cycle credits are primarily designed to recognise technologies that can deliver actual on-road CO_2 emissions reductions but are not 'captured' by the standard tailpipe emissions test used for compliance. Such credits may include, for example, measures for the more efficient operation of vehicle air conditioners, which are standard on most new vehicles but turned off during the standard test cycle.

Off-cycle credits could contribute to the overall reduction of transport emissions by providing additional incentives to reduce all emissions associated with real-world vehicle use. If credited, they may also provide a more cost-effective way for manufacturers to reduce emissions than measures that are directly assessed through standard tailpipe emissions testing. However, off-cycle credits would increase the administrative and regulatory complexity of the scheme.

A central issue with off-cycle credits is the design of objective, repeatable methodologies and processes to determine and validate the claimed additional CO_2 benefits. Internationally, both the US and EU have attempted to recognise and quantify the CO_2 benefits from off-cycle technologies within their standards. Both place the burden for demonstrating off-cycle credits with the liable entities.

The EU provides procedures for approving and certifying 'innovative technologies' not captured by the standard test cycle and assessing their CO_2 emissions benefits. In the US, the EPA and NHTSA have undertaken an extensive analysis covering air conditioners and a broad range of off-cycle technologies including high-efficiency lighting and engine heat recovery.

The US work has developed a 'menu' of technologies assessed as providing real-world CO_2 benefits, which assigns default CO_2/mile credit values for each. This approach reduces the need for extensive testing, and uses analysis and simulations rather than full vehicle testing as much as possible. Both the US and EU apply a cap on the maximum overall fleet benefit a manufacturer can claim for innovative or off-cycle technologies. This recognises, in part, the inherent uncertainty of a general assessment of off-cycle performance as opposed to testing the individual vehicle models (US EPA and NHTSA 2011a) (EU Regulation 725/2011).

The EU adopts a stricter approach in only considering off-cycle technologies that are deemed innovative and are intrinsic to the transport function of the vehicle (excluding accessory functions) (EU Regulation 725/2011). In practice, while a small number of eco-innovations have been approved, feedback from stakeholders indicates that implementation has proven difficult.

The FCAI submission to the 2011 DIT discussion paper (FCAI 2011c) acknowledges the fundamental burden of demonstrating additional off-cycle benefits should rest with individual manufacturers and that there is a need for a system of rigorous assessment and validation. While pre-existing international methods could be adapted for the Australian context, the emissions reductions recognised by off-cycle credits vary as a function of driving behaviour, congestion, road infrastructure, speed limits and ambient temperature, and therefore differ significantly from country to country. Adapting methods would require significant effort and involve a considerable administrative burden in both design and ongoing assessment for the standards.

On balance, off-cycle credits are not considered a necessary option to pursue at this stage, due to the significant administrative and regulatory burden they would impose to design and implement. However, there may be merit to off-cycle credits and their inclusion in later phases of the scheme could be considered as part of the proposed 2021 review.

CONCLUSION
Off-cycle credits are not necessary to the functioning of a vehicle emissions standard and are not proposed at this time.

C.3 TIMING AND COMPLIANCE

C.3.1 TIMING

Introducing a light vehicle emissions standard to Australia will require time for detailed policy development, stakeholder consultation, and the establishment of monitoring and reporting processes. The key timing decisions are:

- start year
- length of first phase.

C.3.1.1 START YEAR

The first timing decision is the appropriate start year for standards. Greater environmental and economic benefits will be achieved by introducing light vehicle emissions standards early. This needs to be balanced against providing an appropriate lead time to allow for industry consultation, the consideration and development (if required) of an appropriate legislative framework, and the establishment of monitoring and reporting processes.

Early introduction of vehicle standards would increase the fuel savings and emission reductions available to Australia. Results of the modelling conducted by the CSIRO for the Authority (discussed in Appendix B) show timing is a key determinant of benefits. Over the period to 2050, lenient standards introduced in 2018 are projected to deliver greater emission reductions than stringent standards introduced in 2025 (CCA 2014a). Early adoption of a standard maximises the benefits—it takes time for changes to new vehicles to improve the fleet overall. A strong standard starting in 2018 generates the greatest emissions reductions and the greatest financial benefits to Australian motorists.

As discussed in Chapter 1, the introduction of a light vehicles emissions standard is not a new concept in the Australian context, and significant work has already been done to both explore an appropriate design and consult with industry. In addition, as discussed in Chapter 4, the proposed target for Australia will not be more stringent than in other key economies. Australia will import all its new vehicles by 2018, and currently lags behind other major markets (including most of our major suppliers). This means that the required adjustment for manufacturers will be a choice about which models and model variants are supplied to the Australian market, rather than necessitating fundamental design and product changes. It suggests that lead times for a standard could be relatively short.

Internationally, lead times of about three years for the initial introduction of vehicle emissions standards are common. The EU 2012–15 standards and target for 2020 were announced in April 2009 (European Council 2009), while the US 2012–16 vehicle standards were announced in May 2009. Both have large domestic car manufacturing industries that would need to have made adjustments to comply with the new standards.

Best practice would suggest that two years is sufficient for policy planning and development (IEA 2012b). As outlined below, Australia has much of the required measurement and reporting in place already, so is well placed for rapid implementation.

A start year of no later than 2018 should therefore provide for adequate consultation and an orderly phase-in of new light vehicle emission standards in Australia. This provides a three-year lead time if a policy decision is taken in 2015.

CONCLUSION
The new light vehicle emissions standard should commence no later than 2018.

C.3.1.2 LENGTH OF FIRST PHASE

The second timing decision is the length of the first phase of standards (phase one). The period needs to be long enough to allow liable entities to adjust their business operations, but short enough to avoid 'locking in' standards that prove inappropriate due to technology developments, market changes or other factors.

Internationally, compliance periods have tended to range between four and seven years. The EU and US currently have targets out to 2020 and 2025 in place under their emissions standards, and China has proposed a target to 2020.

Aligning the first Australian standards to major jurisdictions could assist with future global harmonisation, possibly simplifying the compliance process for manufacturers. With a proposed start year of 2018, ending phase one in 2020 would appear too short. A 2025 end date, however, provides a reasonable first phase (2018–25) of eight years.

This would not set a binding precedent for future phases. For example, the time span for phase two could be shorter (such as 2026–30).

CONCLUSION
The first phase for the new light vehicle emissions standard should be 2018 to 2025.

C.3.2 COMPLIANCE OPTIONS

The key design options for compliance with the standard are:

- whether compliance is required on an annual or a periodic basis
- what flexibility mechanisms should be allowed to enable liable entities to cost-effectively comply with the standard
- the frequency and start date for reporting obligations
- what form of penalties should apply for non-compliance.

C.3.2.1 ANNUAL OR PERIODIC COMPLIANCE

Standards can require annual (frequent) or periodic (infrequent) compliance. The choice of approach has a strong relationship to what flexibility mechanisms, such as banking, borrowing or trading, are allowed within the scheme (discussed in C.3.2.2).

Annual compliance requires manufacturers to meet a set target each year, and thus drives early and progressive efforts to reduce emissions. Internationally, the US is the only major market that has mandatory annual targets. While this may increase compliance costs, mechanisms such as banking and borrowing that allow for normal business ebbs and flows can enhance flexibility for manufacturers and minimise any costs. The US allows for banking, borrowing and trading.

Periodic compliance entails manufacturers meeting a set target by a fixed future year and does not mandate an annual rate of improvement. Internationally, the EU and Japan have targets for 2015 and 2020 with no interim targets (ICCT 2014).

Annual compliance is likely to drive greater environmental effectiveness as it ensures fleet performance improves each year. Periodic compliance will have a lower administrative burden, but runs the risk of liable entities only striving to improve the emissions of vehicles sold in the final year of the period. Further concerns with periodic compliance include a risk of suppliers lobbying for target revisions, which, if successful, would unfairly disadvantage competitors who have already taken action to meet the standard; and the possibility of 'fringing' effects of new entrants and suppliers leaving the market and avoiding compliance altogether. Either of these could compromise policy stability and credibility and environmental effectiveness.

The extent of the administrative burden posed by annual compliance depends on the new reporting obligations introduced by the standard. As discussed in C.3.2.3, the proposed standard involves only a modest additional reporting obligation.

On balance, annual compliance is the preferred approach. It would encourage progressive improvement in fleet performance, and guard against lobbying and fringing effects. The additional administrative burden is likely to be very small.

CONCLUSION

The standard should set annual compliance obligations for liable entities.

C.3.2.2 FLEXIBLE COMPLIANCE MECHANISMS—BANKING, BORROWING AND TRADING

Flexible compliance mechanisms provide liable entities with a range of options to cost-effectively comply with a given standard. They can improve the pace of progress in meeting given standards and assist in driving emissions improvements, while allowing flexibility in year-to-year performance.

Banking allows liable entities to save credits generated by overachieving against their targets and use them for future compliance, either within a compliance period (for example, phase one) or between periods (for example, between phase one and phase two). Similarly, borrowing allows liable entities to use credits from future periods to meet current compliance obligations. Trading allows for the movement of credits between liable parties.

In determining whether to allow one or more of these options, the starting point, as outlined in Chapter 5, has been to consider the vehicle emissions standard design for Australia that maximises emissions reductions while ensuring the cost-effectiveness, equity and credibility of the scheme for consumers and manufacturers.

As discussed in C.3.2.1, decisions on banking, borrowing and trading are closely linked with decisions on the type of compliance and the compliance period. For example, banking and borrowing can reduce the costs of annual compliance by allowing year-on-year flexibility to account for normal business ebbs and flows. They are less relevant in a scheme with periodic compliance.

Flexibility mechanisms operating within a compliance period; for example, phase one (2018–25), and between phases (pre- and post-2025) may have different impacts on the integrity of the scheme. If the Australian standard was set at a level significantly less stringent than other markets, especially in the first phase, and banking or trading across phases was allowed, liable entities could potentially establish large volumes of credits in the early years with relatively little effort. This would significantly reduce the need to act in later phases as the standards get tighter, thereby diluting the environmental effectiveness of future standards. If, however, Australian standards are on par with international standards, this is less of a concern.

Flexibility within phase one does not create the same risks to environmental effectiveness, as entities would be obliged to meet the given standard within the time frame specified.

Borrowing within phase one increases flexibility but could create risks of non-compliance in future years, or incentives to lobby to weaken the standard. This would reduce the credibility of the scheme. Borrowing from future phases could exacerbate credibility concerns. These risks can be managed by imposing limits on borrowing and restricting it to within the phase.

Trading increases flexibility and provides an incentive for performance beyond the standard. While it is difficult to predict the likely market for trade of excess credits between liable entities in the Australian context, international experience and feedback from domestic stakeholders suggests uptake may be limited. This suggests the benefits of a bespoke trading mechanism within the standard are unlikely to justify the associated administrative complexity and cost.

There may be scope to encourage performance beyond the standard through other mechanisms. For example, if a methodology could be developed to estimate and credit emissions reductions achieved through superior performance by a supplier, the ERF may be a suitable vehicle.

On balance, to give liable entities flexibility to meet their compliance requirements, banking and limited borrowing should be allowed within phase one. While trading could improve the cost-effectiveness of a standard, it does not appear warranted at this time.

CONCLUSIONS

Banking and limited borrowing should be allowed within phase one of the standard.

Trading is not necessary to the functioning of a vehicle emissions standard.

C.3.2.3 TIMING OF REPORTING OBLIGATIONS

Key considerations for reporting obligations are the start date and frequency of reporting.

Early introduction of reporting obligations (prior to the commencement of the standard) is likely to bring benefits. It will help liable entities track their position prior to facing formal compliance obligations, and make any necessary changes to their business operations. It also allows entities and administrators to test and refine reporting and monitoring systems.

Overall, with a proposed start date of no later than 2018, it would be worthwhile for reporting to begin two years prior, in 2016. In the event of delay, a one-year lead time for reporting would still be beneficial. Testing and refining reporting and monitoring systems could be prioritised in the policy development process, if necessary, to enable reporting to commence in 2016.

Annual compliance would clearly require annual reporting. Even if periodic compliance was preferred, annual reporting from 2016 would still be desirable as it would help identify suppliers above and below the minimum threshold for liability. Annual reporting would enable regulators, industry and policy makers to monitor performance against the standard and provide the necessary data to underpin any banking and borrowing provisions.

As discussed in Box 5.1, CO_2 emissions, fuel consumption and other data is already legally required for all new vehicles entering the Australian market under the ADR81/02. The government does not, however, currently collect annual vehicle sales or footprint data, which will be required to determine individual emissions targets for liable entities. As vehicle suppliers already hold this data, requiring this to be reported to government is only likely to be a small additional burden for industry. It will also help policy makers to monitor the target and assess compliance.

In the interest of policy credibility and transparency, the government should consider making non-commercially sensitive data collected to assess compliance with the standards publicly available. This is recommended by the IEA and is currently undertaken by the EU (IEA 2012a, p. 71) and US.

CONCLUSION

By 2016, liable entities should be required to report annually on sales and vehicle data needed to underpin the standard.

C.3.2.4 PENALTIES

Penalties are a critical component of any regulatory scheme. The form and level of a penalty for non-compliance must be sufficient to encourage manufacturers to meet the required standard.

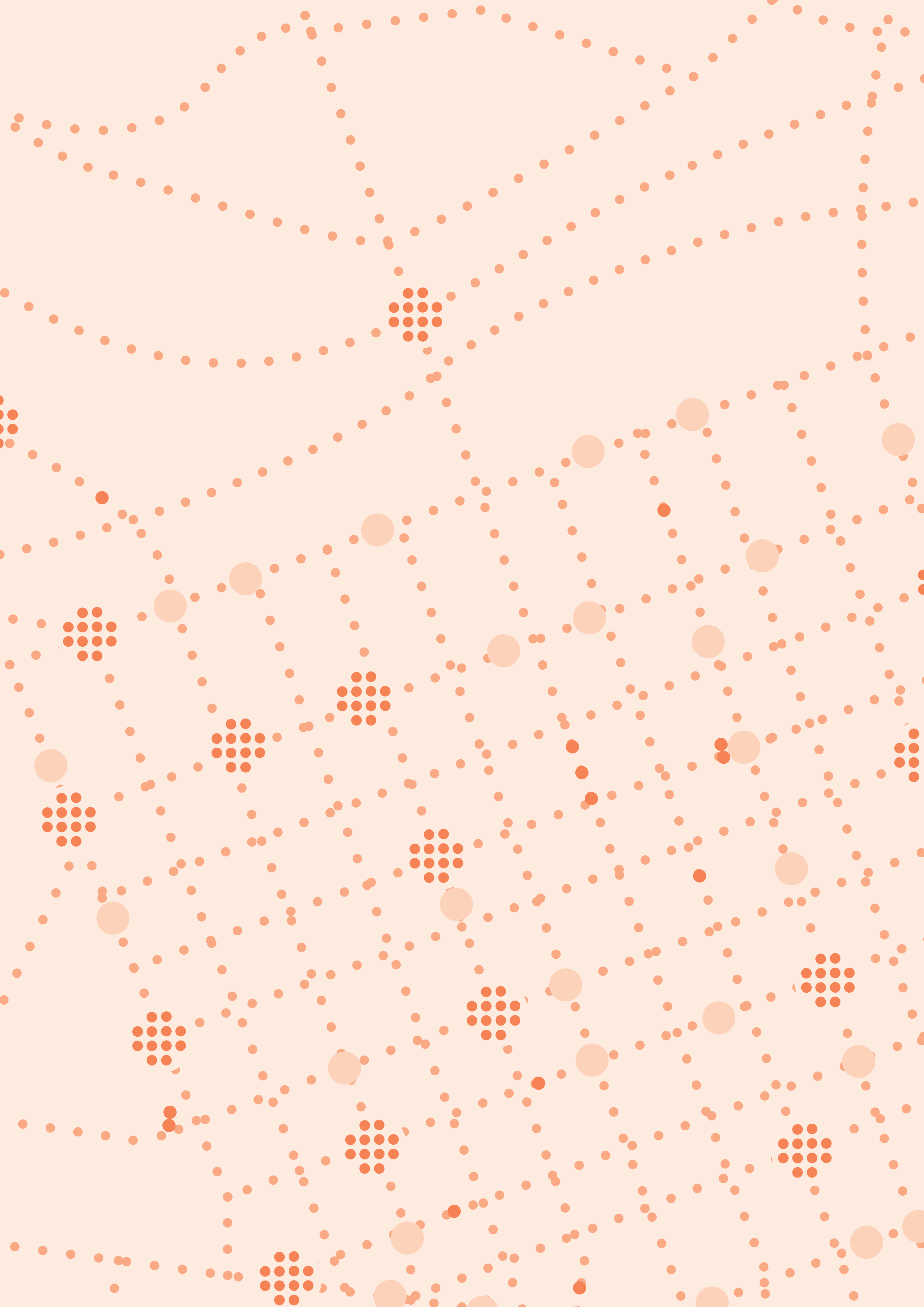
Financial penalties are commonly used, including in both the US and EU. In the US, a US$5.50 fine applies for each 10th of a mile per gallon of each new vehicle sold above the target. In the EU, a €95 fine for every gram of emissions of each new vehicle sold above the target is charged. In Japan, a smaller financial penalty applies and firms must make a public announcement of their non-compliance.

Non-compliance over a period can also be accounted for through a make-good provision at the end of a phase. Make-good provisions are easier to administer if trading is allowed.

Financial penalties seem appropriate for Australia. Further analysis by government would be required to determine the appropriate penalty level.

CONCLUSION

A financial penalty should apply to liable entities who do not comply with the standard.



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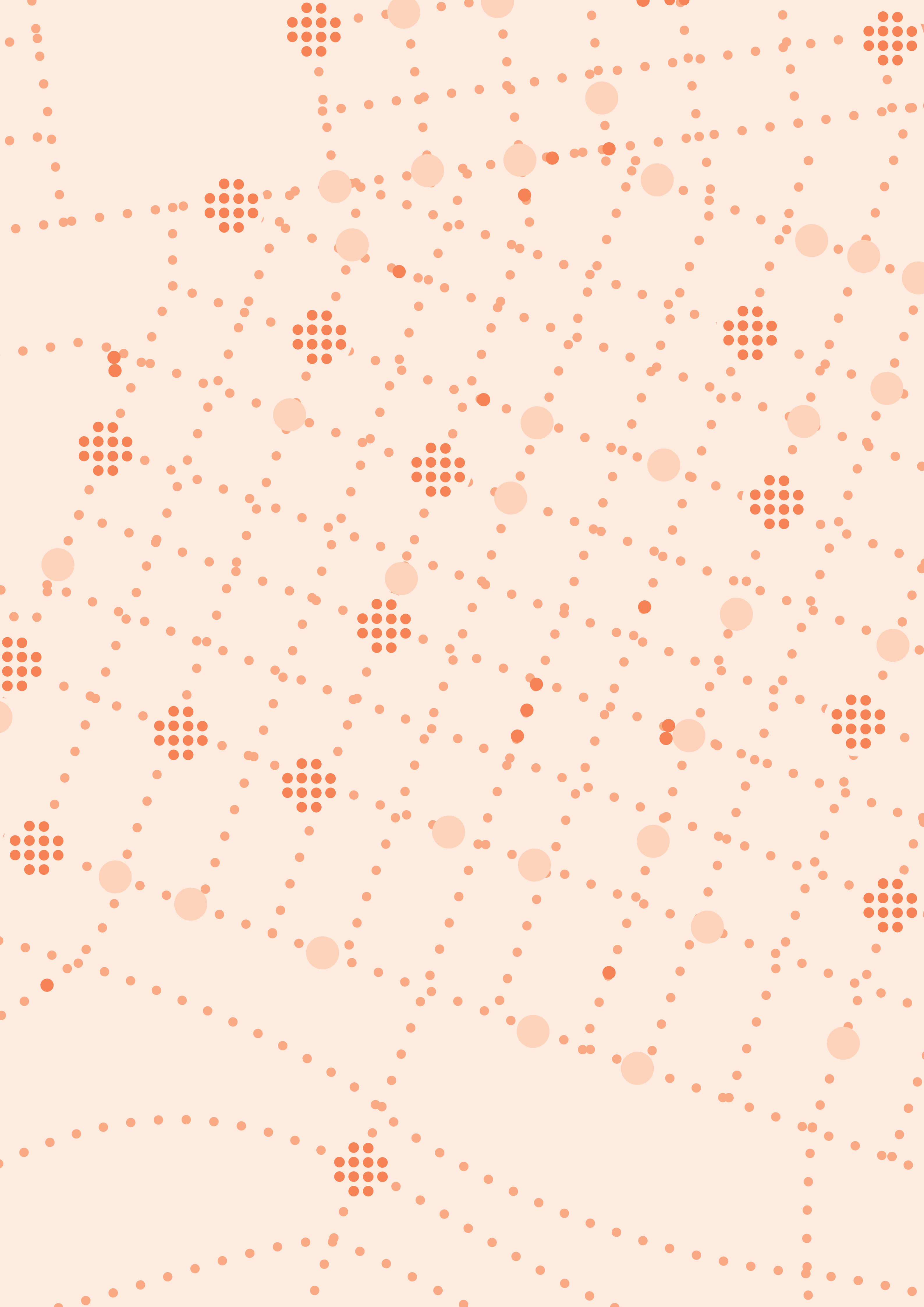
GLOSSARY

attribute-based standard	A light vehicle emissions standard where the level of the standard varies with an attribute of the vehicle (typically vehicle mass or size).
emissions intensity	A measure of the emissions associated with a unit of output; for example, the amount of greenhouse gases emitted by a vehicle over a given driving distance, measured in grams of carbon dioxide per kilometre (g CO_2/km). There is a direct relationship between fuel efficiency and emissions intensity for any given fuel. Different fuels have different emissions intensities.
emissions intensity of light vehicles (measured)	An estimate of actual, or 'real-world', new light vehicle emissions intensity. These estimates tend to be higher than 'tested' emissions intensity.
emissions intensity of light vehicles (tested)	'Test cycle' readings of new light vehicle emissions intensity, resulting from laboratory testing. Generally differs from measured emissions intensity (see above).
emissions reductions	The act or process of limiting or restricting greenhouse gas emissions.
fleet-average emissions	The average emissions intensity of all vehicles in a fleet. Fleet-average emissions standards typically apply to new light vehicles.
footprint	The size of a vehicle as determined by the product of the vehicle track width and the wheelbase (distance between the two axles).
light commercial vehicle	A motor vehicle that has a utility or panel van-type body. Includes pickup trucks, vans and small buses that carry more than eight passengers.
light vehicles	All motor vehicles under 3.5 tonnes gross vehicle mass, including passenger vehicles, sports utility vehicles (SUVs) and light commercial vehicles, but excluding motorcycles.
light vehicle emissions standard	A regulatory tool that sets emissions intensity targets for new light vehicles.
limit curve	A mathematical relationship between an attribute, such as size or mass, of vehicles and their tested emissions intensity, which defines the required average emissions intensity.
multipliers	Compliance credits awarded to liable entities under some light vehicle emissions standards, multipliers are typically awarded to vehicles that satisfy low-emissions benchmarks or use specific technologies or fuels claimed to reduce CO_2 emissions relative to conventional vehicles.
national average target	A fleet-average emissions target for Australia's new light vehicle fleet, expressed in grams of carbon dioxide per kilometre.
net individual impact	The net impact of any increase in the purchase price of a vehicle due to standards, minus the savings from reduced fuel use over the period of ownership, compared with business-as-usual (BAU).
net private impact	The sum of net individual impacts across all motorists. If the lifetime fuel savings exceed the increase in upfront costs, the standard has 'net private benefits'.
net social impact	The value of fuel savings and emissions reductions to the public, adjusted for the technology costs and other changes necessary for vehicle suppliers to meet the standards.
off-cycle credits	Compliance credits awarded to liable entities under some light vehicle emissions standards, off-cycle credits recognise technologies that deliver emissions reductions that are not measured by the test cycle, such as efficient vehicle air conditioners.
passenger vehicles	Motor vehicles principally designed for the carriage of up to eight adults. Includes cars and SUVs.
test cycle	A protocol to allow repeatable and comparable measurement of exhaust emissions for different engines or vehicles. Test cycles specify the conditions under which the engine or vehicle is operated during the emission test.
vehicle fuel efficiency	The amount of fuel consumed by a vehicle over a given driving distance, expressed in litres per 100 kilometres (L/100 km).



ABBREVIATIONS AND ACRONYMS

AC	air-conditioning
BAU	business-as-usual
CO_2	carbon dioxide
CO_2-e	carbon dioxide equivalent
COAG	Coalition of Australian Governments
CSIRO	Commonwealth Scientific and Industrial Research Organisation
DCCEE	Department of Climate Change and Energy Efficiency
DoE	Department of the Environment
DIICCSRTE	Department of Industry, Innovation, Climate Change, Science, Research and Tertiary Education
DIT	Department of Infrastructure and Transport
ERF	Emissions Reduction Fund
ESM	Energy Sector Model
EU	European Union
EV	electric vehicle
FCV	fuel cell vehicle
g CO_2/km	grams of carbon dioxide emitted per kilometre
GHG	greenhouse gas
HEV	hybrid electric vehicle
ICCT	International Council on Clean Transportation
ICEV	internal combustion engine vehicle
IEA	International Energy Agency
ITS	Intelligent Transport Systems
LED	light emitting diode
MEP	Minimum Energy Performance standards
mpg	miles per gallon
Mt	megatonne (mass, one million metric tonnes)
MVSA	Motor Vehicle Standards Act
MWh	megawatt hour (energy, equal to 3.6 gigajoules)
NEDC	New European Drive Cycle
NHSTA	National Highway Traffic Safety Administration (US)
PHEV	plug-in hybrid electric vehicle
RIS	Regulation Impact Statement
SUV	sports utility vehicle
tk	tonne kilometres
vkt	vehicle kilometres travelled
US	United States

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